Understanding the influence of ethnicity on medicines adherence

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Abstract

Diabetes is a significant global public health issue, resulting in serious and costly complications and reduced life expectancy. Adherence to prescribed medication is an essential component of diabetes management to obtain optimal outcomes. Understanding the factors influencing adherence is key to optimising adherence to antidiabetic medication. One factor that has yet to be studied in this context is ethnicity and given the increased incidence of diabetes in certain ethnic groups, it is important to establish if or how adherence to diabetes medication varies by ethnic group (Chapter 1). A systematic review of the existing quantitative literature was conducted to explore whether medication adherence to antidiabetic medications in people with diabetes varied by ethnicity (Chapter 2). Most of the included studies showed statistically significant disparities in adherence among different ethnic groups, with minority ethnic groups in high-income countries often reporting the lowest rates. A second systematic review (meta-ethnography) was undertaken to synthesise the existing qualitative data to explore the barriers to and facilitators of adherence to antidiabetic medications experienced by people from minority ethnic communities in high-income countries (Chapter 3), revealing a gap in the literature concerning ethnicity-related factors from the perspectives of both minority ethnic communities and the majority within the context of socioeconomic deprivation. Chapters 4 and 5 detail two qualitative studies conducted in socioeconomically deprived settings in the United Kingdom and Saudi Arabia. The UK study (Chapter 4) explored the perspectives of people from South Asian and White British ethnic backgrounds in the North East of England. The results identified a range of barriers and facilitators, with some shared by both groups and others unique to the South Asian participants, including a preference for alternative medicine, certain religious-related beliefs and practices, social stigma associated with the condition, and unawareness of free prescription availability. The Saudi Arabian study (Chapter 5) involved participants from South Asian and Saudi Arabian backgrounds, highlighting a range of barriers and facilitators—some shared across both groups and others unique to each ethnic community. This research identified several factors influencing adherence, including ethnicity-related and socioeconomic influences, as well as personal and healthcare system-related factors; these findings should inform the development of tailored interventions (Chapter 6).

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List of Abbreviations

Abbreviation	Full Description
AKH	Andrew K Husband
AT	Adam Todd
AR-B	Anna Robinson-Barella
AI	Anum Iqbal
AIDS	Acquired Immune Deficiency Syndrome
CASP	Critical Appraisal Skills Programme
CMA	Continuous Multiple-Interval Measures of Availability
EMP	Electronic Medication Packaging
EThOS	Electronic Theses Online Service
GBTM	Group-Based Trajectory Modelling
GRADE-CERQual	Confidence in the Evidence from Reviews of Qualitative Research
HbA1c	Haemoglobin A1c
HIV	Human Immunodeficiency Virus
IDF	International Diabetes Federation
ISPOR	International Society for Pharmacoeconomics and Outcomes Research
IMD	Index of Multiple Deprivation
JBI	Joanna Briggs Institute
MENA	Middle East and North Africa
MEMS	Medication Events Monitoring System
MMAS	Morisky Medication Adherence Scale
MPR	Medication Possession Ratio
NHS	National Health Services

PDC	Proportion of Days Covered
RA	Rayah Asiri
rTA	Reflexive Thematic Analysis
SA	Saudi Arabia
SES	Socioeconomic Status
TDM	Therapeutic Drug Monitoring
UK	United Kingdom
US	United States
WHO	World Health Organisation

Chapter 1. Introduction and background

1.1 Introduction

This thesis will concentrate on a crucial aspect of patient care in clinical settings, investigating the impact of ethnicity on medication adherence among people with diabetes. Understanding how ethnicity affects medication adherence is essential for developing intervention measures tailored to the needs of increasingly ethnically diverse populations. Thus, the aim of this thesis is to explore the relationship between ethnicity and adherence to antidiabetic medication among people with diabetes, as well as to identify ethnicity-related factors that contribute to this challenge. These findings will serve as a foundation for engaging communities and creating patient-centred medication adherence interventions, addressing the unique barriers and facilitators perceived by different ethnic groups.

This introductory chapter reviews the literature and provides essential background information on diabetes, covering its definition, classification, epidemiology, and overall burden. Additionally, it outlines the concept of medication adherence, including its definitions, classifications, measurements, influencing factors, and its significance in people with diabetes. The chapter concludes with a discussion of the definition of ethnicity as applied in this thesis and finally presents the overall aim and objectives of this PhD project.

1.2 Diabetes

Diabetes is a common and clinically significant metabolic disorder and has become a major medical burden, reaching the point of a global pandemic.[1, 2] Over the past few decades, the prevalence of diabetes has increased dramatically across the globe, affecting both high-income countries and those in low- and middle-income categories.[1] In 2019, diabetes prevalence worldwide was 9.3% (463 million people), and by 2045 it is projected to reach 10.9% (700 million).[3] Partly, this can be attributed to the growth of the ageing population, the development of the economy, and consequent changes in cultural practices and unhealthy lifestyle choices.[4, 5] Diabetes is an incurable chronic condition that is often associated with other long-term comorbidities, resulting in a high prevalence of multiple long term conditions among people with diabetes.[6, 7] These long-term conditions can arise either because of diabetes or as an independent condition that is not directly linked to the pathophysiology of the disease. The increase in diabetes prevalence, as well as the complications and/or multiple

long term conditions that result from it, place a significant burden on health systems worldwide.[8]

1.2.1 Diabetes definition and classification

Diabetes is defined by the World Health Organisation (WHO) as a collection of metabolic disorders marked by high blood glucose levels (hyperglycaemia) resulting from impaired insulin secretion, its action, or both.[9] In 2019, the WHO classified diabetes into six categories: type 1 diabetes, type 2 diabetes, hybrid forms of diabetes (including slowly evolving immune-mediated diabetes of adults and ketosis-prone type 2 diabetes), other specific types (including monogenic diabetes, such as maturity-onset diabetes of the young, diseases of the exocrine pancreas, endocrine disorders, and drug- or chemical-induced diabetes), unclassified diabetes (a category used when a definitive diagnosis is unclear, particularly around the time of diagnosis, where the type of diabetes cannot be easily classified as type 1 or type 2), and hyperglycaemia first detected during pregnancy (which includes gestational diabetes mellitus and diabetes mellitus first diagnosed during pregnancy).[10] Since type 1 and type 2 diabetes are the primary focus of this thesis, the section below will provide descriptions of these two categories.

Type 1 diabetes

Type 1 diabetes, also referred to juvenile-onset diabetes or insulin-dependent, typically arises from a complete insulin deficiency, which results from cellular-mediated and autoimmune destruction of pancreatic beta cells. This type of diabetes represents 5-10% of the total population affected. Typically, it appears in childhood and adolescence, peaking between 9 and 14 years of age, although it can occur at any point in life.[10] Type 1 diabetes symptoms are caused by the inability of insulin to enable glucose uptake into tissues for energy production, leading to the destruction of adipose tissue and muscle protein causing polyphagia and weight loss. Glucosuria also occurs when elevated blood glucose levels are filtered through the kidneys, causing water loss that leads to increased urination and a sensation of extreme thirst. This type of diabetes necessitates daily insulin replacement treatment for survival.[10]

Type 2 diabetes

Type 2 diabetes is characterised by insufficient insulin production due to pancreatic beta cell dysfunction and insulin resistance in target tissues.[11] It represents the greatest burden of the disease, accounting for about 90 to 95 % of all diabetes cases. Although there has been a noticeable trend of type 2 diabetes diagnosis emerging in children and adolescents in recent years, it is usually diagnosed in adults.[10] Several risk factors have been identified to contribute in the developing type 2 diabetes, encompassing unhealthy eating habits, obesity, inadequate physical exercise, older age, familial history of the condition, smoking, high cholesterol and being from specific ethnic groups.[10, 12] Symptoms of type 2 diabetes are like those of type 1 diabetes, with the notable exception of ketonuria. Additionally, in type 2 diabetes hyperglycaemia leads to the reabsorption of glucose and sodium back into the bloodstream from the renal collecting tubules, which leads to increased weight and elevated blood pressure.[10] It is estimated that between 30% and 80% of people who live with diabetes do not receive a diagnosis. This occurs because symptoms like polyuria and polyphagia are often overlooked. In some instances, the diagnosis of diabetes is not made until complications associated with the disease have become apparent.[10] In most cases, people with type 2 diabetes do not require insulin at the time of diagnosis and can manage their condition with oral anti-diabetic medications. Nevertheless, the function of pancreatic beta cells gradually declines over time, despite medication, potentially requiring insulin injections.[13]

The pathophysiological pathway of glucose intolerance in the development of type 2 diabetes is influenced by several different factors. [11] The fundamental abnormality that initiates the disease is insulin resistance in the muscles and liver, along with β-cell failure.[13] People who are genetically predisposed to type 2 diabetes inherit genes that cause insulin resistance in their tissues.[14] Insulin resistance manifests in the muscles as an inability to uptake glucose after consuming carbohydrates, leading to hyperglycaemia after meals.[15, 16] Two conditions indicate that the liver is insulin resistant: 1) excessive glucose production in the basal or fasting state despite high insulin circulation, and 2) poor insulin-mediated suppression of hepatic glucose production following a meal.[13, 15, 16] To counteract insulin resistance, these insulin-resistant conditions trigger pancreatic β-cells to increase insulin secretion. Glucose levels remain within normal range if the cells are capable of effectively producing insulin.

However, these cells deteriorate over time, resulting in increased postprandial blood glucose levels and, later, fasting blood glucose levels, eventually resulting in a type 2 diabetes diagnosis.[13, 17] The diagnosis is made based either on the levels of glucose in the blood or the levels of Haemoglobin A1c (HbA1c).[10]

1.2.2 Global prevalence of diabetes

In 2021, the International Diabetes Federation (IDF) published its latest estimates, indicating that 537 million people aged 20-79 years had diabetes (10.5% of all adults in this age group). It is also predicted that 643 million adults aged 20–79 will live with diabetes by 2030, and 783 million by 2045.[18] Furthermore, even though the global population is predicted to grow by 20% during this period, the number of people with diabetes is anticipated to rise by 46%. Additionally, diabetes prevalence is expected to increase by 16% due to population ageing. The most significant relative growth in prevalence from 2021 to 2045 is anticipated in middle-income countries, attributed to their ageing populations. Conversely, an estimated 94% of the increase in people with diabetes by 2045 will occur in low- and middle-income countries, where a higher population growth rate is projected.[19] Early diagnosis is essential to prevent or delay complications, improve quality of life, and avoid premature mortality. However, nearly half of the adult population aged 20 to 79 years, approximately 44.7% or 239.7 million individuals with diabetes, are unaware of their condition. Late diagnosis leads to increased consumption of healthcare services due to diabetes-related complications, further exacerbating healthcare system challenges and adding additional strain.[20]

The estimates from 2021 also show that the prevalence of diabetes increases with age, a trend anticipated to persist into 2045. The age group 20-24 years old has the lowest diabetes prevalence at 2.2% in 2021. For adults aged 75-79 years, the prevalence is estimated at 24.0% in 2021, with a forecasted increase to 24.7% by 2045. As the global population ages, the number of individuals over 60 years of age with diabetes is expected to grow. Estimates also vary by sex, with diabetes prevalence in women aged 20–79 years slightly lower than in men (10.2% vs 10.8%). In 2021 worldwide, there are 17.7 million more men living with diabetes than women.[20]

Additionally, the prevalence of diabetes varies based on the regional and country levels, as demonstrated in Table 1.[21] The prevalence of diabetes in individuals aged 20-79 years in the

Middle East and North Africa (MENA) region is the highest when compared to other regions, with a rate of 18.1% in 2021. This figure is expected to rise, and by 2045, the MENA region will still have the highest prevalence rate, estimated at 20.4%. The comparative prevalence in the Africa region is currently the lowest at 5.3%, which is partly due to lower levels of urbanisation and a lower prevalence of overweight and obesity compared to other regions. According to estimates, the prevalence is expected to increase from 4.5% in 2021 to 5.2% in 2045, but the increase is expected to be smaller than that of other IDF regions such as Europe, MENA, North America and the Caribbean, South and Central America, South-East Asia and the Western Pacific. Considering the rapid urbanisation and expected changes in lifestyles and ecosystems in this region, this is likely to be an underestimate. China, India and Pakistan were the top three countries with the highest numbers of adults aged between 20-79 years who have diabetes in 2021. The prediction is that they will continue to maintain this position even in 2045. In 2021, Pakistan (30.8%), French Polynesia (25.2%) and Kuwait (24.9%) have reported the highest comparative diabetes prevalence rates. These countries are also expected to have the highest comparative diabetes prevalence overall in 2045. Pakistan is projected to reach 33.6%, while Kuwait is expected to be 29.8% and French Polynesia 28.2%.[20]

Table 1: Prevalence of diabetes in adults (20–79 years) in IDF Regions in 2021 and 2045 (produced by the researcher; adapted from the IDF Diabetes Atlas) [21]

		2021			**2045**		
Rank	IDF Region	Number of people with diabetes (millions)	Diabetes prevalence (%)	Comparative diabetes prevalence* (%)	Number of people with diabetes (millions)	Diabetes prevalence (%)	Comparative diabetes prevalence** (%)
	World	536.6	10.5	9.8	783.2	12.2	11.2
1	MENA	72.7	16.2	18.1	135.7	19.3	20.4
2	NAC	50.5	14.0	11.9	62.8	15.2	14.2
3	SEA	90.2	8.7	10.0	151.5	11.3	11.3
4	WP	205.6	11.9	9.9	260.2	14.4	11.5
5	SACA	32.5	9.5	8.2	48.9	11.9	9.8
6	EUR	61.4	9.2	7.0	69.2	10.4	8.7

7	AFR	23.6	4.5	5.3	54.9	5.2	5.6

AFR: Africa; EUR: Europe; MENA: Middle East and North Africa; NAC: North America and Caribbean; SACA: South and Central America; SEA: South-East Asia; WP: Western Pacific

* 'Prevalence is standardised to each national population for the respective year.' [20]

** 'Prevalence is standardised to the world population for the respective year.' [20]

Furthermore, diabetes prevalence varies by ethnicity within countries, particularly in high-income countries with multiethnic compositions. For example, in the United Kingdom (UK), the prevalence of type 2 diabetes differs significantly among ethnic groups, with minority populations experiencing disproportionately higher rates compared to the majority. People of South Asian and Black ethnic backgrounds have diabetes prevalence rates approximately five times and three times higher, respectively, than those of White British ethnicity.[22-25] Similarly, in the United States (US), diabetes prevalence is highest among American Indians, followed by African Americans and Hispanics, compared to White Americans.[26] Likewise, in Canada, diabetes prevalence among minority ethnic groups, particularly those of South Asian origin[27] and Black ethnicity, is higher than in the general population.[28] Similar patterns are observed in other multiethnic countries such as Australia, South Africa, and Singapore, where minority groups facing a greater burden of diabetes.[29-31]

In addition to ethnicity, the prevalence of diabetes is also influenced by socioeconomic status (SES). People from lower socioeconomic backgrounds consistently related to increased diabetes prevalence compared to those from higher socioeconomic backgrounds within different countries.[32-36] For instance, a longitudinal analysis from the British Regional Heart Study cohort found that both neighbourhood-level deprivation and individual SES were associated with an increased risk of developing type 2 diabetes among older British men. This analysis revealed that men living in the most socioeconomically deprived neighbourhoods had a 1.5 to 2 times higher risk of developing diabetes than those living in the least deprived areas. [37] This association has also been observed among South Asian and Black minority ethnic groups in the UK, where socioeconomic deprivation has been linked to a higher prevalence of type 2 diabetes compared to those from the majority population.[38, 39] Likewise, in Saudi Arabia (SA) Al-Hanawi *et al.,* used data from the Saudi Health Interview Survey to identify the socioeconomic inequalities in diabetes prevalence. The study found that diabetes prevalence is higher among lower-income and less-educated populations.[40]

These consistent patterns across different countries indicate that minority ethnic groups, especially people of South Asian origin and people experiencing socioeconomic deprivation, have a disproportionately high prevalence of diabetes. The increased prevalence among South Asians is attributed to several factors, including genetic adaptations due to historical famines, beta-cell dysfunction, increased visceral adiposity, and lifestyle changes resulting from urbanisation and migration.[41-44] Additionally, people from socioeconomically deprived communities are also more likely to develop diabetes due to poor health related behaviours (such as poor dietary habits and reduced physical activity), limited access to healthcare and more likely to be exposed to risk factors like obesity and smoking.[36, 45, 46] Given the increased prevalence discussed above and the higher risk of diabetes complications among people of South Asian ethnicity and those from socioeconomically deprived areas, this thesis focuses specifically on these populations.

The increased diabetes burden in people from ethnic minority and socioeconomically deprived groups was not limited to the disease's prevalence but also increases the risk of diabetes-related complications and mortality. [32, 41, 47-49] Diabetes can progress to a variety of acute and chronic complications, such as cardiovascular disease, kidney failure, neuropathy, and retinopathy, all of which put additional strain on both individuals and healthcare systems. The following section will discuss these complications and explore how they disproportionately affect these groups.

1.2.3 Diabetes-related complications

A wide range of diabetes related complications can occur if diabetes is not managed properly, placing a significant burden on healthcare systems.[50] These can present as either acute or chronic complications. Acute complications also referred to as diabetes emergency are characterised as sudden and severe health issues that can be life-threatening, occurring due to abnormal blood glucose levels, which may be either too high (hyperglycaemia) or too low (hypoglycaemia).[51] Uncontrolled hyperglycaemia can induce two conditions, diabetic ketoacidosis and hyperglycaemic hyperosmolar states. These conditions may result from intercurrent illnesses, infections, medication nonadherence, and psychological stress. On the other hand, hypoglycaemia is characterised by a lower-than-normal blood sugar level, which can result from a loss of autonomic blood sugar control, an adverse effect of treatment, or factors such as poor prescribing and incorrect medication use.[52-55] These acute

complications that occur in patients with diabetes are associated with significant morbidity and mortality.[52-54]

The long-term complications of diabetes become apparent as the disease progresses. Even in the pre-diabetes stage, the development of these complications begins, and their prevalence rises with an increase in diabetes duration, particularly when blood sugar levels are not appropriately managed.[56, 57] The prolonged exposure of tissues to elevated glucose levels can lead to endothelial dysfunction of blood vessels, both small (microvascular) and large (macrovascular). Microvascular damage can subsequently cause tissue and organ damage, frequently affecting the central nervous system (autonomic neuropathy), the kidneys (nephropathy), peripheral nerves (peripheral neuropathy), and the eyes (retinopathy). This damage can lead to cardiovascular complications such as cardiomyopathy, atherosclerosis, stroke, and myocardial infarction.[58, 59] The development of these complications can be further enhanced by the presence of certain factors, most commonly dyslipidaemia, hypertension, and smoking.[60, 61]

While all people living with diabetes are at risk of diabetes related complications, minority ethnic groups, particularly South Asians and those experiencing socioeconomic deprivation are disproportionately affected.[32, 41, 47-49] Compared to people of White ethnicity and other ethnic groups, people of South Asian ethnicity with type 2 diabetes have a higher risk of developing complications due to factors such as genetic predisposition, developing diabetes at a younger age, delayed diagnosis, poor management, and medication nonadherence.[41, 62] Studies have consistently shown that South Asians have an increased risk of both macrovascular and microvascular complications.[62] In the UK Asian Diabetes Study, cardiovascular events and mortality were analysed over a two-year period among 1,486 people of South Asian ethnicity and 492 people of White ethnicity from general practices in the UK. The study found that people of South Asian ethnicity had a higher risk of cardiovascular events and mortality, particularly at a younger age, with the mean age at death being 66.8 years for South Asians, compared to 74.2 years for people of White ethnicity.[63] Further research from Scotland demonstrated that Pakistani ethnicity was an independent risk factor for cardiovascular disease among individuals with type 2 diabetes.[64] Additionally, a study conducted by Pardhan *et al.,* determined the prevalence of sight threatening retinopathy among people of South Asian and White ethnicities attending a diabetic clinic in the UK. The

results indicated that people of South Asian ethnicity had a significantly higher prevalence of sight threatening retinopathy than those of White ethnicity.[65] Furthermore, socioeconomic deprivation, both at the individual and area levels, increases susceptibility to these complications.[32, 47] A systematic review investigated the relationship between SES and microvascular and macrovascular complications in people with type 2 diabetes in high-income countries. The review included 28 studies and found consistent evidence of socioeconomic disparities in diabetes complications. People with low SES (based on education and income) or living in deprived areas have a higher risk of complications such as retinopathy, nephropathy, cardiovascular disease, and diabetic foot disease. For instance, people with lower levels of education and income were more likely to develop retinopathy, nephropathy, and cardiovascular complications than those in higher socioeconomic groups. Additionally, people living in deprived areas are also more likely to require laser therapy for retinopathy or major amputations for diabetic foot ulcers.[47]

Although these complications result in increased morbidity and mortality and place a significant burden on the healthcare system,[66-71] effective diabetes management can help reduce the risk or delay these complications, as well as reduce mortality and reduce the burden on the healthcare system.[72-74] The following section will provide an overview of diabetes management.

1.2.4 Management of diabetes

There are a wide variety of approaches to managing diabetes, with the treatment plan being dependent upon the type of diabetes diagnosed. People with type 1 diabetes typically require the administration of external insulin to manage their condition. Conversely, people with type 2 diabetes can be managed using a variety of approaches, which can include lifestyle adjustments as well as pharmacological therapy.[75] Lifestyle adjustments, such as increased physical activity and diet modifications, serve as the foundation in the treatment of type 2 diabetes. A regular physical activity regimen has been demonstrated to improve HbA1c levels and is associated with effective diabetes management.[76] A minimum of 150 minutes of moderate-intensity aerobic exercise per week can enhance insulin efficiency in muscles and the liver.[77] In addition, walking as a fundamental form of daily exercise has been shown to significantly reduce the risk of type 2 diabetes-related complications, such as cardiovascular disorders by 50% .[78] It is also imperative for people with type 2 diabetes to incorporate

physical activities into their daily routines, including household chores and gardening.[78] A healthy diet plays also a crucial role in the management of both type 1 and type 2 diabetes.[76] A systematic review analysed 60 studies, including randomised controlled trials and cohort studies, to evaluate the effectiveness of medical nutrition therapy in adults with type 1 and type 2 diabetes. Medical nutrition therapy is an important part of diabetes management that includes dietician counselling and recommendations for dietary intake and nutrition goals to improve metabolic control and treatment outcomes.[79] This review found that reductions in HbA1c levels of 1% to 2% can be achieved through medical nutrition therapy.[80] It is recommended that the diet consists of 50% carbohydrates, focusing on complex carbohydrates over simple ones, 15-20% protein, and 20-35% fat.[81] Along with lifestyle adjustments, antidiabetic medications are considered an integral part of diabetes management, not only for achieving glycaemic control, but also for preventing acute complications and delaying or preventing chronic complications.[82] Several classes of evidence-based medications are available for the management of type 2 diabetes, as summarised in Table 2.[83] Despite their efficacy in the achievement of optimal outcomes,[84] a recent metanalysis found that the overall prevalence of medication adherence among people with type 2 diabetes worldwide was relatively low.[85] This emphasises the need to explore and understand medication adherence and the factors influencing it, as improving adherence could lead to better overall health outcomes among these populations, a topic that will be explored in the following section.

Table 2: Evidence-based summary of type 2 diabetes medications

Medication class	Mechanism of action	Effect on HbA1c
Biguanides: Metformin The recommended first-line therapy for managing diabetes may involve either monotherapy or a combination of medications, depending on the patient's needs and clinical guidelines.	This medication works by enhancing the body tissues' sensitivity to insulin and regulates blood sugar levels by reducing glucose production in the liver. Additionally, it modifies carbohydrate metabolism, further lowering the liver's glucose production.[86, 87]	A total of 12 randomized controlled trials were involved in the systematic review, with 11 double-blind trials, comparing metformin monotherapy to a placebo. The study length averaged at 21.5 weeks with an average of 103 participants per study. The results of this review showed that metformin monotherapy had a significant impact on reducing HbA1c levels with a standardized mean difference of -0.97%, (95% CI, -1.25 to -0.69). Fasting plasma glucose levels were also significantly reduced by metformin monotherapy, with a standardized mean difference of -0.87 and (95% CI, -1.13 to -0.61).[88]
Thiazolidinedione: Pioglitazone Combination therapy	This medication class involves activating the nuclear receptor peroxisome proliferator-activated receptor gamma (PPARγ). This activation enhances glucose uptake in several tissues, such as adipose tissue, muscle, and liver, improving insulin sensitivity.[89]	Thiazolidinediones have been found to be effective in reducing HbA1c levels when used alone or in combination with other medications such as metformin, sulfonylureas, or insulin. A comprehensive meta-analysis consisting of 19 randomized controlled trials and three cohort studies has demonstrated that thiazolidinediones can decrease HbA1c by a mean difference of -0.64% (95% CI, -0.93 to -0.35) and fasting plasma glucose by mean difference -26.27 (95% CI, -44.90 to -7.64). The analysis further indicates that when thiazolidinediones are combined with metformin, HbA1c is reduced more significantly, ranging between 0.64% and 1.26%.[90]
Sulfonylureas: Gliclazide, Glimepiride Second line monotherapy or combination	Medications in this class reduce blood glucose levels primarily by stimulating pancreatic insulin secretion. This can be achieved by inhibiting the ATP-sensitive potassium channels in pancreatic beta cells. The inhibition of these channels induces cell depolarization, which triggers voltage-dependent calcium channel opening. The increased calcium influx stimulates insulin	Sulfonylureas have proven to be effective in reducing HbA1c levels, indicating their efficacy in glycaemic control. A systematic review encompassing 31 trials highlighted their effectiveness. In nine of these studies, sulfonylureas as monotherapy reduced HbA1c by 1.51% compared to placebo, with (95% CI, 1.25 to 1.78). Additionally, four studies showed that adding sulfonylureas to existing oral diabetes treatments resulted in a further reduction in HbA1c by 1.62% (95% CI 1.0 to 2.24). Moreover, 17 studies found that the addition of sulfonylureas to insulin therapy reduced HbA1c by 0.46% (95% CI, 0.24 to 0.69), highlighting their role in improving treatment regimens for better diabetes management.[92]

	release, reducing blood glucose levels.[91]	
Glucagon-like peptide-1 (GLP-1) inhibitors: Albiglutide, Dulaglutide, Exenatide, Liraglutide, Lixisenatide, and Semaglutide Combination therapy	Medications in this class provide many benefits for managing diabetes including improving insulin sensitivity, lowering fatty acid levels, and promoting weight loss, and enhancing insulin sensitivity. As a result, glycaemic control and overall diabetes management are improved. [93]	In a meta-analysis including 29 randomized controlled trials, GLP-1 agonists significantly reduced HbA1c levels by -0.97% (95% CI, -1.13% to -0.81%) compared to placebo. Further, a systematic review of 34 clinical trials involving 14,464 patients revealed that GLP-1 agonists not only lowered HbA1c levels but also fasting plasma sugar levels, both of which were reduced by -0.55% and -0.73 mmol/L, respectively. Lixisenatide and dulaglutide, especially, showed even greater effects, lowering HbA1c levels by -1.21% and -1.97 mmol/L for dulaglutide, respectively, indicating their effectiveness in controlling blood glucose levels. [94]
Dipeptidyl peptidase-4(DPP-4) inhibitors: Alogliptin, Linagliptin, Saxagliptin, Sitagliptin, and Vildagliptin, Monotherapy	This class work by inhibiting the breakdown of incretins, including glucose-dependent insulinotropic peptide and GLP-1, which leads to an increase in insulin secretion. [95]	Cochrane reviews analysed the effect of DPP-4 inhibitors on HbA1c levels. Three studies involving sitagliptin observed 1,103 patients for durations ranging from 18 to 52 weeks. The results showed a reduction of about 0.7% in HbA1c levels. Six studies involving vildagliptin included 1,139 patients with follow-ups ranging from 12 to 52 weeks, resulting in a decrease of 0.6% in HbA1c levels. Saxagliptin studies showed a decrease in HbA1c levels of approximately -0.9%.[96]

when patients contraindicated to metformin		
Sodium-glucose linked transporter (SGLT2) inhibitors: Canagliflozin, Dapagliflozin, Empagliflozin Combination therapy	This class of medication act by restraining the reuptake of glucose within the proximal tubules located in the kidneys, which results in an increase of glucose excretion through urine.[97]	A review of seven randomized controlled trials found that SGLT2 inhibitors significantly decreased HbA1c levels, averaging at -0.54% (95% CI, -0.676 to -0.40) compared to placebo. Moreover, a study of 1,450 people with diabetes was randomized and double-blind to canagliflozin 300 mg, canagliflozin 100 mg, or glimepiride (6 or 8 mg). It showed a decrease in HbA1c of −0.65% with canagliflozin, −0.74% with canagliflozin, and −0.55% with glimepiride over a 104-week duration. Additionally, the combination of dapagliflozin with metformin and sulfonylurea resulted in a significant reduction in HbA1c of −0.86% compared to −0.17% in the placebo group at 24 weeks. Recent research has also shown that SGLT2 inhibitors can lead to an 11% decrease in the development of cardiovascular events in T2D patients with atherosclerosis, a 23% decrease in heart failure cases, and a 45% decrease in renal disease.[98]
Meglitinides: Nateglinide Repaglinide Monotherapy or combination therapy	This class of medication works by stimulating the release of insulin from pancreatic beta cells, like the sulfonylureas.[99]	A systematic review of 15 randomized clinical trial have proven that meglitinides, such as repaglinide and nateglinide, are effective in managing blood glucose levels in diabetic patients. In comparison to a placebo, repaglinide has been shown to decrease HbA1c levels between 0.1% to 2.1%, while nateglinide has been demonstrated to achieve a decrease in HbA1c levels ranging from 0.2% to 0.6%.[100]
Alpha-Glucosidase inhibitors (AGI):	This class of medication by decreasing the absorption of sugars in the intestine by	A systematic review and metanalysis of 41 studies have proven that compared with placebo, AGI had a beneficial effect on HA1c acarbose −0.77% (95% CI ; 0.64 - 0.90) miglitol −0.68% (95% CI, 0.44 - 0.93) , fasting and post load blood glucose and post load insulin.[102]

Acarbose Miglitol Combination therapy	inhibiting intestinal alpha-glucosidase enzymes, which are responsible for breaking down carbohydrates into simple sugars like glucose. This inhibition slows the digestion and absorption of carbohydrates, leading to a reduction in blood glucose levels rise after meals.[101]	

1.3 Medication adherence

1.3.1 Medication adherence definitions

The definition of adherence is debated in the literature, primarily due to the heterogeneous terminology used. Different terms used to describe adherence include compliance, adherence, concordance, and persistence.[103, 104] Compliance was historically the most commonly used term, and it is defined, according to the International Society for Pharmacoeconomics and Outcomes Research (ISPOR), as the degree to which patients follow the provider's recommendations in the following aspects of medication-taking: timing, dosage, and frequency.[104, 105] Recently, 'compliance' has become less popular as a term because it suggests that patients are passive in decision-making, indicating an acquiescence to prescriber authority.[106] However, the term adherence implies the collaboration of patients and healthcare providers by integrating providers medical opinions and preferences to improve health outcomes.[107-110] Therefore, it has been defined as the extent to which patients follow the instructions of a prescriber when taking medicines.[111] Given that 'adherence' is the preferred term currently, it will be consistently employed in this thesis to refer to the process of taking medication as prescribed.[112] Among the more recent terms is 'concordance', which highlights the quality of the interaction between the patient and the prescriber rather than the behaviour of taking medications and is sometimes mistakenly used to mean the same as adherence.[103] A fourth term, 'persistence', is used in research to refer to the interval between initiation and the last dose, immediately preceding discontinuation.[104, 111]

Medication adherence can be also described as the process consisting of three separate, but interconnected phases: initiation, implementation and discontinuation.[111, 113]

Phase 1: Initiation

Initiation involves a patient obtaining and starting to take a newly prescribed medication according to instructions.[111] According to a review published by ISPOR, which identified medication initiation as involving two key steps: the act of prescribing and the act of dispensing the medication.[114] The process starts with the patient's initial prescription in a specific therapeutic category, marking initiation as a period from the moment the prescription is written to when the medication is first dispensed.[111] Measuring adherence at the initiation

stage is challenging due to the limited availability of data sources that capture both prescribing and dispensing actions.[114] Non-initiation, where the patient does not get the medication dispensed, is estimated to occur in around 4% of patients in a clinical trial setting.[115] However, this figure is significantly higher in real-world scenarios, where around 28% of new medication prescriptions are not dispensed, based on an analysis of over 82,000 electronic prescriptions in an electronic health record system in the US.[116] Medications for long-term diseases like diabetes, hypertension, and hyperlipidaemia show the highest rates of non-initiation.

Phase 2: Implementation

Implementation adherence is defined as the degree to which the patient follows the recommended regimen for dosing, from initiation and ending with the last dose.[111, 113] Unlike initiation adherence, assessment of implementation adherence does not require knowledge of the prescribing event. Implementation adherence is commonly discussed in the literature because it can be measured in a variety of ways.[116] It is commonly measured as a metric that summarises adherence behaviour over a given period into a single number. The most used measures are the percentage of days adhered to according to the dosing instructions, the occurrence of medication breaks, and the time interval between doses.[111, 113] Longitudinal studies are particularly effective in observing the fluctuating nature of implementation adherence, allowing for a precise determination of when discontinuation happens.[111]

Phase 3: Discontinuation

Discontinuation is the act of a patient stopping their medication, whether or not this was clinically recommended. In administrative pharmacy claims databases, it is referred to the gap between one dispensing episode and a subsequent one (if one occurs) for the same medication within a certain period of time.[117] The duration of a medication gap is determined by the maximum days' supply allowed per refill, which varies according to the refill policy of the healthcare system. For instance, in the US, a standard supply under an insurance plan typically covers 30 days, and a gap ranging from 60 to 90 days between dispensing instances may indicate discontinuation.[117] In contrast, the National Health Services (NHS) commonly prescribes a 28-day supply, but actual practice may extend beyond this due to

varying local policies and patient circumstances.[118, 119] The act of discontinuing therapy initiates the period of non-persistence, but adherence literature often uses both terms interchangeably.[111] Persistence with a medication regimen includes both the initiation of the regimen as well as its implementation. As with initiation, persistence is usually represented as a time-to-event variable.[120, 121] It can be determined as the number of days from when the medication is first dispensed to when it is dispensed for the last time, adding on the supply days included in the last dispensing.[117]

1.3.2 Classifications of nonadherence

Adherence is a multifaceted and dynamic concept, influenced by a variety of factors. Numerous behaviours that could be considered as nonadherence have been the subject of classification by researchers, recognizing that nonadherence is not binary but exists on a range as follow:

Primary vs. secondary nonadherence

Nonadherence has been categorised into primary and secondary nonadherence.[122-124] Primary nonadherence occurs when patients fail to collect their initial prescription for a new medication, essentially assessing if the first prescription issued is dispensed or not.[122] Secondary nonadherence refers to the situation where a patient obtains their prescription, but does not follow the specified instructions for taking it.[122] This type of nonadherence evaluates the patient's adherence with the medication regimen once it has been dispensed, covering all three stages of adherence: initiation, implementation, and discontinuation.[111]

Intentional vs. unintentional nonadherence

The National Coordinating Centre for the NHS has also differentiated medication nonadherence into 'intentional' and 'unintentional' categories, a classification that has provided valuable insight into the complexities of adherence behaviours.[103] Intentional nonadherence occurs when individuals consciously decide not to follow their prescribed medication regimen, a choice which may be influenced by their personal beliefs or behaviours. This decision-making can be considered either logical or illogical. It is a behaviour stemming from deliberate decisions regarding medication use, shaped by an individual's beliefs, behaviours, personal situations, interpretations of medical advice, and their motivation to

adhere to treatment.[103] Unintentional nonadherence occurs through actions that are not consciously decided, often influenced by factors such as time orientation, memory capabilities, and physical challenges. This may manifest as forgetting to take medications, misinterpreting how to take them, or difficulties in physically taking/using the medicine, like swallowing. Unintentional nonadherence essentially reflects an individual's capability to manage their medication regimen.[125, 126] These adherence behaviours exhibit variability, not only among different individuals, but also within the same individual over time, highlighting the complexity of medication adherence. For example, a patient may both intentionally disregard a medication deemed unnecessary and unintentionally forget to take it, demonstrating how perceptions of the value of a medication influence the action of taking it. [127] Furthermore, the likelihood of both intentional and unintentional nonadherence can vary depending on the complexity of a patient's prescribed medication regimen.[103] This suggests that the number of medications prescribed to an individual can significantly impact their adherence behaviour, adding another layer of complexity to understanding and addressing medication non adherence behaviours.[128, 129]

1.2.1 Medication adherence measurements

Medication adherence can be measured using numerous ways; however, no gold standard approach has been established to date.[130, 131] These measures can be categorised based on what is measured, and how it is measured. Research into these measures shows that they are designed to gather diverse information on medication adherence,[132] encompassing aspects such as barriers to adherence,[133] beliefs influencing adherence,[134] and the patterns of medication taking.[135] To systematically assess these facets, various methods and tools have been developed and validated.[136] There are two primary categories of medication adherence measures: direct measures and indirect measures.[136]

- **Direct measurements** include measuring the concentration of a drug, their metabolites and/or detection of a biological marker given with drug in bodily fluids, such as blood or urine, while observing the patient's administration of their medications.[136]
- **Indirect approaches** involve an assumption to some extent that the patient has taken the medication, making them more popular in adherence research due to the direct method being costly, challenging to perform, and in some cases, potentially invasive[136] These

indirect approaches can be classified according to the WHO into objective and subjective measures.

- **Subjective measurements** encompass methods that require either patient self-reports or evaluations by healthcare professionals to assess adherence to prescribed medications.
- **Objective measurements** employ more quantifiable techniques, such as pill counting, electronic monitoring of package opening and analysis of secondary databases such as pharmacy insurance claim or electronic prescription service.[113]

Both measures have advantages and drawbacks, and it is preferred to use them in combination.[108] The following sections detail the specific methods used for measuring medication adherence.

Measures based on secondary database analysis: pharmacy refill claims

The frequency of repeat prescriptions, also known as medication refills, documented within pharmacy administrative databases, has been broadly used in research to assess medication adherence.[117, 137, 138] Within closed pharmacy systems, such as those found in countries with universal health coverage, it can provide accurate assessments of medication adherence, assuming the data is comprehensive and fully detailed.[117] Furthermore, pharmacy refill claims data can provide an estimate of 'real world' adherence across large populations in a cost-effective and efficient way, depending on the accessibility of such data.[117] It can be also integrated with clinical information in electronic health record systems. This integration can assist in calculating adherence at initiation by tracking the first dispensing of a prescription after it has been prescribed, identifying medication switching through observing modifications in medication types or dosages over time, and determining therapy discontinuation by identifying whether patients adhere to or discontinue their medication. Since it can be calculated longitudinally, this method is ideal for determining adherence to long-term medications.[117]

Pharmacy refill claims databases have utilised multiple interconnected algorithms to assess medication adherence.[117] The most frequently used methods are the medication possession ratio (MPR), the proportion of days covered (PDC), and related measures like continuous multiple-interval measures of availability (CMA).[117, 137] Primarily, these formulas are used to assess the implementation phase of adherence. Nonetheless, significant

variability in how these measures are defined and applied has been observed in the literature.[117, 137] The MPR is calculated as the total days of medication supplied during the observation period divided by the total number of days in that period. The inclusion of the supply from the previous refill can differ depending on the calculation method used.[117] For example, if an individual with diabetes receives a metformin supply for 90 days within a 120-day observation period, the MPR would be calculated as follows:

$$MPR = \frac{Total\ Days\ of\ Medication\ Supplied}{Total\ Days\ in\ Observation\ Period}$$

$$MPR = \frac{90}{120} = 0.75$$

This MPR value of approximately 0.75 indicates that this individual had access to metformin for 75% of the observation period, reflecting partial adherence. MPR close to 1.0 would indicate better medication adherence, while substantially lower values might indicate significant issues.

The calculation for PDC involves the number of days that prescription refills cover during a specific period. This period is typically defined as the time from the first refill to the end of the measurement period, and it serves as the denominator. The numerator in this equation represents the actual number of days covered by the prescription refills during this time frame.[139] The estimate of adherence provided by the PDC is considered to potentially underestimate the actual adherence. This is because it considers the date of dispensing as well as the number of days for which the prescription is supplied.[139] In case a prescription is refilled before the current supply is finished, it is assumed that the new supply will only be started after the previous supply has been completed.[139] The PDC measure is considered more accurate than the MPR as it excludes overlapping medication supplies. Consequently, due to its accuracy and reliability, research and various organisations recommend using this measure to calculate adherence using pharmacy claims data.[140-143] The Pharmacy Quality Alliance has chosen a PDC ≥ 80% as the optimal adherence threshold for long-term conditions, although there is limited evidence to support this cut-off.[144, 145]

Within administrative databases, continuous multiple-interval measures of medication availability can be calculated with eight different formulas. An open-source software program called AdhereR has been recently developed within the R statistical package, which enables

the computation of these CMA measures.[146] The longitudinal adherence patterns are also being identified and visualised using group-based trajectory modelling (GBTM) technique on the pharmacy refill claims data, a method recently introduced and implemented to analysed medication adherence in this context.[147-150] GBTM is a statistical method that utilises groups to estimate the distribution of trajectories within a population.[151]. This method uses a form of finite mixture modelling to determine an unknown distribution.[151] The models identify groups, which ought to be regarded as distinct groups within a population rather than literal entities.[151] A group refers to a set of people who exhibit similar patterns of adherence behaviour. GBTM involves frequent measurement of adherence at regular intervals (typically monthly) and grouping individuals based on similar patterns of adherence over time.[147] The model assumes that any correlation observed in an individual's adherence behaviour over time can be fully explained by the adherence trajectory curve estimated for their specific group.[147] Maximum likelihood is used to calculate model parameters, which allows for unbiased estimates to be generated even if there are missing data, as long as the missing data is randomly missing.[151, 152]

Several significant limitations exist in using pharmacy refill claims data to assess medication adherence. Firstly, refill rates primarily only provide insight into the acquisition of medication, not on the actual consumption.[117] This approach also fails to capture daily variations in medication use (e.g., dosing frequency and timing), leaving gaps in a comprehensive picture of adherence. Moreover, dispensing systems can lose sensitivity when medications are provided for extended periods, for instance, a 90-day supply is often used in the US,[153] whereas the NHS generally follows a 28-day repeat prescription model.[154] However, there are exceptions within the NHS where longer dispensing intervals are used, particularly for stable long-term conditions.[154] In these cases, the reduced frequency of refills results in fewer data points from dispensing records, potentially limiting the accuracy of adherence assessments based on these data.[153] Additionally, data on medications not covered by the pharmacy program, such as over-the-counter medicines, are typically not recorded in most countries, including the NHS prescription databases.[117, 155] This omission can lead to incomplete adherence assessments, as patients may use over-the-counter options that are not captured in their medication records. The presence of prescription charges in the NHS, unless exempt, in the UK may also impact the accuracy of adherence calculations.[156] To avoid these

charges, patients may choose to purchase certain medications over-the-counter, resulting in gaps in prescription data. Despite the standardised NHS prescription charge and not a co-payment per medication, as in some other countries, it can affect patient behaviour regarding medication acquisition. In other healthcare systems like the US, co-payments can also affect the accuracy of database adherence measurements. Some reimbursable medications can be purchased without a prescription by patients outside of the pharmacy program, which can reduce costs. Both scenarios demonstrate how out-of-pocket costs can cause patients to obtain medications through alternative means, resulting in incomplete prescription records and affecting the precision of adherence calculations.[117] Furthermore, if patients receive their medication during hospital stays, it could influence adherence estimates based on community pharmacy dispensing records. The integration of hospital and community pharmacy records varies by NHS trust in the UK.[157] If healthcare records are not fully integrated, medication dispensed in hospitals may not be reflected in community pharmacy data, resulting in inaccurate adherence measurement.[158]

Measures based on using electronic medication packaging (EMP) devices

EMP devices, defined as adherence-monitoring tools integrated into the packaging of prescription medications, offer a variety of features despite the differences among available models. Common characteristics include: (i) logging dosing events and maintaining adherence records; (ii) providing audiovisual alerts for the next dose; (iii) featuring digital displays; (iv) enabling real-time adherence tracking; and (v) supplying feedback on adherence behaviour.[159] These features are preferred by users in the order listed, although not every device includes all these functions.[136] However, the capability to record adherence behaviour stands out as critical for analysing adherence patterns and designing personalised intervention strategies. Among these, the Medication Events Monitoring System (MEMS) stands out as the EMP device most frequently utilised in studies on medication adherence.[136] MEMS integrates micro-circuitry within pharmaceutical packaging, enabling the detection, time stamping, and recording of actions necessary to release a dose of medication.[160, 161] This system records each instance of a medication container being opened, thus obtaining a measure of medication adherence in chronological order.[162] MEMS provide accurate estimates of medication adherence, unaffected by the recall or social desirability biases often seen in self-reported adherence measures. These tools enable

longitudinal assessments of adherence, allowing for real-time intervention in cases of nonadherence. They also offer the ability to identify the exact phase of nonadherence, be it initiation, implementation, or discontinuation, more accurately than other methods.[161] However, the utilisation of MEMS comes with significant drawbacks. They are expensive and time-consuming to administer effectively.[163, 164] Additionally, the physical design of these devices can lead to operational challenges, such as difficulty in opening the device or the potential for taking multiple doses by mistake, which can impact the accuracy of adherence estimates.[120, 164] A critical limitation of MEMS is their inability to confirm actual ingestion of medication. Studies have found that 75% of users do not use MEMS correctly, with some removing multiple doses at once.[165] Furthermore, the use of MEMS introduces ethical concerns related to the management of large volumes of detailed electronic data, particularly the risk of possible breaching patient confidentiality.[166]

Self-report measures

Medication adherence can be self-reported through a variety of methods, including scales, questionnaires, diaries, and patient interviews.[136, 137] Among these, numerous self-report measures, mainly questionnaires, have been developed [167, 168] For instance, the Morisky Medication Adherence Scale (MMAS) is one of the most commonly used validated questionnaires that assess medication adherence by asking patient questions that address common adherence-related issues such as forgetfulness, carelessness, and intentional skipping of doses.[169] Interviews and diaries are also utilised as self-reporting formats to collect detailed patient adherence information. In medication diaries, patients record each dose taken in real-time, giving a detailed insight into their daily adherence and highlighting missed doses or changes in their daily medication taken from the prescribed regimen. Patient interviews, such as semi-structured interviews, allow healthcare providers and researchers to explore the personal factors that affect adherence more deeply.[168, 170, 171] These methods are widely utilised in clinical and research contexts to evaluate medication adherence, due to their low cost and ease of implementation.[132, 138] However, these are subjective measures, and prone to recall bias. For example, when completing a questionnaire or conducting an interview, patients may forget about a missed dose earlier in the week, resulting in overestimating adherence. The information derived from adherence scales can vary, with some scales more effective at identifying the reasons behind nonadherence rather than

quantifying its degree.[136] Some self-report scales do not specify a time frame, limiting adherence assessment to a singular point in time. Nonetheless, longitudinal adherence assessments can be achieved through repeated measurements at various intervals. Utilizing diaries, patients can document their medication use either daily or weekly, which enables the measurement of adherence over that specific period. The accuracy and comprehensiveness of patients' self-reported data are essential to guarantee the reliability of these assessments. However, when measuring adherence to multiple medications, the specificity of self-reported measures might be limited.[136] These measures have been widely reviewed across the literature.[172] It was found that questionnaires and diaries showed the highest correlation with electronic monitoring methods, while data derived from interview methodologies exhibited the greatest level of unexplained variation.[173] The high level of unexplained variance in interviews could result from the social desirability bias that often accompanies face-to-face interactions.[130] Nevertheless, interviews yield detailed data narratives, capturing insights and topics that other methods might not uncover. Furthermore, it is inappropriate to compare qualitative adherence assessment techniques with interview methods, as they are grounded in different research philosophical frameworks.[167, 168]

The use of self-reported methods for assessing medication adherence has several limitations. While these methods, including questionnaires, offer the advantage of being quick to administer and cost-effective for large-scale surveys, and postal questionnaires can be anonymised to improve confidentiality and reduce social desirability bias, they come with substantial challenges.[172] The collection of comprehensive data can be complicated by missing data caused by incomplete responses and low response rates, particularly in unsolicited postal surveys.[174, 175] The lack of objectivity and vulnerability to external influences, such as the underreporting of medication nonadherence by patients suffering from depression,[173] further question their validity.[138] Social desirability bias, where individuals may be reluctant to admit nonadherence to avoid negative self-presentation, is a notable issue.[138]

Direct measures

Therapeutic drug monitoring (TDM) is a direct and objective method for measuring medication adherence through the systematic clinical laboratory evaluation of a specific chemical substance at predetermined intervals. By measuring these levels, TDM assists healthcare

providers in identifying whether the patient is taking the medication as recommended and whether dose modifications are required to achieve or maintain therapeutic drug concentrations.[120, 138] TDM is particularly valuable for drugs with a narrow therapeutic index, as it aids in customising individual dosing regimens. However, the accuracy and reliability of TDM as an adherence measure are influenced by the drug's half-life, making it a time-sensitive process. A notable challenge to TDM's validity is 'white coat' adherence, where patients temporarily improve their adherence before a clinic visit, potentially skewing the steady-state concentration measurements.[176] Additionally, TDM is a costly technique that requires extra personnel for sample collection and testing, generally making it suitable primarily for clinical trials.[138]

Pill counts

Pill counts are an indirect method for assessing adherence, which includes counting the dosage units taken between visits to the clinic or between two scheduled appointments. The adherence ratio can be then calculated by comparing this number with the number of units the patient has received.[136] It can be also done during unscheduled home visits or by asking patients to count their remaining pills over the phone.[131]

Pill counts have emerged as the second most frequently utilised method for assessing medication adherence after self-report methods, as it is considered simple and inexpensive method.[138] Although studies examining both concurrent and predictive validity have supported the use of pill count measures for assessing adherence,[131] it has several disadvantages. This method can underestimate adherence since the dispensed date is the denominator without considering the possibility of surplus medications. This is particularly true among those with long-term conditions as patients often refill their medication before it runs out.[136] Moreover, pill counts have been found to overestimate adherence for a variety of reasons, including being susceptible to manipulation.[164] Patients may, for example, intentionally remove medication before a scheduled pill count to avoid any suspicion of nonadherence.[138] even though pill count relies on the same assumption as MEMS, specifically that removing the dosage unit is equivalent to taking the medication, pill count does not indicate a medication-taking pattern.[177, 178] When the correct number of dosage units are removed from the container, the patient does not necessarily consume the

medications. Additionally, pill counting is unable to identify the causes of adherence as well as to identify the pattern of adherence.[164]

1.3.3 Medication adherence influencing factors

Several factors have been identified as potentially impacting adherence to long-term medication regimens.[127, 179, 180] According to the WHO, five factors are known to influence medication adherence: treatment-related factors, condition-related factors, healthcare system factors, socioeconomic factors and patient-dependent factors.[181] The interconnections between these factors are strong and can influence each other, as well as the choices patients make about their adherence. For instance, the level of a patient's health literacy can impact their understanding of medication, potentially causing confusion about dosage instructions and leading to lower medication adherence.[182, 183] These factors are reviewed and discussed below.

Treatment related factors

Several factors related to treatment may impact medication adherence, including complex medication regimens, adverse effects experienced by patients, dosing frequency, the number of medications prescribed, treatment duration, success or failure of previous treatments, unpleasant tastes, and practical issues.[108] Specifically, adverse effects and medication regimen complexity have been commonly reported as barriers to adherence to antidiabetic medication. These factors are reviewed and supported by the literature below.

The experience of adverse effects can have a significant impact on the adherence to medication.[184] According to a recently published scoping review of qualitative research on medication adherence among people who have long-term diseases, many of which focused on diabetes, one of the most common barriers to medication adherence is adverse effects. Additionally, concerns about these effects can result in some patients stopping their medication, altering their regimen independently, or skip starting the medication entirely.[185] Additionally, a cross-sectional study conducted among people with type 2 diabetes to identify factors affecting medication adherence revealed that the majority reported concerns regarding the adverse effects of medication, which were commonly reported as a barrier to medication adherence.[186]

There was also consistency across literature regarding the link between medication adherence and medication regimen complexity. A review was conducted to explore the effects of medication regimen simplification on adherence and clinical outcomes in people with long-term medical conditions, with some studies focusing specifically on those with diabetes. Most simplification strategies, including combinations of fixed doses and once daily dosing, resulted in an improvement in medication adherence, although it is unclear whether this improvement was sustained over time.[187] The results of this review are supported by a study conducted on people with type 2 diabetes in Ethiopia, which concluded that medication regimen complexity might influence adherence and simplifying the medication regimen such as dosing frequency and dosage forms could also have a significant impact.[188]

Condition related factors

Several condition-related factors have been associated with adherence behaviour, including the characteristic features of an illness, such as symptom severity or visibility, duration since diagnosis or the chronicity of the illness, history of hospitalisations, the extent to which it causes disability, and the rate of progression or overall prognosis.[108] An individual's perception of risk and beliefs about the necessity of adhering to their treatment plan may influence the impact of these factors on adherence.[108] In support of this, Mann et al. explored how disease beliefs influence adherence to diabetes medications. They found that people who believed they only had diabetes when their blood sugar was high, or who felt that medication was unnecessary when glucose levels were normal, were significantly more likely to be nonadherent.[189]

Medication adherence and disease severity have been also studied, and some research suggested that there was a significant relationship between them. As shown in a meta-analysis conducted by DiMatteo *et al.,* which explored the relationship between health beliefs, disease severity, and patient adherence, a total of 122 studies examined medication adherence in people with a wide range of medical conditions, including long-term illnesses such as diabetes, hypertension, acquired immune deficiency syndrome (AIDS), and cancer. The analysis found that medication adherence is positively correlated with patients' perception of the severity of their disease.[190] A study has examined the relationship between disease severity, health beliefs, and medication adherence among patients with AIDS, revealing a correlation between disease severity and medication adherence.[191] There are also links between medication

adherence and the presence or severity of asymptomatic diseases, like hypertension, hyperlipidaemia or asthma, where symptoms can fluctuate.[184] People with such conditions may be less motivated to take their medications as they may not experience immediate observable benefits from them.[192] Conversely, studies have shown that patients who experience significant improvement in symptoms due to medication typically exhibit higher levels of adherence.[184] For instance, there is a strong correlation between adherence to medication and the presence or absence of symptoms in people with asthma or cardiac disease, who may perceive this connection and modify their medication intake based on it.[193] Further, primary prevention patients are less likely to adhere to their medication than secondary prevention patients.[194] This could be due to a lower perceived need, as primary prevention patients frequently do not experience symptoms or consequences immediately, making them less motivated to continue taking their medications over time.[194] In line with the previously described evidence, in the context of diabetes, where complications often develop silently over the years, patients' perceptions of disease severity and misconceptions about the need for continuous medication (even when blood glucose appears controlled) have both been reported to impact adherence.

Healthcare providers and system related factors

There are several factors relating to health care systems and health professionals that may influence medication adherence. These include health care accessibility, the cost of care, inadequate medicines availability, continuity of treatment, patient-healthcare provider relationships, limited consultation time, and communication.[108]

The relationship between the health professional and patient, mainly the skills and communication style of the professional, is one of the most well-researched factors. Based on a meta-analysis, patients experiencing inadequate communication from their physician have a 19% increased risk of not adhering to their treatment regimens compared to those whose physicians communicate effectively with them. Furthermore, physicians who received communication training showed significant improvements in patient adherence with odds of patient adherence 1.62 times higher than those when a physician did not receive such training.[195] Additionally, patients who are satisfied with physician-patient communication are more likely to adhere to their medication regimen.[196] Other aspects of the patient-healthcare provider relationship, such as personal interactions that encompass friendliness

and approachability, the capability to show empathy, elicit and respond to patients' concerns, the healthcare professional's attitude towards patients, the degree of trust and satisfaction with the professional, as well as the length and regularity of interactions, have been explored in research.[197] Particularly for people with diabetes, it has also been reported that patients who have multiple doctors prescribing for them and who utilise more than one pharmacy have lower adherence rates, likely because of poor relationships with healthcare providers.[198] The critical role of communication and the relationship between people with different long term conditions and health professionals in improving adherence is further supported by qualitative studies involving both patients and providers.[199-201] Building on these evidence, clear communication and strong provider relationships have been reported to influence adherence among people with diabetes.

Patient related factors

Patient-related factors encompass, according to the WHO, available resources, knowledge, attitudes, and beliefs about the illness or therapy, anticipation of the treatment outcomes, motivation, and perceptions of their self-efficacy to participate in the disease treatment plan.[108] These internal factors are significantly influenced by context and background. Additionally, these factors interact with each other, making the understanding of suboptimal adherence causes more complex.[108] Some of these factors, reviewed and supported by literature, are described below.

The relationship between medication adherence and patients' medication and health condition knowledge is not fully understood. Adherence requires a certain level of knowledge, including understanding the health condition, their medication's purpose, how to take it (dosing instructions), possible adverse effects, and how essential it is to take prescribed medication consistently. Furthermore, patients need skill sets to use this information effectively, such as organising their medications, adapting daily routines to accommodate medication schedules, recognising adverse effects and responding appropriately. The relationship between medication adherence, clinical outcomes, and patients' knowledge of their health condition and treatment has been explored in some studies.[202-204] For instance, in people with type 2 diabetes, increased knowledge about diabetes has been positively correlated with better adherence to antidiabetic medication and better glycaemic control.[202] Similarly, another study conducted among people infected with human

immunodeficiency virus (HIV) found an association between low health literacy and a lower level of knowledge about HIV, lower levels of adherence to antiretroviral therapy adherence, lower CD4 cell counts, and higher viral loads.[205] However, a systematic review concluded that there is little data to support a link between patients' knowledge of their medication schedule and their adherence.[198] Furthermore, reports have indicated that a lower level of knowledge about diabetes is associated with a higher level of adherence to oral hypoglycaemic medications.[206] Some research suggests that although knowledge is necessary, it alone is not sufficient to ensure adherence behaviour.[103]

Illness-related beliefs and attitudes towards medications play a major role in motivation to take medications as directed.[207] Several beliefs about illness associated with better adherence have been identified in the literature. Among them are the belief that an illness or its consequences pose a significant threat, and the feeling of vulnerability to illness or its consequences.[184] According to a meta-analysis, adherence and patients' perceptions of disease severity are strongly correlated. There was about a threefold increase in adherence odds among patients who believed their disease was severe and potentially dangerous.[190] Qualitative data also supports this finding, showing that patients who experienced a heart attack or stroke are more likely to take hypertension medications as prescribed.[208] Conversely, believing that an illness is uncontrollable may act as a barrier to medication adherence.[184]

Attitudes towards medications play a crucial role in predicting adherence, more so than clinical or socio-demographic factors. It has been proven that a significant relationship exists between medication-related beliefs and adherence behaviours across different types of illnesses.[193] Higher adherence rates are associated with a greater perceived need for medication, while lower adherence rates are linked to heightened concerns about medication.[193, 206, 209] Beliefs about the need for medication can be influenced by the symptoms experienced and the overall perceptions of the illness. Various concerns may lead to medication nonadherence, including worries about potential adverse effects, fears of becoming dependent on it, or concerns that medication effectiveness may diminish over time.[184] A review of qualitative studies found that medicines-related concerns accounted for most nonadherence issues.[210] Besides the perceived necessity for and concerns related to medicines, adherence can also be influenced by patients' perceptions of their self-efficacy to participate in the disease treatment

plan.[184] Self-efficacy is an individual's belief in their ability to perform the behaviours required to achieve a desired outcome successfully.[211] It is a critical concept from Bandura's Social Cognitive Theory, which states that individuals who believe they can perform a behaviour are more likely to engage in and persist with it.[212] Several systematic reviews have provided evidence that patient self-efficacy plays a positive role in determining the level of adherence to treatment plans - where patients with higher levels of self-efficacy are more likely to adhere to their treatment regimens.[207, 213] Importantly, in diabetes, these patient-related factors—knowledge about the disease, beliefs regarding its severity and consequences, and self-efficacy in daily management—are especially critical factors influencing adherence.

Socioeconomic factors

The WHO reported a wide range of socioeconomic factors influencing adherence, including: poverty, low educational level, illiteracy, unemployment, insufficient social support, unstable housing conditions, significant distance from healthcare facilities, costly transportation, high medication costs, family instability, fluctuating environmental conditions, and cultural as well as lay beliefs about illness and treatment.[108] Among these, factors such as education, income, employment status, social class, and health literacy have been extensively examined in the literature for their potential impact on adherence. Reviews have provided some evidence of a link between nonadherence to medication and factors like unemployment, and inadequate medical coverage.[207] Furthermore, a meta-analysis has indicated a positive, but weak, association between education, income, and medication adherence.[214] However, a review of several studies did not find a correlation between nonadherence, education, and unemployment.[184] Certain studies have identified a positive correlation between low health literacy levels and poor medication adherence.[182] Yet, a systematic review focusing on medication adherence among older people with cardiovascular disease and diabetes found no clear correlation between health literacy level and medication adherence.[215]

Socioeconomic deprivation is also among the SES factors that have been reported in the literature to have influenced medication adherence negatively in people with different medical conditions.[216-219] For instance, the Aston Medication Adherence Study examined medication nonadherence to medications prescribed for various long-term conditions, including diabetes, dyslipidaemia, and hypothyroidism. This study identified socioeconomic

deprivation as a significant predictor of medication nonadherence, in which people from areas with high socioeconomic deprivation had significantly lower adherence rates compared to people in the least deprived area.[216] Kurdi *et al.,* found similar patterns when they investigated factors influencing adherence to antihypertensive medications in the UK using the Townsend Deprivation Index. The study revealed that those in the most deprived socioeconomic quintiles had significantly lower adherence levels, as measured by PDC.[217]

The evidence concerning the associations between adherence and sociodemographic variables such as marital status, age, ethnicity, and sex varied greatly. Despite the documentation of inconsistent relationships, no definitive trend has been established in these associations.[108, 197, 198, 207] Systematic reviews and meta-analyses across a broad range of studies have concluded that there is no significant association between age, sex and medication nonadherence.[184, 198, 214] This relationship, however, can be highly context-dependent. For instance, in a study carried out in the UK, it was found that older adults with epilepsy exhibited higher medication adherence than younger individuals. Younger individuals may feel 'different' because their peers do not understand their condition, which can lead them to deny their illness and consequently not adhere to their medication.[220] Conversely, a study by Balbay *et al.,* conducted in Turkey among people with tuberculosis found that younger people were more adherent to treatment than older patients, which was attributed to the low education level of the older adults.[221] Nonetheless, ageing is reported to negatively affect adherence due to several age-related factors, including a high prevalence of physical and cognitive impairments, the presence of comorbidities, increasing polypharmacy and the complexity of medication regimens.[108]

Medication adherence in people of different races and ethnicities who use medications to manage their long-term illnesses is a topic that has been examined in several studies. Two observational studies have investigated medication adherence in multi-ethnic patients with heart failure in the US, [222] and Singapore.[223] The study conducted in the US concluded that acceptable rates of adherence are low among people from the following ethnic groups: Native Americans, Blacks, Asians, and Hispanics, compared to Whites, even after controlling for demographic variables such as income and educational level.[222] In contrast, the study conducted in Singapore reported that ethnicity was not a significant predictor of medication adherence.[223] The inconsistency of these findings may be attributed to the fact that some

ethnicities belong to minority groups, which are negatively associated with medication adherence according to a systematic review conducted to identify factors influencing medication adherence.[224] This review reported depression, belonging to ethnic minorities, age, and co-payment as factors negatively associated with medication adherence.[224] The impact of ethnicity on medication adherence has also been investigated in people with cardiovascular disease across several cross-sectional studies.[225-227] Lank *et al.,* reported that there was no difference in adherence to the five classes of preventive medicines used post-cerebrovascular accident for people of Mexican American and non-Hispanic White ethnicities.[225] In contrast, data from other studies have shown that adherence to the medication used for primary or secondary prevention of stroke differed significantly among ethnic groups.[226, 227]

Previous research in this field has predominantly focused on exploring adherence to antidiabetic medication across various races and ethnicities. In an update of a systematic review regarding racial differences in medication adherence among people living with diabetes, Adams *et al.,* concluded that the relationship between adherence and ethnicity continues to exist over time; health literacy and cost of therapy may explain this relationship.[228] Factors associated with the poor adherence of people with diabetes taking three different medication classes have been identified through a retrospective observational study on people from six ethnic groups (White, native Hawaiian, Japanese, Chinese, Filipino and mixed race). This study found that there was a significant difference in adherence to these medication categories among the ethnic groups. For instance, the people from Hawaiian ethnicity and those from other groups (White, Chinese, Filipino and mixed race) were significantly less adherent to antidiabetic and antihypertensive medications than the people of Japanese ethnicity.[229]

In addition, ethnic differences in adherence have been explored among US veterans with type 2 diabetes. A study revealed that medication adherence as assessed by the annual MPR differed significantly by the ethnicity of patients, irrespective of their demographics, metabolic control, and comorbidities.[230] The role of ethnicity in adherence to medication for chronic psychiatric conditions, and factors associated with adherence to those medication, has also been recognised.[231] Opolka *et al.,* assessed the association between ethnicity and adherence to antipsychotic medication in people from three ethnic groups (White, Mexican

American, and African American) with schizophrenia. Antipsychotic medication adherence was measured by calculating the number of days the patient had a supply of medication over the course of one year, which was summed to obtain the total number of adherent days. The outcome of this study showed that people of White ethnicity had higher adherence days compared to people from Mexican American and African American ethnicities; this difference was statistically significant ($p < 0.001$).[231] In summary, while the impact of socioeconomic factors on medication adherence varies across contexts and conditions, evidence consistently suggests that in diabetes, socioeconomic deprivation, health literacy, and ethnicity can play a pivotal role in shaping adherence.

1.3.4 Medication Adherence in people with diabetes

What is already known?

Medication adherence plays a crucial role in the effective management of diabetes, as improved adherence contributes directly to achieving glycaemic control, which in turn leads to preventing or delaying both acute and chronic complications and reducing the risk of mortality.[232] The WHO has emphasised that 'increasing the effectiveness of adherence interventions may have a far greater impact on the health of the population than any improvement in specific medical treatment'.[108] Several studies have shown a strong association between medication adherence and achieving glycaemic control in people with diabetes.[233, 234] For instance, Lin *et al.*, found that people with lower adherence to oral antidiabetic medication, specifically a PDC of 40%, had a significant association with higher Haemoglobin A1C (HbA1c) levels. In these patients, HbA1c increased by 0.4 (95% CI, 0.2 to 0.5).[233] Another example of this provided by a cross-sectional survey carried out in Japan among people of Japanese ethnicity with type 2 diabetes to assess the effect of medication adherence on glycaemic control. The result of this study showed that there is a negative association between 8-item MMAS and HbA1c level (beta –0.13, 95% CI – 0.15 to – 0.02, p = 0.012).[235] This is also exemplified in work undertaken by Mosen *et al*., to examine the correlation between adherence to oral antidiabetic medication and glycaemic control. The findings of this study are consistent with the previously mentioned studies. People with a higher adherence rate (PDC 80% or more) were more likely to have better glycaemic control (OR 0.54, 95% CI, 0.50 to 0.59) compared with other groups with lower medication adherence rates.[234]

Medication nonadherence also negatively impacts morbidity, mortality rates, and risk of hospitalisation.[181, 236] A recent study assessed the influence of antidiabetic medication adherence on all-cause mortality and new-onset diagnosis of cerebrovascular disease (CVD) and myocardial infarction in patients with type 2 diabetes over nine years. After adjusting socioeconomic and clinical variables, the results of this study revealed that the all-cause mortality and risk of the CVD were 1.4 times (adjusted hazard ratio 1.45, 95%, CI, 1.36 - 1.54) higher in patients with the PDC <0.20 compared to those with the PDC ≥0.80.[12] Similarly, a meta-analysis examined the association between adherence to type 2 diabetes medication and the risk of cardiovascular disease, all-cause mortality, and hospitalisation. It analysed eight observational studies with a total of 318,125 people with type 2 diabetes. Results indicated that people with a higher medication adherence rate (greater than 80%) had a 38% decrease in all-cause mortality (RR 0.72, 95% CI 0.62 to 0.82) and a 10% reduction in hospitalisation (RR 0.90, 95% CI 0.87 to 0.94) compared with those with low adherence rates.[74]

Furthermore, adherence to antidiabetic medications was linked to lower healthcare costs. Curtis *et al.,* Investigated the relationship between adherence to antidiabetic medication and all-cause medical costs, acute care resource utilisation, and acute complications in people with type 2 diabetes. According to the study, people who adhered to their medications had significantly lower acute care and outpatient costs. Moreover, adherence was associated with significant improvements in acute care outcomes, including reduced hospitalisations (17.65% vs. 22.71%; p<0.0001) and emergency department visits (38.47% vs. 45.61%; p<0.0001). People who adhered had fewer hospital admissions (0.27 vs 0.40; p<0.0001), emergency visits (0.83 vs 1.23; p<0.0001), and shorter hospital stays (1.25 vs 2.16 days; p<0.0001).[237] Although medication adherence is crucial to diabetes management, adherence to antidiabetic medication remains suboptimal,[85] leading to inadequate glycaemic control.[238] This contributes to a higher prevalence of diabetes related complications, increased mortality, and poorer health outcomes,[232, 238] particularly among minority ethnic groups and people from socioeconomically deprived backgrounds, who are reported in the literature to be disproportionately affected.[32, 41, 47-49]

What's unknown?

Considering the significant ethnic disparities in diabetes prevalence and outcomes, where some ethnic groups are more likely to experience severe complications from diabetes as well

as higher incidence of diabetes, it is essential to explore how ethnicity influences medication adherence. Despite extensive research into various factors affecting adherence, ethnicity is still not fully understood. This knowledge gap is crucial, as a better understanding of this influence could inform the development of targeted medication adherence interventions tailored to the needs of each ethnic group. Addressing this gap may eventually help to reduce health disparities and improve clinical outcomes for people with diabetes. Therefore, this PhD aims to explore the association between ethnicity and adherence to antidiabetic medications and identify ethnicity-related factors, which will aid in understanding this association.

1.4 Ethnicity

As this thesis aims to address the gap in understanding how ethnicity affects medication adherence among people with diabetes, it is essential to provide a clear definition of ethnicity and a description of how it will be reported throughout the thesis.

1.4.1 Overview and definitions

The term ethnicity is derived from the Greek word 'ethnos' which means a nation.[239] It is multifaceted characteristic that refers to the group of people who identify with specific shared characteristics, including geographical and ancestral origins, but with a significant emphasis on cultural and religious tradition, as well as language.[240] In relation to this concept, a person from an ethnic minority is someone who is part of a larger community or country, distinguished by its distinctive cultural, religious, and linguistic characteristics, that differentiate them from the majority population (these definitions were followed for this thesis).[241] Ethnicity is considered more ethically and scientifically sound when using it in research on health-related behaviours, such as medication adherence.[242, 243] It is different from race, nationality, religion, and migrant status; however, it may include aspects of these concepts as well. Despite the conceptual differences between race and ethnicity, there are some areas of overlap. For example, race, according to Merriam-Webster, has been defined as 'any one of the groups that humans are often divided into based on physical traits regarded as common among people of shared ancestry'.[244] Additionally, ethnicity, nationality, and migrant status are concepts that should be considered in isolation; for example, people from the Indian subcontinent who move to the UK might have British nationality, but still belong to specific ethnic groups, like Sikh Punjabis.[242] Their UK-born children may identify with their

parents' ethnic group, adopt broader ethnic categories such as Indian, Asian, or Black, or even develop an additional ethnic identity that reflects their integration into the host society.[242] Ethnicity and religion are also separate; religion is considered a significant component of ethnicity, giving individuals a strong sense of cultural and social identity.[242]

1.4.2 Ethnicity data reporting in the thesis

In this thesis, Chapter 2, which constitutes the systematic review, ethnic groups are represented in accordance with their description and classification in the original primary studies. In Chapter 3, encompassing the meta-ethnography and systematic review, the term 'minority ethnic communities' (populations that are numerically smaller and possess distinct ethnic, religious, or linguistic backgrounds compared to the majority population within the country where the research was conducted) is utilised. In Chapter 4, primary qualitative research conducted in the UK, the studied ethnic groups are categorised and represented according to the classifications published in the 2021 Census of England and Wales.[245] Further, in Chapter 5, where the researcher conducted primary qualitative research in Saudi Arabia, the studied ethnic groups are categorized and represented according to the classifications published in the 2021 Census,[246] and the 2015 National Content Test conducted by the US Census Bureau.[247]

1.5 Aim and Objectives of the PhD programme of work

1.5.1 Aim

The overarching aim of this PhD is to explore the relationship between ethnicity and adherence to antidiabetic medication among people with diabetes, and to identify the ethnicity-related factors contributing to this relationship.

1.5.2 Key Objectives

1. To explore whether adherence to antidiabetic medications differs by ethnicity among people with diabetes, by reviewing quantitative evidence.
2. To identify the key barriers and facilitators of antidiabetic medication adherence among minority ethnic communities, by synthesising qualitative findings from the literature.

3. To explore ethnicity-related factors from the perspectives of both minority ethnic communities and the majority population within the context of socioeconomic deprivation by using qualitative methodology.
4. To make recommendations informed by the identified findings that guide the design of future interventions aimed at improving medication adherence in the studied ethnic populations.

Chapter 2. Ethnic disparities in medication adherence? A systematic review examining the association between ethnicity and antidiabetic medication adherence

The literature review presented in Chapter 1 provided a valuable overview of the significance of optimising medication adherence in people with diabetes. This optimisation can be achieved by understanding various factors that influence adherence, particularly those that are understudied, such as ethnicity. It has been shown in Chapter 1 that there is conflicting evidence regarding the relationship between ethnicity and medication adherence. As part of the next stage of investigation, a systematic review was conducted to further understand the influence of ethnicity on adherence to antidiabetic medications. The aim of this chapter was to systematically review existing literature in this area, with a focus on exploring whether adherence to antidiabetic medications in people with diabetes varies by ethnicity, and how it varies among different ethnic groups. This systematic review and narrative synthesis has been published in PLOS ONE (Appendix 1).[248] The findings from this chapter have also been presented at the Annual British Clinical Diabetologists Conference in September 2022.

2.1 Introduction

Medication adherence plays a crucial in the management of both type 1 and type 2 diabetes, greatly impacting treatment outcomes. In type 2 diabetes, adherence to antidiabetic medication is key for achieving optimal glycaemic control and reducing the future risks of diabetes related complications.[249] Poor adherence can lead to inadequate glycaemic control, elevated morbidity and mortality, and increased healthcare costs.[238, 249] For example, in a study involving more than 11,000 veterans with type 2 diabetes, monitored for a minimum of five years, a significant correlation was found between suboptimal medication adherence (defined as MPR < 80%) and inadequate glycaemic control (HbA1c > 8%).[250] Additionally, a national survey, including 1,198 people with type 2 diabetes, revealed that for every single point decrease in medication adherence reported on the Morisky Medication Adherence Scale, there was a corresponding increase of 0.21% in HbA1c levels.[251] This decrease in adherence was also linked to a 20.4% increase in emergency visits, and a 20.9% increase in hospitalisation.[251] Furthermore, a study of 15,984 patients from general practices across the UK, all treated with oral antidiabetic medication, found that poor medication adherence and missing clinical appointments each independently contributed to a significant rise in the risk of all-cause mortality, showing a 1.6-fold increase.[252] Similarly, improved glycaemic control and reduction of acute complications in people with type 1 diabetes has been linked with improved adherence to insulin therapy.[253-255] There are,

however, many factors that affect adherence to antidiabetic medication, including disease-related (*e.g.,* the course of the illness and presence of other long-term conditions) and treatment-related factors (*e.g.,* complex therapy, adverse effects, and polypharmacy).[108, 181, 256] Moreover, such factors can also be influenced by information accessibility and transparency, community support, beliefs and attitudes towards a healthy lifestyle, the patient–healthcare provider relationship, mental health, and self-efficacy.[257] Furthermore, patient characteristics, such as socioeconomic background and cultural beliefs, also have potential to influence how people adhere to their medicines.[108] One such patient factor that has seldom been studied in this context is ethnicity. Given there is an increased incidence of diabetes in certain ethnic groups,[258] it is important to establish if, or how, adherence to diabetes medication varies by ethnic groups, as discussed thoroughly in Chapter 1. This systematic review, therefore, aimed to explore whether medication adherence to antidiabetic medications in people with diabetes varied by ethnicity.

2.2 Methods

2.2.1 Protocol registration

This systematic review was registered with PROSPERO (CRD42021278392, Appendix 2) and conducted with the 'Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)' guidelines.[259]

2.2.2 Search strategy and study selection

A systematic and comprehensive literature search was conducted in the following electronic databases: MEDLINE, Embase, CINAHL, and PsycINFO; from inception to June 2022. No search restrictions were applied to the language or date of publication. Quantitative observational studies and the quantitative sections of studies with mixed methods, examining adherence to antidiabetic medications according to ethnicity were eligible for inclusion.

The inclusion criteria of this review were conceptualised by the PICOS (Population, Intervention, Comparison, Outcome and Study Design) framework:

- Population: people from any ethnic groups with type 1 or type 2 diabetes mellitus.
- Intervention: insulin and/or other antidiabetic medication, including sulfonylureas, biguanides, meglitinide, thiazolidinedione, dipeptidyl peptidase-4 inhibitors, sodium-

- glucose cotransporter inhibitors, α-glucosidase inhibitors, and glucagon-like peptide-1 receptors agonists.
- Comparison: people from any other ethnic groups with type 1 or type 2 diabetes mellitus.
- Outcome: Medication adherence or persistence, measured by any medication adherence measure (measures based on the data of electronic databases, self-reported measures, pill counts, electronic monitoring, and biomedical measures), reported according to ethnicity.
- Study design: quantitative observational and mixed method studies reporting on adherence by ethnicity.

The studies were required to measure adherence to antidiabetic therapy in more than one ethnic group to allow comparison between groups and observe if there is variation in adherence by ethnicity. Any study only reporting adherence for one ethnic group was excluded, as were studies that evaluated adherence to all medications used to control diabetes and other comorbid conditions. Qualitative studies, reviews, editorials, conference abstracts, and intervention studies were also excluded from the review.

To complement the database searches, a grey literature search (by searching OpenGrey, the top 150 Google search hits, and Electronic Theses Online Service (EThOS)) was undertaken. The reference lists of all included studies were hand-searched for relevant papers not retrieved in the database search. The search strategy is described in Table 3 and 4. N.B. the search strategy for all databases = [all terms in column 1 linked using 'OR'] AND [all terms in column 2 linked using 'OR'] AND [all terms in column 3 linked using 'OR'] OR [all terms in column 4 linked with 'OR']. The initial screening of titles and abstracts was undertaken by one reviewer (RA), while full-text article screening was conducted by Rayah Asiri (RA) and checked in full by (AT or AKH). Any disagreement was resolved through discussion and consensus within the research team. However, no disagreements occurred during the screening process.

Table 3: Search strategy for Medline, EMBASE and CINAHL

Medication adherence	**Diabetes**	**glycaemic control**	**Ethnicity**
medication adherence.mp.	diabetes mellitus.mp.	glycaemic control.mp.	ethnicity.mp.
medication compliance.mp.	diabetes Mellitus, Type 1.mp.	glycated haemoglobin A.mp.	ethnic groups.mp.
medication concordance.mp.	diabetes Mellitus, Type 2.mp.	haemoglobin A, Glycated.mp.	race.mp.
medication persistence.mp.	diabetes.mp.	Hb A1c.mp.	Continental Population Groups.mp.
adherence.mp.	insulin dependent diabetes mellitus.mp.	Glycosylated haemoglobin A.mp.	Black.mp.
treatment adherence.mp.	non-insulin dependent diabetes mellitus.mp.		African Continental Ancestry Group.mp.
	type 1 diabetes.mp.		White.mp.
	type 2 diabetes.mp.		European Continental Ancestry Group.mp.
			Caucasian.mp.
			African American.mp.
			Hispanic.mp.
			Asian.mp.
			Asian Continental Ancestry Group.mp.
			British Asian.mp.
			Asian American.mp.

			South Asian.mp.
			Hispanic Americans.mp.
			Arabs.mp.
			Latino.mp.
			Mexican American.mp.
			Population Groups.mp.
			Minority Groups.mp.
			Maori.mp.
			pacific.mp.
			mixed race.mp.

Table 4: Search strategy for PsycINFO database

Medication adherence	**Diabetes**	**glycaemic control**	**Ethnicity**
exp Treatment Compliance	diabetes mellitus.mp.	glycaemic control.mp.	exp Ethnic Identity
medication adherence.mp.	diabetes Mellitus, Type 1.mp.	glycated haemoglobin A.mp.	ethnicity.mp.
medication concordance.mp.	diabetes Mellitus, Type 2.mp.	haemoglobin A, Glycated.mp.	race.mp.
medication persistence.mp.	exp diabetes	Hb A1c.mp.	Continental Population Groups.mp.
adherence.mp.	insulin dependent diabetes mellitus.mp.	Glycosylated haemoglobin A.mp.	exp black.mp.
medication compliance.mp	non-insulin dependent diabetes mellitus.mp.		African Continental Ancestry Group.mp.
	type 1 diabetes.mp.		exp white.mp.
	type 2 diabetes.mp.		European Continental Ancestry Group.mp.
			Caucasian.mp.
			African American.mp.
			Hispanic.mp.
			exp Asian.mp.
			Asian Continental Ancestry Group.mp.
			British Asian.mp.
			Asian American.mp.

			South Asian.mp.
			Hispanic Americans.mp.
			exp Arabs.mp.
			exp "Latinos/Latinas"
			Mexican American.mp.
			exp European Cultural Groups
			Minority Groups.mp.
			Maori.mp.
			pacific.mp.
			mixed race.mp.

2.2.3 Data extraction and quality appraisal

One reviewer (RA) undertook the data extraction and was checked by another reviewer, Anna Robinson-Barella (AR-B). Data from each study was extracted using a customised data extraction form containing the following headings: the study, study aim, intervention, population, outcomes, key findings, medication adherence measures, and study limitations. Three reviewers (RA, AT, AKH) undertook quality assessment using two relevant tools: a checklist for medication adherence and persistence studies, using retrospective databases,[260] and the Joanna Briggs Institute's (JBI) critical appraisal tools for cross sectional studies.[261] The checklist for medication compliance and persistence studies using retrospective databases was developed by the ISPOR in order to ensure quality and consistency of such studies. This checklist includes some essential elements, including guidelines on study design, data sources, inclusion and exclusion criteria, and measurement of compliance and persistence. The checklist emphasises the importance of clear objectives and standard definitions for compliance and reliability to increase transparency. Furthermore, it recommends providing detailed descriptions of data sources, sampling methods, statistical analyses and calculating compliance measures using standardised methods, such as the MPR and PDC.[260] While the JBI critical appraisal tool for cross sectional studies includes questions related to inclusion criteria, study population and setting, measurement validity and reliability, identification and management of confounding factors, and the appropriateness of statistical analysis.[261] These two different tools were needed due to the heterogeneity in study designs among the included studies, as no single validated quality assessment tool was suitable for all types of observational studies included in this review. This method ensured that all included studies regarding methodological quality were thoroughly and appropriately evaluated.

2.2.4 Analysis and synthesis

Due to the anticipated heterogeneity of ethnic groups, and measures used for medication adherence across the included studies, meta-analysis to combine individual study results was anticipated to be not possible; instead, a narrative synthesis approach was employed to synthesise the data to identify whether and how adherence to antidiabetic medication differs among different ethnic groups.[262] The influence of ethnicity on adherence to antidiabetic therapy was described based on medication adherence measures, used across the included

studies: measuring adherence using electronic databases, self-reported measures, and pill counts. Ethnicity was reported according to what is described in Chapter 1, Section 1.4.2.

2.3 Results

2.3.1 Literature search and study characteristics

The initial electronic database searches identified 18,107 citations, and another 22 publications were found from reference lists, citation, and a grey literature search. Following the removal of duplicates, 17,410 studies were reviewed for eligibility, based on the title and abstract; from this, 164 studies were selected for a full-text review. After full text screening, 41 studies were included in this systematic review (Figure 1).

All articles were published between 2005 and 2022 and were conducted in nine countries: United States (n=26),[229, 230, 263-286] New Zealand (n=3),[287-289] United Kingdom (n=2),[216, 290] Canada (n=1),[291] Malaysia (n=4),[292-295] Singapore(n=2),[233, 296] Brazil (n=1),[297] Qatar (n=1),[298] and United Arab Emirates (n=1).[299] Most included studies were retrospective database studies,[216, 229, 230, 233, 263-265, 267-285, 287-291, 293, 296] while the remainder were cross-sectional studies.[229, 286, 292, 294, 295, 297-299] The sample sizes ranged from 57[293] to 1,888,682 patients,[273] and the mean age of patients ranged from 14 to 71 years. The terminology used to report participant ethnicity varied across the studies, such as: ethnicity (14 studies),[216, 233, 263, 287-292, 294, 296-299] race/ethnicity (16 studies),[229, 230, 266, 268, 269, 271-276, 279, 281, 282, 284, 286] and race (12 studies).[264, 265, 270, 277, 278, 280, 283, 285, 293, 295] Most studies examined adherence to antidiabetic medication among people with type 2 diabetes mellitus; only two studies examined adherence to antidiabetic medications for people with type 1 diabetes mellitus.[297, 300] Thirty studies used medication adherence measures based on electronic database data: medication possession ratio, the proportion of days covered, or other measures centred on a pharmacy database. Of the remaining nine studies, two used pill counts to measure adherence,[275, 286] while nine used self-reported measures of adherence.[266, 283, 292, 295-299, 301] The characteristics of included studies are detailed in Table 5.

2.3.2 Quality assessment

Two quality assessment tools were used in this review based on the study design. The first tool, a checklist for medication adherence and persistence studies using retrospective databases, was used for the 33 retrospective database studies.[260] All study titles were descriptive and reflective of the study purpose, and all abstracts provided a short description of the work. The rationale and scientific background were reported in the majority of studies except for five, which did not clearly state their objectives.[263, 271, 278, 281, 293] Most of the articles clearly stated the study design that matched the objectives; only eight did not do so.[216, 272, 276, 283, 287-289, 296] The data sources were clearly defined in all studies; however, three papers did not state the time frame for data.[233, 263, 283] Of the 33 studies, 29 clearly stated the eligibility criteria, but 16 did not explain the rationale for these criteria.[216, 229, 230, 263, 270, 275, 281, 283-285, 288, 289, 291, 293, 296] The method of medication adherence measurement was clearly described in 25 studies, but, for some studies, the method of handling the switching of drugs within and between therapeutic classes was not appropriately explained.[216, 233, 263, 264, 270, 274, 278-282, 284, 285, 289, 291, 296] All studies apart from three,[276, 277, 289] controlled the confounders and clearly presented their results and discussed the implications of the work (see Appendix 3). The quality of the eight remaining cross-sectional studies was assessed using the Joanna Briggs Institute's critical appraisal tools for cross-sectional studies.[301] All studies clearly defined the inclusion criteria, study subjects, and settings, but two did not report on strategies to deal with confounding factors.[266, 294] 40 out of 41 studies used a valid and reliable measure of medication adherence (Table 6).[297]

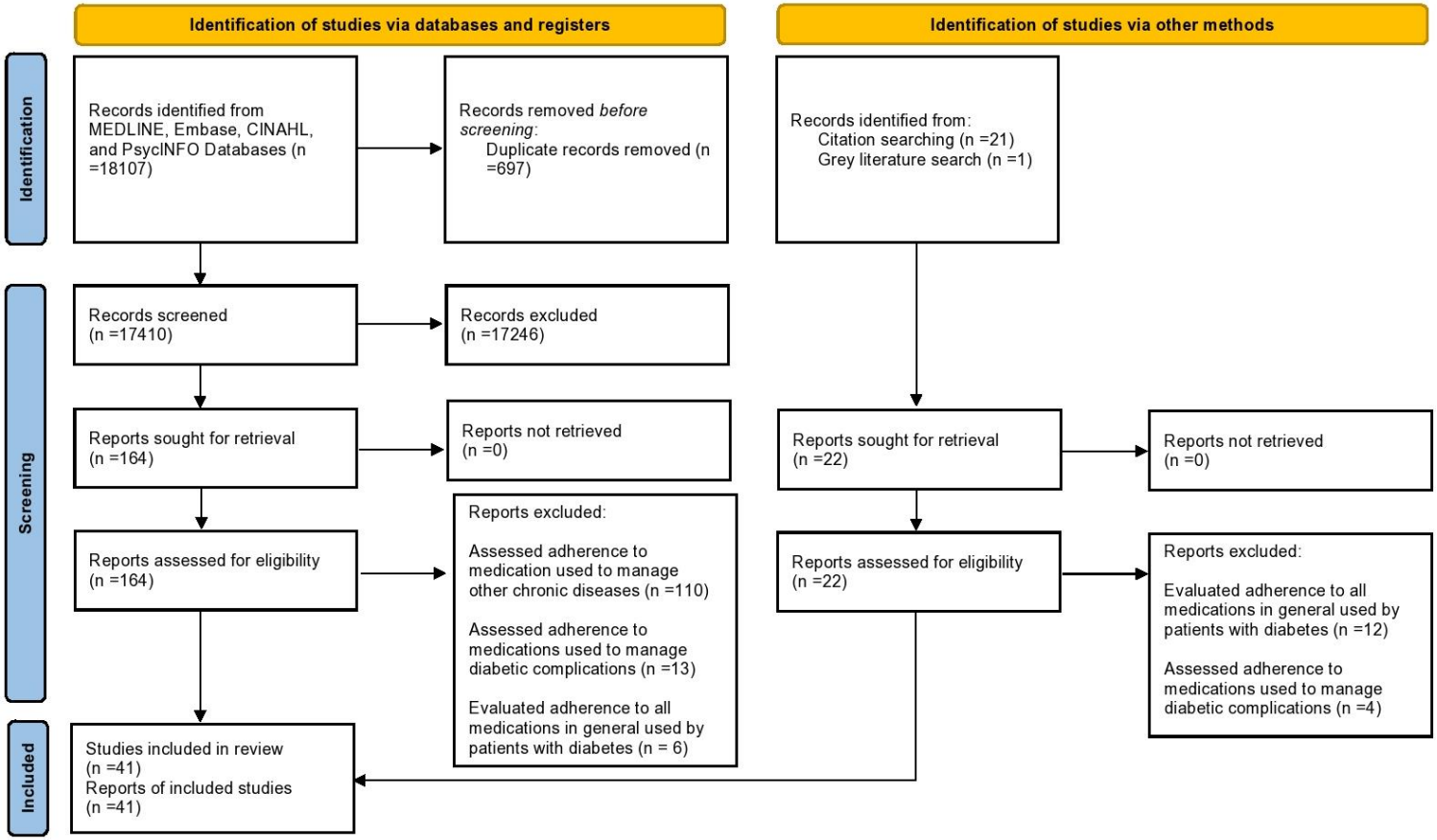

Figure 1: PRISMA flow diagram of included studies.

Table 5: Study characteristics

Study citation	Country	Study Design	Data source	Population (number, ethnicity data)	Antidiabetic medication	Medication adherence measure	Key finding
Trief *et al.,* 2022**[286]**	US	Cross-sectional	-	N= 381 Hispanic Non-Hispanic Black Non- Hispanic White	Insulin and/or OADs	Unannounced pill count	Non-Hispanic Blacks were 5 and 6 times more likely to be low-adherent to OADs than Hispanics and non-Hispanic whites, respectively (95% CI: 2.28 - 11.90, p < 0.001) (95% CI: 2.12 - 15.49, p = 0.001)
Nasruddin *et al.,* 2021**[295]**	Malaysia	Cross-sectional	-	N=249 Chinese Indian Malay	Insulin	IAQDM	There was no significant association between ethnicity and adherence to insulin therapy.
Chepulis *et al.,* 2020**[288]**	New Zealand	Retrospective database	Data collected from 10 general practices in the Waikato region.	N= 1595 New Zealand European Maori Asian Pasifika Others	Metformin	MPR	Māori and Pasifika patients had poorer metformin adherence than patients of other ethnicities. After adjusted analysis, the difference remained Māori compared to New Zealand Europeans (OR 0.41; 95% CI 0.30–0.56; P<0.001).
Marshall *et al.,* 2020**[271]**	US	Retrospective database	Data from Kaiser Permanente	N= 9923 White	Insulin and/or OADs	PDC	Non-Hispanic Black (ARR, 1.52; 95% CI, 1.32–1.74), Hispanic (ARR,

			Northern California.	Black Hispanic Asian Other			1.28; 95% CI, 1.15–1.43), and Asian (ARR, 1.14; 95% CI, 1.01–1.29) women were more likely than non-Hispanic White women to be nonadherent.
Walker *et al.,* 2020**[302]**	US	Retrospective database	Data from DPP randomized clinical trial.	N=30445 White Black Hispanic Other	Metformin	Pill count	Odds of adherence was significantly lower for Black participants (HR 0.44; 95% CI 0.29 – 0.66; P<0.001) compared to Whites.
Horsburgh *et al.,* 2019**[287]**	New Zealand	Retrospective database	The New Zealand Ministry of Health's national data collections.	N=90530 Māori Pacific European Asian Indian Middle Eastern/Latin American/African other and Unknown	Metformin	MPR	After adjusting for all the person- and health-related factors, the annual MPR for Māori (MPR -0.08 ,95% CI -0.08 to 0.07) and Pacific (MPR-0.09 ,95% CI -0.10 to 0.08) peoples were lower than Europeans.
Abdullah *et al.,* 2019**[292]**	Malaysia	Cross-sectional	-	N=232	Insulin and/or OADs	Validated Medication	Malay patients had 1.43 times higher odds of nonadherence to medications than Chinese

				Malay Chinese Indian others		Compliance Questionnaire	and Indian patients (95% CI 1.32–1.74; p=0.031).
Kharjul *et al.,* 2019**[289]**	New Zealand	Retrospective database	Pharmaceutical Collection Database maintained by the New Zealand's Ministry of Health.	N= 7138 New Zealand (NZ) European Other European NZ Māori Indian	OHAs	PDC	Adherence was significantly higher in the NZ European ethnic group (PDC 64.4 vs. 9.1,20.1, and 2.8; P < 0.001). Non-adherence was significantly higher in patients in New Zealand Māori patients (PDC 33.3 vs. 48.3,7.6, and 4.8; P < 0.001).
Xie *et al.,* 2019**[272]**	US	Retrospective database	Longitudinal claims data from a large US-based insurance provider	N=56720 White Asian Black Hispanic	OADs	PDC	Average adherence rates of blacks and Hispanics were 4.8 to 6.5 percentage points lower than whites (p <0.01).
Jannoo and Khan 2019 **[294]**	Malaysia	Cross-sectional	-	N= 497 Malay Indian Chinese	OADs	MMAS	There was statistically significant association between ethnicity and medication adherence (X^2 =10.660; P=0.031). The Indians had higher medication adherence compared with the Malays and the Chinese
Gatwood *et al.,* 2018**[265]**	US	Retrospective database	The Veterans Affairs electronic health records	N= 148544 White African American	OADs	PDC	Except for Asians, all other minorities were less likely to be adherent compared with whites (OR = 0.62; 95% CI = 0.605-0.645).

			& outpatient pharmacy	Asian Native American Hawaiian/Pacific Islander			
McGovern *et al.,* 2018**[290]**	UK	Retrospective database	Royal College of General Practitioners Research and Surveillance Centre database	N=60327 White Asian Black Mixed Other	OADs	CMG	Non-white ethnicity associated with reduced medication persistence compared to Whites (HR 1.53; 95%CI 1.47–1.59; P<0.001)
Jaam *et al.,* 2018**[298]**	Qatar	Cross-sectional	-	N= 260 Arab Asian Other	Insulin and/or OADs	ARMS-D	Ethnicity was an independent predictor of adhere score (Beta -1.731; 95% CI -3.153 – 0.309; p=0.017). Arab ethnicity was likely to be non-adherent compared to Asian.
Taira *et al.,* 2017**[229]**	US	Retrospective database	Administrative claims data Hawaii	N= 5163 Japanese Native Hawaiians Whites Filipinos Chinese Mixed race and other race	OADs	PDC	After adjustment, Filipinos [OR=0.58, 95%CI (0.45,0.74)], Native Hawaiians [OR=0.74, 95%CI (0.56,0.98)], and people of other race [OR=0.67, 95%CI **(**0.55,0.82)] were significantly less adherent to anti-diabetic medications than Japanese

Lee *et al.,* 2017**[296]**	Singapore	Retrospective database	Public primary care clinic	N= 5163 Chinese Malay Indian Other	OADs	MARS-5	Compared to Indian, patients of Chinese ethnicity (OR 2.80; 95% CI 1.53–5.15; P<0.01) had low adherence to OADs.
Ying and Shah 2017**[293]**	Malaysia	Retrospective database	Clinic Paediatric at University Kembangan Malaysia Medical Centre	N=57 Malay Chinese Indian Others	Insulin	MPR and glycated haemoglobin	Race was not associated with adherence(p=1.000)
Sutton *et al.,* 2017**[276]**	US	Retrospective database	Administrative claims data from a large health insurance company in Hawaii	N= 30445 Japanese Filipino Chinese Caucasian Native Hawaiian Other Pacific Islander	Insulin and/or OADs	MPR	Native Hawaiians, Other Pacific Islanders, and Filipinos had significantly lower adherence rates for each medication compared to other groups.
Lin *et al.,* 2017**[233]**	Singapore	Retrospective database	Multicentre data of the National Healthcare Group	N= 2463 Chinese Malay Indian	Insulin and/or OADs	PDC	Indian ethnicity (OR 0.59; 95% CI 0.48–0.73; P<0.001) was associated with poorer adherence compared with other ethnic groups in Singapore

				Others			
Fernández *et al.,* 2017**[263]**	US	Retrospective database	Kaiser Permanente Northern California Diabetes Registry	N= 30838 White Hispanic/Latino African American Asian	Insulin and/or OADs	CMG	Latinos had greater non-adherence than white patients($p<0.05$)
Reynolds *et al.,* 2016**[269]**	US	Retrospective database	Data from Kaiser Permanente Southern California	N= 23612 Non-Hispanic White Black Hispanic Asian or Pacific Islander Other/Unknown	OHAs	CMG	Black race (RR 1.28;95% CI 1.17 – 1.41), Hispanic ethnicity (RR 1.11 ;95% CI 1.03 – 1.20) were associated with discontinuation of one or dual OHAs.
Patel *et al.,* 2016**[270]**	US	Retrospective database	MarketScan Multi-State Medicaid Database	N= 1529 Caucasians African Americans Other races	OADs	MPR	African Americans (OR 0.71; 95% CI 0.55–0.93; $P<0.05$) had significantly lower MPR than Caucasian patients.
Gomes and Negrato 2016**[297]**	Brazil	Cross-sectional	-	N= 1698 Caucasian Non-Caucasian	Insulin	Self-reported scales	Adherence to insulin was not related to ethnicity.

Lo-Ciganic *et al.,* 2016**[277]**	US	Retrospective database	Pennsylvania Medicaid administrative claims data	N= 16256 White Black Hispanic Other/unknown	OHAs	PDC	Compared to perfect adherers, enrolees who discontinued oral hypoglycaemics were non-white groups (43.3–57.3 % vs. 37.3 %; P<0.0001)
Al-Haj Mohd *et al.,* 2015**[299]**	UAE	Cross-sectional	-	N= 446 Arab Emarati. Arab non-Emarati Asian	Insulin and/or OADs	MMAS	Adherence levels differed significantly between ethnic groups (p<0.001) with the lowest adherence levels for Emirati patients (81.6 %) followed by Arab Non-Emirati (47.1 %) and Asians (15.4 %).
Calip *et al.,* 2015**[284]**	US	Retrospective database	Group Health cooperative in Washington State and parts of Idaho	N= 509 White African American American Indian / Alaska Native Asian / Pacific Islander Not Hispanic Hispanic	Insulin and/or OADs	MPR	Non-Hispanic were more likely to be non-adherent to diabetes medications compared to Hispanic.
Lopez *et al.,*2014**[266]**	US	Cross-sectional	-	N= 7239 White African American Hispanic	Insulin and/or antidiabetic drugs	MMAS	The White group had higher medication adherence (50.3%; P<0.001) compared to all groups except the American Indian group.

				Asian American American Indian			
Chong *et al.,* 2014**[291]**	Canada	Retrospective database	Health administrative and pharmacy data from British Columbia	N=167243 White South Asian Chinese	Insulin and/or OADs	PDC	South-Asian (OR 0.44; 95% CI 0.41–0.47; P<0.0001) and Chinese people (OR 0.87; 95% CI 0.82–0.93; P<0.0001) had significantly lower adherence compared with white people.
Juarez *et al.,* 2014**[281]**	US	Retrospective database	A Hawaiian health plan.	N=43445 White Japanese Chinese Filipino Native Hawaiian Other Pacific Islander	Insulin and/or OADs	PDC	Filipinos, Native Hawaiians, and other Pacific Islanders were significantly less adherent than Whites(p<0.05).
Langley and Bush 2014**[216]**	UK	Retrospective database	Aggregated prescribing data of 76 General Practice surgeries within the Heart of Birmingham teaching Primary Care Trust	N= 23687 White Asian Black Mixed Other	OADs	MPR	There was a statistically significant variations in adherence between the major ethnic groupings. (MPR range from 86.8% for White groups to 58.3 % for Black groups)

Rolnick *et al.,* 2013**[282]**	US	Retrospective database	A large, Midwestern, integrated health system	N= 31636 White Black Asian Hispanic American Indian	Antidiabetic drugs	MPR	Non-White patients (OR 1.66 ; 95% CI 1.41 – 1.95 ; P<0.001) have statistically significant lower adherence compared to the White
Raebel *et al.,* 2012**[274]**	US	Retrospective database	Data from Kaiser Permanente Colorado	N= 12061 Non-Hispanic White Hispanic Other	Antidiabetic drugs	PDC	Patients of Hispanic ethnicity (OR 1.33; 95% CI 0.84–2.10) were more likely to be primarily non-adherent compared to White.
Adeyemi *et al.,* 2012**[285]**	US	Retrospective database	Texas Medicaid prescription claims data	N= 3109 White Black Hispanic Other	OADs	MPR	Race was statistically significantly related to adherence. The adherence was two times higher for whites compared to. Hispanics (OR 2.02; 95% CI, 1.54 –2.66; P<0.0001).
Egede *et al.,*2011 **[230]**	US	Retrospective database	The National Patient Care &Pharmacy Benefits Management database	N= 690968 NHW NHB Hispanic Other	Insulin and/or OHAs	MPR	Relative to non-Hispanic whites, MPR was significantly (6.07%) lower in non-Hispanic blacks, and (1.76%) Hispanics.

Zhu *et al.,* 2011**[278]**	US	Retrospective database	Indiana Network of Patient Care	N= 3976 White African American	OADs	PDC	African American race were a significant risk factor for non-adherence compared to White race (OR 0.61; 95% CI 0.50 –0.73 ; P<0.001)
Gebregziabher *et al.,* 2011**[279]**	US	Retrospective database	Veterans Administration datasets	N= 11,272 NHW NHB Hispanic Other	Insulin and/or OHAs	MPR	NHB had statistically significantly lower MPR compared to NHW.
Osborn *et al.,* 2011**[283]**	US	Retrospective database	Two primary care clinics and two diabetes specialty clinics	N= 383 White African American	Antidiabetic drugs	SDSCA questionnaire	African American race was significantly associated with less medication adherence (r=−0.10, p<0.05)
Yang *et al.,* 2009**[273]**	US	Retrospective database	Administrative claims data primarily pharmacy claims data	N= 1888682 White Black Hispanic Others	OHAs	PDC	Black (OR 1.39; 95% CI 1.38 –1.41; P<0.001) and Hispanic patients (OR 1.37; 95% CI 1.35–1.39; P<0.001) more likely than whites to be nonadherent.
Trinacty *et al.,* 2009**[264]**	US	Retrospective database	Harvard Vanguard Medical Associates electronic medical record system	N= 1906 Black White	Insulin and/or OADs	Monthly average rate of adherence	Blacks had statistically significantly lower MPR compared to Whites (IRR 079; 95% CI 0.63–0.99; P<0.05).

Adams *et al.,* 2008**[267]**	US	Retrospective database	Harvard Vanguard Medical Associates	N= 1806 Black White	OADs	Refill-based medication adherence	Black patients had a significant lower average of medication adherence compared to whites. (71.7% vs. 77.6%; P<0.0001)
Shenolikar *et al.,* 2006**[280]**	US	Retrospective database	Data from the North Carolina Medicaid program	N= 17685 African American White	OADs	MPR	The adherence rate of African American patients was significantly lower by 12% than whites (p<0.05)
Lee and Taira 2005 **[268]**	US	Retrospective database	A large health care plan in Hawaii	N= 20685 Japanese Chinese Whites Hawaiians Filipinos other	OADs	MPR	Compared to Whites, Japanese patients (OR 1.20; 95% CI 1.0 –1.30) were the most likely to be adherent, followed by Chinese (OR 1.0; 95% CI 0.89 –1.20), Hawaiians (OR 0.89; 95% CI 0.77 –1.0), and Filipinos (OR 0.78; 95% CI 0.68 – 0.90)

Key: MPR: medication possession ratio, PDC: proportion of days covered, MMAS: Morisky Medication Adherence Scale, CMG: continuous single-interval measure of medication gaps, ARMS-D: Adherence to Refill and Medications Scale in Diabetes, MARS-5: five-question Medication Adherence Rating Scale, SDSCA: the Summary of Diabetes Self-Care Activities questionnaire, IAQDM: Insulin Adherence Questionnaire for Diabetes Mellitus, OHAs: oral hypoglycaemic agents, OADs: oral antidiabetic drugs ,NHW: Non-Hispanic Whites, NHB: Non-Hispanic Blacks, US: United State, UK: United Kingdom, OR: odd ratio, CI: confidence interval, ARR: adjusted risk ratio, P: p value, HR: hazard ratio, RR: relative risk, r:correlation coefficient, IRR: incidence rate ratio.

Table 6:Results of the risk of bias assessment of cross-sectional studies

Critical Appraisal Skills Tool Screening Questions	**Author, Year**							
	Trief *et al.*, 2022[286]	**Nasruddin *et al.*, 2021[295]**	**Abdullah *et al.*, 2019[292]**	**Jannoo and Khan 2019[294]**	**Jaam *et al.*, 2018[298]**	**Gomes and Negrato 2016[297]**	**Al-Haj Mohd *et al.*, 2015[299]**	**Lopez *et al.*,2014[266]**
Were the criteria for inclusion in the sample clearly defined?	Y	Y	Y	Y	Y	Y	Y	Y
Were the study subjects and the setting described in detail?	Y	Y	Y	Y	Y	Y	Y	Y
Was the exposure measured in a valid and reliable way?	X	X	X	X	X	X	X	X
Were objective, standard criteria used for measurement of the condition?	Y	Y	Y	Y	Y	Y	Y	Y
Were confounding factors identified?	Y	Y	Y	N	Y	Y	Y	N
Were strategies to deal with confounding factors stated?	Y	Y	Y	N	Y	Y	Y	N
Were the outcomes measured in a valid and reliable way?	Y	Y	Y	Y	Y	N	Y	Y
Was appropriate statistical analysis used?	Y	Y	Y	N	Y	Y	Y	N
Key	Y = yes, N = no, X = not applicable							

2.3.3 Narrative synthesis of the influence of ethnicity on adherence to antidiabetic medication by method of measurement

Studies were described below thematically according to medication adherence measures using a narrative synthesis approach.[262]

Studies measured adherence using electronic databases

A variety of measures using pharmacy refill data were used to assess adherence to antidiabetic medications among different ethnic groups, including the MPR,[216, 229, 230, 270, 276, 279, 280, 282, 284, 285, 287, 288, 293, 296] PDC,[233, 265, 271-274, 277, 278, 281, 289, 291] and other measures, such as medication refill adherence and continuous single- or multiple-interval measures of medication gaps.[263, 264, 267, 269, 290]

Medication possession ratio: Fourteen studies used the MPR to evaluate medication adherence for people with diabetes from different ethnic groups. Three studies assessed adherence to antidiabetic medications among the following ethnic groups: Chinese, Filipinos, Hawaiians, Japanese, mixed races, other races ,and Whites.[229, 276, 296] The reported adherence rates varied by ethnicity with people of Japanese ethnicity most likely to be adherent to antidiabetic medications, followed by Whites, Chinese, Hawaiians, Filipinos, and other ethnic groups; this difference was statistically significant in two studies ($p< 0.001$, [229] $p< 0.01$ [296]). The difference between people from the following ethnicities: Whites, African Americans, Hispanics, Asians, American Indians, and others in adherence to antidiabetic medications was also reported in seven studies.[230, 270, 279, 280, 282, 284, 285] People with a Non-White ethnicity had a statistically significant lower MPR compared to people with White ethnicity across these studies. Two other studies examined adherence to metformin among ethnic groups in New Zealand and revealed that people from Māori and Pacific ethnic groups had poorer adherence than people from the European group($p< 0.01$, [287] $p< 0.001$ [288]). Langley and colleagues also reported statistically significant variations in adherence to oral antidiabetic medications among different ethnic groups in the United Kingdom, with highest adherence rates reported for people from Irish ethnic groups, while lowest adherence rates were reported for people from African ethnic groups.[216] Only one study assessed adherence to insulin therapy for type 1 diabetes; across three Asian ethnic groups – Malay, Chinese, and Indian – in this case, ethnicity was not associated with adherence.[293]

Proportion of days covered: Eleven studies used the PDC to assess adherence to antidiabetic medications by people of different ethnic groups. Of these, seven studies indicated that people from Black, Hispanic, and Asian ethnicity were more likely to be non-adherent to antidiabetic medications than people of White ethnicity, and these findings were statistically significant in four studies.[271-274, 277, 278] The adherence levels also differed among people with White, Chinese, Black, Hawaiian, Japanese, Filipino, and Native American ethnicities.[265, 281, 291] In contrast to the studies using the MPR, one study found that medication adherence of people from Chinese and Japanese ethnic groups did not differ significantly from people from White ethnicity; however, members of other ethnic groups were found to be significantly less adherent compared to people from White ethnic groups.[281] Additionally, significant differences in adherence to antidiabetic agents were reported among three Asian ethnic groups in a study conducted in Singapore, in which people from Indian ethnic groups had the lowest adherence rates compared to people from Malay or Chinese ethnic groups ($p< 0.001$).[233] Lastly, Kharjul and colleagues reported a significantly higher rate of non-adherence amongst people from Māori ethnicity compared to other ethnic groups in New Zealand, which is consistent with the findings of studies assessing the same groups, using the MPR as a measure of adherence ($p< 0.001$).[289]

Other measures (medication refill adherence and continuous single- or multiple-interval measures of medication gaps): Two studies, estimating adherence based on pharmacy refill data, reported a statistically significant difference in adherence to antidiabetic medication between people from Black and White ethnicities ($p< 0.05$, [264] $p< 0.0001$[267]). Medication persistence was also assessed in three studies of different ethnic groups, using a continuous single-interval measure of medication gaps. These studies showed that non-White ethnicity was associated with lower medication persistence when compared to White ethnicity.[263, 269, 290]

Study measured adherence using pill count

Two studies used pill counts to assess adherence to oral antidiabetic medications for three ethnic groups: Blacks, Hispanics, and Whites. The authors found that the adherence varied significantly by ethnicity, and the odds of better adherence were lower for people with Black ethnicity than those of White and Hispanic ethnicity ($p< 0.001$).[275, 286]

Studies measured adherence using self-report measures of adherence

Eight studies assessed adherence to antidiabetic medications using a variety of self-report measures, including the five-question Medication Adherence Rating Scale[64], Morisky Medication Adherence Scale,[266, 294, 299] validated Medication Compliance Questionnaire,[292] Insulin Adherence Questionnaire for Diabetes Mellitus,[295] Adherence to Refill and Medications Scale in Diabetes,[298] medication adherence subscale of the Summary of Diabetes Self-Care Activities questionnaire,[283] and self-reported scales.[297] In three of these studies, statistically significant differences in adherence were found among three Asian ethnic groups: Chinese, Indians , and Malays.[292, 294, 296] Lopez and colleagues[266] and Osborn and colleagues[283] demonstrated a significant association between increased adherence to antidiabetic medications and White ethnicity compared to compared to African American, Hispanic, Asian, and American Indian ethnic groups($p< 0.001$, [266] $p< 0.05$ [283]). A study conducted in the United Arab Emirates also reported significant variation in adherence levels to antidiabetic medications among three ethnic groups (Arabs of the United Arab Emirates, Arabs non-Emirate, and Asians) with the highest level of adherence reported for people with Asian ethnicity and the lowest for people with Arab ethnic groups($p< 0.001$).[299] The findings of this study are consistent with another study conducted in Qatar, in which people with diabetes of Arab ethnicity were more likely to be non-adherent to their medication compared to people from Asian ethnicity ($p< 0.01$).[298] Notably, only two of the 41 included studies specifically examined type 1 diabetes, and both reported that adherence to insulin therapy did not differ by ethnicity in people with type 1 diabetes.[297, 300]

2.4 Discussion

This systematic review aimed to examine the association between ethnicity and adherence to antidiabetic medications in people with type 1 and type 2 diabetes mellitus. The review identified several studies showing that adherence to antidiabetic medications varied according to the ethnic groups. This variation was statistically significant in 34 out of the included 41 studies and, overall was observed between people from minority ethnic groups(defined as populations who are numerically smaller and have a different ethnic, religious, or linguistic background than the majority population in the country where the study was conducted)[303] and the majority populations in high income countries. Moreover, this observed variation was apparent across studies that used different adherence measures. The finding of this review

supports the work of Peeters and colleagues who reported a direct association between ethnicity and adherence across three studies.[257] This work, however, only focused on oral hypoglycaemic medications in type 2 diabetes and was published in 2011 (and since this time more relevant literature has been published).[257] Taken together, these findings help to explain the observed disparities in diabetes outcomes across different ethnic groups.[22, 304, 305] Achieving optimal glycaemic control, which is closely linked to consistent medication adherence, is crucial for effective diabetes management and outcomes.[238, 264, 306, 307] Therefore, these insights may clarify one of the factors contributing to why people from minority ethnic groups, such as non-Hispanic Black and Hispanic American communities, typically experience worse glycaemic control and a higher rate of diabetes complications than people of White ethnicity.[258] Nonetheless, these findings also offer a strong foundation for exploring the ethnicity-related factors that might explain the differences in adherence to antidiabetic medications. Understanding the possible reasons why these differences occur among minority ethnic groups will help develop tailored interventions, improve patient engagement, and provide information in culturally and linguistically appropriate formats for patients in ethnically diverse populations. Given the emphasis of previous literature emphasising the need to understand patient-specific factors to design effective adherence interventions, the findings of this work are even more relevant for future research.[308]

One interesting finding of this review is that most studies reported statistically significant differences in adherence to antidiabetic medications after controlling for different confounders (*e.g.,* socioeconomic variables) mediating the association between ethnicity and adherence to antidiabetic medications. However, the ethnicity–adherence association in some studies could be attributed to socioeconomic differences among ethnic groups, or other uncontrolled confounders, such as clinical, demographic, and psychological factors, which could mediate the ethnicity-adherence association. In accordance with the present results, one study suggested that the disparities in medication adherence between ethnic groups can partly be explained by differences in socioeconomic status.[272] Additionally, the study by Osborn *et al.,* has demonstrated that improved health literacy diminished the ethnic differences in adherence to antidiabetic medications.[283] This is especially critical because people from ethnic minorities have a higher risk of having poor health literacy.[309] Consequently, they may experience challenges that negatively impact medication adherence,

including difficulties identifying medications,[310] understanding dosage and timing, and understanding instructions.[311] These findings highlight the importance of addressing health literacy in ethnic minority communities to improve medication adherence and reduce health disparities.

A possible explanation for the differences in adherences to antidiabetic medications among different ethnic groups after controlling confounders mediating adherence-ethnicity associations is related to the socio-cultural background and patients' beliefs and perceptions about treatment, which was shown in a systematic review of 25 cross-sectional studies to be significantly associated with medication adherence in patients with type 2 diabetes, asthma, and hypertension.[312] The association may also be explained by the findings reported in several qualitative studies of the barriers of nonadherence to antidiabetic medications and diabetes self-management in some ethnic groups. For example, social stigma and cultural pressure associated with diabetes in people from South Asian background as a barrier for diabetes management.[313] Additionally, the preference for traditional medicines over the use of metformin in people from Māori ethnicity has been identified as a cause for suboptimal adherence.[314] Furthermore, feeling frustrated and fearful about taking medicines lifelong amongst people from African American ethnicity have been cited as a reason for nonadherence.[315] These factors are all possible explanations of the disparities. Future work could examine the socio-cultural factors affecting adherence to antidiabetic medications for minority ethnic groups.

This review has some limitations. Firstly, it is important to acknowledge the diversity among included studies regarding the settings, designs, measurements of adherence to antidiabetic medications, and inconsistency in reporting ethnicity data. It is therefore not possible to compare across included studies to determine which ethnic group is the most adherent in the context of diabetes management. Secondly, there is no validated quality assessment tool for all observational studies, including retrospective database observational studies and cross-sectional studies. Consequently, using two critical appraisal tools does not allow for a comparison of quality across all studies. Lastly, the included studies primarily used self-reported measures or pharmacy claims data to assess adherence. Self-reported measures may lead to overestimating adherence due to reporting biases, while pharmacy claims data can fail to reflect medication taking behaviour accurately.[316] Additionally, studies have

characterised adherence in various ways, with some focusing on persistence or discontinuation rather than actual adherence. These discrepancies potentially affect the comparability and accuracy of adherence assessments across studies. Therefore, developing a cross-culturally validated adherence measure in future work may help identify and improve adherence issues across different ethnic groups.[317] Notwithstanding these limitations, the results of this review have important implications for optimising adherence to antidiabetic medications among different ethnic groups. Additionally, the large number of studies that met the eligibility criteria included in this review by using search strategies include broad terms with no restrictions on publication date or language, and an additional grey literature search complemented the original canvass, ensuring the inclusion of all relevant studies (Table 3 and 4).

2.5 Conclusion

This systematic review is one of the first to examine the association between ethnicity and medication adherence in people with type 1 and type 2 diabetes mellitus. The findings show that differences in adherence to antidiabetic medications among diverse ethnic groups occur only in type 2 diabetes, and these differences persist after controlling for different demographic, clinical, socioeconomic, and psychological factors. Future research should therefore focus on explaining and understanding why these disparities occur across different ethnic groups. Understanding the reasons behind these disparities will have important implications for the future care of people with diabetes, including developing possible patient-centred interventions for optimising adherence to diabetic therapy.

2.6 Summary of Chapter 2

This chapter aimed to explore whether adherence to antidiabetic medications in people with diabetes varies by ethnicity and how it varies among different ethnic groups. Most of the studies reviewed revealed disparities in adherence to antidiabetic medication among different ethnic groups, with this variation being statistically significant in many studies. Furthermore, after accounting for various confounding factors, such as socioeconomic variables, most studies still reported statistically significant differences in adherence to antidiabetic medications. The observed disparities in medication adherence were primarily between minority ethnic groups and the majority populations within the context of each study, with

minority ethnic groups in high income countries frequently reporting the lowest adherence rates. Given these findings, further research is needed to explore the underlying causes of these disparities. Building on the literature review presented in Chapter 1 and this comprehensive systematic review, Chapter 3 will explore additional knowledge gaps that were identified, utilising a meta-ethnographic approach to systematically review and combine the available qualitative data in this area.

Chapter 3. Understanding the influence of ethnicity on adherence to antidiabetic medication: meta-ethnography and systematic review

The systematic review in Chapter 2 synthesised quantitative data to explore whether adherence to antidiabetic medication in people with diabetes varied by ethnicity. Findings identified a disparity in the adherence to antidiabetic medication between different ethnic groups, with this variation being statistically significant in most of the studies included in the review, despite adjustment for several confounding variables that may otherwise explain these differences. These disparities mainly existed between minority ethnic groups and the majority populations within each study's context, with ethnic minorities in high-income countries often reporting the lowest rates of adherence to their antidiabetic medication. Given these findings, investigating the underlying causes of these disparities becomes crucial. By examining the qualitative literature and incorporating minority ethnic group perspectives, a clearer comprehension of the 'why' behind these disparities in medication adherence can be achieved. To address this knowledge gap, an additional systematic review of qualitative studies was undertaken to further explore the existing literature.

This review utilises a meta-ethnographic approach to analyse and synthesise qualitative findings. Meta-ethnography was primarily developed by Noblit and Hare,[318] and has recently been applied to healthcare-based social science research by Britten *et al.*,[319] Campbell *et al.*,[320, 321] Pound *et al,*[210] and others. This is an inductive and interpretive systematic qualitative evidence synthesis approach, that involves translating of papers and findings into one another. Meta-ethnographies allow researchers to develop broader concepts or gain a deeper understanding of concepts from different studies by transferring ideas, themes, and metaphors across them. The value of meta-ethnographic systematic reviews lies in their ability to reveal insights or interpretations not evident in the individual studies, while still scrutinising the literature to make exemplary research. Moreover, they may be able to identify areas of knowledge that are lacking in the current evidence base and reveal areas that might previously have been considered as evidence gaps. The work from this chapter has been published in PLOS ONE (Appendix 4).[322] The findings from this chapter have also been presented at the 26th International Society for Medication Adherence Conference held in Berlin, Germany, in November 2022 in November 2022 and the European Society of Clinical Pharmacy Conference held in Aberdeen, UK, in November 2023.

3.1 Introduction

The prevalence of diabetes and related complications are higher among people from minority ethnic communities. In the United Kingdom, type 2 diabetes is around three to five times more prevalent amongst minority groups, particularly Asian and African-Caribbean groups, when compared to White populations.[22] Similarly, in the United States, Hispanic, Native Americans, and non-Hispanic Blacks communities report a higher prevalence of diabetes compared to non-Hispanic White people.[323, 324] Additionally, minority ethnic groups in the United States are more likely to suffer diabetes-related complications, including microvascular problems, compared to White groups.[324, 325] The risk of developing macrovascular complications is higher in people from ethnic minority communities in the UK, particularly among Asian groups.[63, 326]

Medication adherence is a key influence on the effectiveness of the treatment and management of diabetes. Associations in adherence and improved long-term health outcomes for people living with diabetes have been well-reported.[250, 327, 328] Yet, despite the importance of medication adherence in contributing to optimal clinical outcomes, evidence remains that certain patient groups continue to report poor adherence to antidiabetic medications; in particular, those from minority ethnic communities.[233, 271, 287, 291, 329] For example, in a number of high-income countries such as the United States, the United Kingdom, New Zealand, Singapore, and Canada, lower rates of adherence to antidiabetic medications have been reported amongst minority ethnic groups.[233, 271, 287, 291, 329] To optimise diabetes care among people from ethnic minority communities, it is crucial to gain a better understanding of patient-related barriers and facilitators associated with adherence to antidiabetic medications. Several qualitative studies have examined the experience of people from minority ethnic communities regarding diabetes self-management generally, or their adherence to antidiabetic medication specifically.[330-332] Although individual qualitative studies can be valuable for providing insights about factors influencing adherence to antidiabetic medications in minority populations, qualitative evidence synthesis can lead to a greater depth of understanding beyond individual qualitative research findings, which is where this study seeks to contribute.[333]

To date, the published qualitative evidence reviews have examined adherence to diabetes self-management among people with type 2 diabetes,[334] adherence to antidiabetic

medications,[335, 336] and adherence to diabetes self-management among people from one ethnic group with type 2 diabetes.[337] This review utilised a meta-ethnographic qualitative synthesis approach to explore the barriers to, and facilitators of, adherence to antidiabetic medications experienced by people from minority ethnic communities in high-income countries, where several studies have shown that minority ethnic groups in these countries had lower adherence rates and worse diabetes outcomes.[48, 49, 233, 271, 287, 291, 329] The meta-ethnographic approach enables reviewers to re-interpret conceptual data from primary qualitative studies (*i.e.,* original themes) to enable the production of a new conceptual evidence synthesis using the findings of individual studies.[320, 321] For instance, this synthesis might highlight unique barriers to medication adherence in minority ethnic groups, which policymakers can address through designing tailored interventions. As a result, future policy and guidance might be informed and shaped by this re-interpretation.[321]

3.2 Methods

3.2.1 Protocol registration

This meta-ethnographic systematic review has been conducted according to the PRISMA guidelines [338] and is registered with PROSPERO (registration number CRD42022320681, Appendix 5).

3.2.2 Search Strategy and Information Sources

Five electronic databases – MEDLINE, Embase, CINAHL, PsycINFO, and Global Health – were searched systematically from their inception to March 2023. No limit was applied on the language or the date of publication. To identify all relevant publications, grey literature (*via* OpenGrey, the top 150 Google search hits, and EThOS), was searched. This was also supplemented by hand searching the reference lists of all included studies and relevant systematic reviews, alongside citation searching of all included studies, using Google Scholar. The databases were searched using a combination of terms covering diabetes, medication adherence, ethnicity, and those relating to qualitative research. The search strategy is described in (Table 7, 8, and 9). N.B. the search strategy for all databases = [all terms in column 1 linked using 'OR'] AND [all terms in column 2 linked using 'OR'] AND/OR [all terms in column 3 linked using 'OR'] AND/OR [all terms in column 4 linked with 'OR'] AND [all terms in column 5 linked with 'OR']AND/OR [all terms in column 6 linked with 'OR'].

3.2.3 Eligibility criteria

The inclusion criteria for this review specified studies that explored factors perceived as barriers to and/or facilitators of adherence to antidiabetic medication among minority ethnic communities. This was defined as populations who are numerically smaller and have a different ethnic, religious, or linguistic background than the majority population in the country where the study was conducted,[303] with type 1 or type 2 diabetes, conducted in high-income countries. High-income countries were determined according to the 2022 Gross National Income (GNI) per capita, with high-income countries being those with a GNI per capita of more than USD 13,205.[339] To be eligible for inclusion studies were required to report qualitative data about the views of minority ethnic groups using a qualitative methodology. In the case of studies conducted in 'mixed' countries (high-income and low or middle-income countries), the data exclusively from the high-income countries were included.

Exclusion criteria included studies that explored factors perceived as barriers to and/or facilitators of adherence to diabetes self-management that did not focus on medication adherence (such as physical activity, diet, self-monitoring of blood sugar); those studies that were conducted in low- and middle-income countries (low-income countries are those with a GNI per capita of less than USD 1,085, and middle-income countries are those with a GNI per capita of greater than USD 1,086, but less than USD 13,205);[30] studies with qualitative data about the views of majority and minority groups without labelling data by ethnic minority groups; study types that were mixed-method and quantitative studies as the meta-ethnographic approach exclusively focuses on inclusion of qualitative studies.[31] Systematic reviews, conference abstracts, and clinical trials were also excluded.

Table 7: Search strategy for MEDLINE, Embase and CINAHL

Search strand and terms					
Medication adherence	**Diabetes**	**glycaemic control**	**Ethnicity**	**Qualitative methodology**	**Barriers or facilitators**
medication adherence.mp.	diabetes mellitus.mp.	glycaemic control.mp.	ethnicity.mp.	qualitative research.mp.	barriers.mp.
medication compliance.mp.	diabetes Mellitus, Type 1.mp.	glycated Haemoglobin A.mp.	ethnic groups.mp.	qualitative analysis	obstacles.mp.
medication concordance.mp.	diabetes Mellitus, Type 2.mp.	haemoglobin A, Glycated.mp.	race.mp.	qualitative.mp.	facilitators.mp.
medication persistence.mp.	diabetes.mp.	Hb A1c.mp.	Continental Population Groups.mp.	focus group.mp.	
adherence.mp.	insulin dependent diabetes mellitus.mp.	Glycosylated haemoglobin A.mp.	Black.mp.	interviews.mp.	
treatment adherence.mp.	non-insulin dependent diabetes mellitus.mp.		African Continental Ancestry Group.mp.	grounded theory.mp.	
	type 1 diabetes.mp.		White.mp.	action research.mp.	
	type 2 diabetes.mp.		European Continental Ancestry Group.mp.	content analysis.mp.	
			Caucasian.mp.	thematic analysis.mp.	
			African American.mp.	NVivo.mp.	
			Hispanic.mp.	Nudist.mp.	

			Asian.mp.	ethnology.mp.	
			Asian Continental Ancestry Group.mp.	perceptions.mp.	
			British Asian.mp.	attitudes.mp.	
			Asian American.mp.	views.mp.	
			South Asian.mp.	ethnographic.mp.	
			Hispanic Americans.mp.	themes.mp.	
			Arabs.mp.	encounters.mp.	
			Latino.mp.	experiences.mp.	
			Mexican American.mp.	meta ethnography.mp.	
			Population Groups.mp.	qualitative study.mp.	
			Minority Groups.mp.		
			Maori.mp.		
			pacific.mp.		
			mixed race.mp.		

Table 8: Search strategy for PsycINFO

Search strand and terms					
Medication adherence	**Diabetes**	**glycaemic control**	**Ethnicity**	**Qualitative methodology**	**Barriers or facilitators**
exp Treatment Compliance	diabetes mellitus.mp.	glycaemic control.mp.	exp Ethnic Identity	exp Qualitative Methods	barriers.mp.
medication adherence.mp.	diabetes Mellitus, Type 1.mp.	glycated haemoglobin A.mp.	ethnicity.mp.	qualitative.mp.	obstacles.mp.
medication concordance.mp.	diabetes Mellitus, Type 2.mp.	haemoglobin A, Glycated.mp.	race.mp.	focus group.mp.	facilitators.mp.
medication persistence.mp.	exp diabetes	Hb A1c.mp.	Continental Population Groups.mp.	interviews.mp.	
adherence.mp.	insulin dependent diabetes mellitus.mp.	Glycosylated haemoglobin A.mp.	exp black.mp.	grounded theory.mp.	
medication compliance.mp	non-insulin dependent diabetes mellitus.mp.		African Continental Ancestry Group.mp.	action research.mp.	
	type 1 diabetes.mp.		exp white.mp.	content analysis.mp.	
	type 2 diabetes.mp.		European Continental Ancestry Group.mp.	thematic analysis.mp.	
			Caucasian.mp.	NVivo.mp.	
			African American.mp.	Nudist.mp.	

			Hispanic.mp.	ethnology.mp.	
			exp Asian.mp.	perceptions.mp.	
			Asian Continental Ancestry Group.mp.	attitudes.mp.	
			British Asian.mp.	ethnographic.mp.	
			Asian American.mp.	themes.mp.	
			South Asian.mp.	experiences.mp.	
			Hispanic Americans.mp.	qualitative study.mp.	
			exp Arabs.mp.	meta ethnography.mp.	
			exp "Latinos/Latinas"		
			Mexican American.mp.		
			exp European Cultural Groups		
			Minority Groups.mp.		
			Maori.mp.		
			pacific.mp.		
			mixed race.mp.		

Table 9: Search strategy for Global Health database

Search strand and terms					
Medication adherence	**Diabetes**	**Glycaemic control**	**Ethnicity**	**Qualitative methodology**	**Barriers or facilitators**
Medication adherence	diabetes	glycaemic control	Ethnic minorities	qualitative research	barriers
medication compliance	diabetes Mellitus	glycated Hemoglobin A	ethnicity	qualitative analysis	obstacles
medication persistence	type 1 diabetes	Hemoglobin A, Glycated	race	focus group	facilitators
medication concordance	insulin dependent diabetes mellitus	Hb A1c	Continental Population Groups	interviews	
Treatment adherence	type 2 diabetes	Glycosylated Hemoglobin A	black	grounded theory	
adherence	non-insulin dependent diabetes mellitus		African Continental Ancestry Group	action research	
			white	content analysis	
			European Continental Ancestry Group	thematic analysis	
			Caucasian	NVivo	
			African American	Nudist	

			Hispanic	ethnology	
			Asian	perceptions	
			Asian Continental Ancestry Group	attitudes	
			British Asian	ethnographic	
			Asian American	themes	
			South Asian	experiences	
			Hispanic Americans.mp.	qualitative study	
			Arabs	meta ethnography	
			"Latinos/Latinas"	qualitative	
			Mexican American		
			European Cultural Groups		
			Minority Groups		
			Maori		
			pacific		
			mixed race.		

3.2.4 Study selection and screening

All citations were exported to EndNote 20 reference manager software to manage duplicate studies, and handle data as part of the screening process.[340] One reviewer (RA) screened the titles and abstracts from the database searches in accordance with the eligibility criteria. The full texts of articles that met the inclusion criteria and those that could not be definitively rejected were retrieved. The screenings of the article full texts were undertaken by RA and checked independently in full by authors (AKH or AR-B). Any disagreement was resolved through discussion and consensus within the research team. However, no disagreements arose during the review process.

3.2.5 Study reading, data extraction and quality appraisal

The included studies were read by two reviewers (RA and AR-B) to ensure familiarity with the data. The data extraction was performed by RA using a customised data extraction form. Data extracted included information about the author details, study aim(s), setting, participant demographics and study findings, including original participant quotes and author interpretations. For studies involving participants from both high- and lower- or middle-income countries, only data specific to high-income countries were extracted. Quality assessment of included studies was conducted by (RA) and checked by another reviewer (AI), using the Critical Appraisal Skills Programme (CASP) tool for qualitative research.[341]

3.2.6 Analysis and interpretive Synthesis

This review used the meta-ethnographic approach described originally by Noblit and Hare[342], which has commonly been used in healthcare research.[319-321] A meta-ethnography is an inductive and interpretive approach that allows researchers to analyse, transfer, and understand ideas, themes, and metaphors across several studies to better understand or inform broader concepts.[342, 343] This review aimed to understand how ethnicity influences adherence to antidiabetic medication by exploring the barriers and facilitators of adherence to medication among people from minority ethnic communities. Meta-ethnography was chosen to understand how ethnicity affects adherence to antidiabetic medications and build a conceptual model that explains the barriers and facilitators of adherence in ethnic minority communities. It encourages a conceptional approach to

understanding experience by synthesising primary research findings rather than describing the results of previous studies.[342]

Meta-ethnography involves seven phases as listed in Figure 2.[342] To determine how studies are related, a table of findings from each primary study was prepared (including the concepts and metaphors developed by the original authors); this facilitated exploration and comparison of the findings. Two reviewers (RA and AR-B) collaboratively analysed relationships between metaphors across studies through a structured discussion. They independently reviewed the table to identify initial patterns and recurring themes and then compared their observations, highlighting similarities and differences in the metaphors used by the original authors. During these discussions, (RA and AR-B) systematically categorised the metaphors into broader thematic groups, ensuring that each theme accurately reflected the underlying concepts presented in the studies. Following that, reciprocal translation was employed to develop third-order constructs as a fundamental step of the meta-ethnographic process. This phase involves a systematic comparison where the findings from the first study are compared with the second study, and shared overarching themes are combined. [320, 342] The combined themes from these two studies are then compared and integrated with the recurring themes in the third study, and so on. By doing so, the authors identified, interpreted, and consolidated common themes that emerged from the studies. Whenever disagreements arose about the identification or interpretation of a theme, the reviewers re-read the studies and discussed their points of view until they reached an agreement. After completing the translation of the studies into one another, the authors (RA and AR-B) began synthesising the data by carefully analysing the first-order constructs (*i.e.,* participant quotations) and the second-order constructs (*i.e.,* authors interpretations) and developing the third-order constructs (overall interpretations). Finally, these third-order constructs represented the findings of the current meta-ethnography.

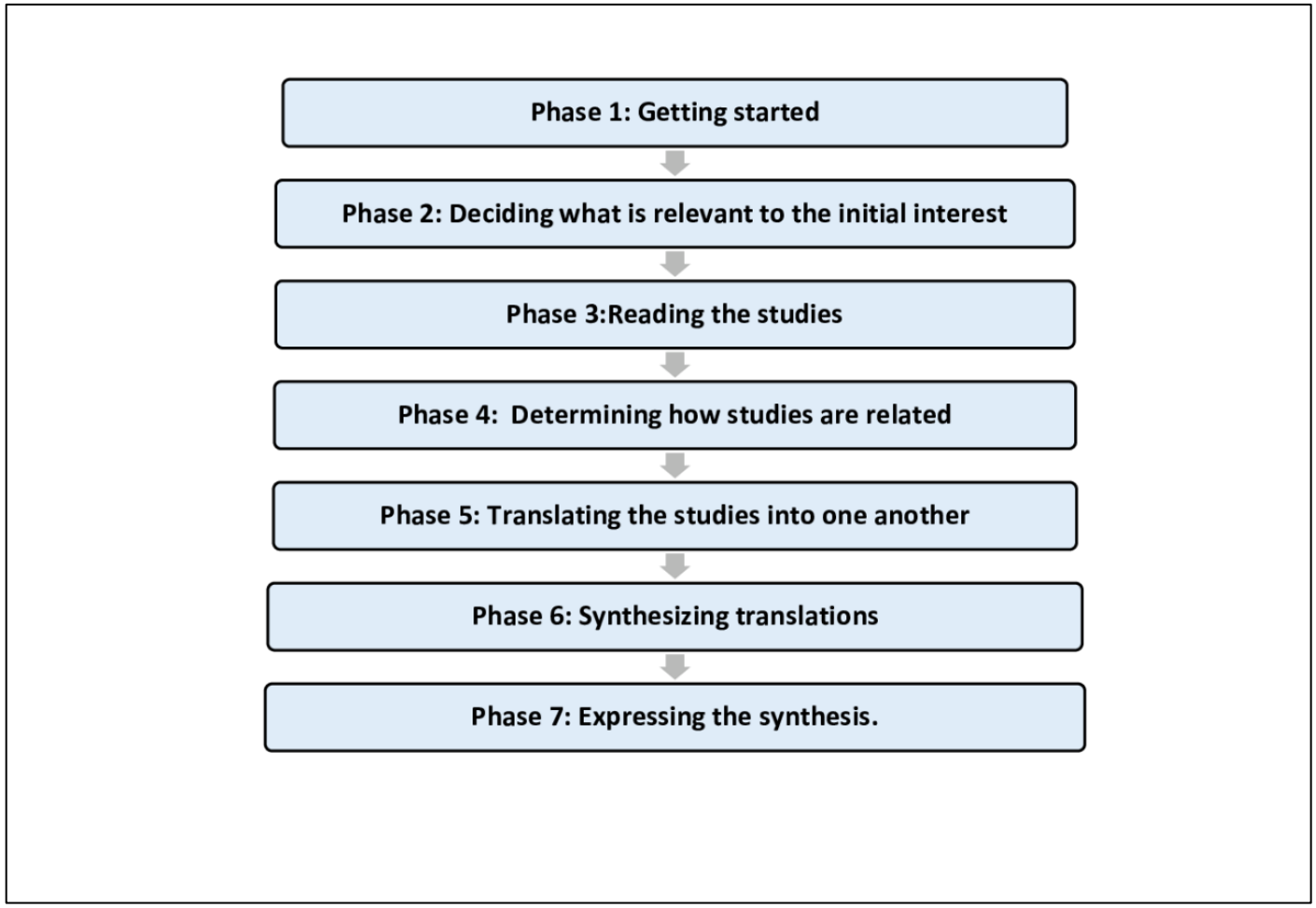

Figure 2: The seven phases of meta-ethnography as described by Noblit and Hare.[334]

3.2.7 Confidence in the synthesised findings

The confidence in this review's findings was assessed by the GRADE-CERQual approach (Confidence in the Evidence from Reviews of Qualitative Research).[344] A GRADE-CERQual assessment considers four main components: the methodological limitations of included studies, the coherence of the qualitative evidence synthesis findings, the adequacy of data used to support the review finding, and the relevance of the included studies to the review question. Based on the results of CERQual, overall confidence was classified into three levels: high, moderate, and low.

3.3 Results

3.3.1 Search results

A total of 13,994 citations were identified through database searches and other sources, including the grey literature and bibliographies of relevant studies. Following the removal of duplicates, 12,987 papers were screened for eligibility. After the title and abstract screening, a total of 69 records met the eligibility criteria for full-text checking. During the full-text review, 48 studies were excluded for reasons outlined in the PRISMA flowchart (Figure 3). In total, 21 studies were eligible for inclusion for this meta-ethnographic systematic review.

3.3.2 Study characteristics

All studies were published between 2005 and 2022 and were conducted across seven single country settings: the United Kingdom (n=6)[330, 345-349], the United States (n=8)[332, 350-356], Australia (n=2)[357, 358], New Zealand (n=1)[359], Canada (n=1)[360], Belgium (n=1)[361], Qatar (n=1).[331]In addition, one multicentre study spanned three European cities (Amsterdam, Berlin and London).[362] The sample sizes ranged from 5[360] to 84 participants [353] and the mean age of patients ranged from 49.1(SD: 9.9) [352] to 68.5(SD: 2.5) years.[351] Minority ethnic groups that were reported across the included studies were: Asian, African American, African Caribbean, Black African, Latino, Mexican American, Māori, Pacific, Slavic, and Turkish.[330-332, 345-362] Twelve studies focused on exploring the barriers to, and/or facilitators of, adherence to antidiabetic medication;[331, 332, 349, 350, 352, 355-361] the remaining focused on diabetes self-management more broadly, which included medication adherence. [330, 345-348, 351, 353, 354, 362] Study characteristics are detailed in Table 10.

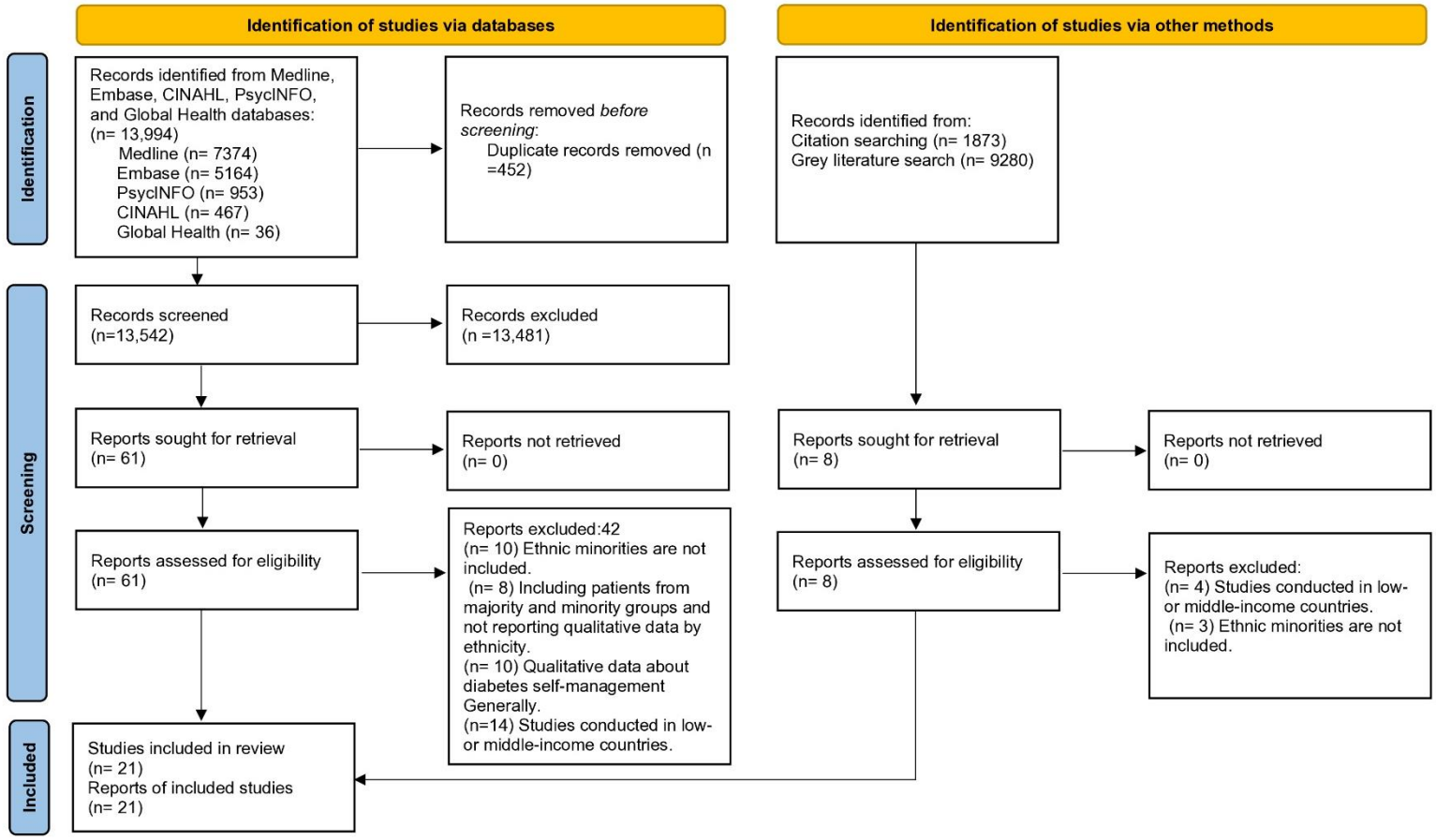

Figure 3: PRISMA flow diagram of included studies

Table 10: Characteristics of included Studies

Author & Year	Study aims (extracted verbatim from the original study)	Setting	Participants						Method of recruitment, data collection & analysis
			Sample size	Gender/sex reported by participants	Age (mean±SD)/median (IQR)	Ethnic minority group:	Type of diabetes	Antidiabetic medication	
Jamil *et al*., (2022) [356]	'To explore how cultural perspectives of South Asian immigrants in the U.S. impact adherence to medications for DM2 and CVD.'	Birmingham Free Clinic and the UPMC Matilda Theiss Health Center, two safety net provider settings in Pittsburgh US	12 participants. 7 Pakistani 4 Indian 1 Bangali	Female: n=6(50) Male: n=6(50)	63(49 -75)	South Asian	Type 2 diabetes	Not mentioned	Semi-structured interviews Data analysis was not reported clearly
Timsina *et al.,* (2022) [355]	'To understand factors affecting diabetes medication adherence in Bhutanese Refugees.'	University of Kansas Medical Center US	13 participants.	Female: n=8(62) Male: n=5(38)	58(42 -79)	Bhutanese people	Type 2 diabetes	Insulin and/or oral antidiabetic drugs	Focus groups Content analysis.
Parkin *et al.,* (2021)[359]	'To explore the views of Māori,	Primary care providers in	30 participants.	Female: n= 22(73)	Not reported.	Māori	Type2 diabetes	Metformin	Purposive sample.

	Pacific, and non-Māori non-Pacific patients with type 2 diabetes about what helps and hinders metformin adherence and persistence after initiating therapy.'	Auckland, Wellington, and Dunedin. New Zealand	10 Māori, 10 Pacific, and 10 non-Māori non-Pacific participants.	Male: n=8(27)		Pacific Non-Māori non-Pacific			Semi-structured, face-to-face interview. Thematic analysis, using the Theory of Planned Behaviour
Ahmad *et al.,* (2021)[357]	'To investigate patients' medication-taking behaviour and factors that influence adherence, particularly at its three phases among Indian migrants.'	Public places in Sydney. Australia	23 participants.	Female: n=5(22) Male: n=18(78)	39(33 - 72)	Indian migrants.	Type2 diabetes	Oral antidiabetic medications, insulin, and/or Ayurvedic medicines	Semi-structured face-to-face interviews. Thematically analysed using a framework for thematic analysis.
Omodara *et al*., (2021)[345]	'To examine cultural beliefs, attitudes, and practices of Black sub-Saharan Africans (BsSAs) in the UK regarding their type 2 diabetes (T2D) self-management using	Black sub-Saharan Africans (BsSA) communities. UK	36 participants.	Female: n=25(69) Male: n=11(31)	52.2±7.2	Black sub-Saharan African	Type2 diabetes	Insulin and/or oral antidiabetic drugs	Purposive sampling. Semi-structured interviews and field notes.

	the concepts of the PEN-3 cultural model.'								Narrative thematic analysis using PEN-3 cultural model.
Pardhan *et al.,* (2020)[330]	'To determine whether barriers to diabetes awareness and self-help differ in South Asian participants of different demographic characteristics (age, gender, and literacy) with type 2 diabetes living in the United Kingdom.'	Community centers and research facilities in Peterborough and Cambridge. UK	35 participants. 26 Pakistani 5 Nepalese 4 Indian	Female: n=17(49) Male: n=18(51)	52±2.9	South Asian	Type2 diabetes	Not mentioned	Pragmatic sampling Focus group Thematic analysis
de-Graft Aikins *et al., (2019)[362]*	'To assess perceptions and knowledge of T2D among Ghanaian migrants in Europe, and their compatriots in Ghana (including gaps in perceptions and knowledge that might raise the risk of T2D, and to examine how insights on perceptions and	(Amsterdam in the Netherlands, Berlin in Germany, and London in the UK)	66 participants. 14 Amsterdam 12 London 40 Berlin	Amsterdam: Female: n=3(21) Male: n=11(79) London: Female: n=8(67)	Not reported	Ghanaian migrants	Type2 diabetes	Not mentioned	Focus groups. Thematic analysis.

	knowledge could be used to develop appropriate T2D interventions for these communities.'			Male: n=4(33) Berlin: Female: n=28(70) Male: n=12(30)					
Jaam *et al*., (2018)[331]	'To explore the barriers to medication adherence among patients with uncontrolled diabetes within primary care by integrating the perspectives of the patients and their health care providers.'	Two primary health care Center Qatar	14 participants. 7(ethnic minority group)	Female: n=4(29) Male: n=10(71)	58.3±8.1	2 Indian 2 Sri Lankan. 1 Pakistani 1 Iranian	Diabetes (not specified the type)	Insulin and/or oral antidiabetic drugs	Purposive sample Semi-structured face-to-face interviews. Thematic analysis technique.
Shiyanbola *et al.,* (2018)[332]	'To explore the reasons for medication nonadherence and adherence among AAs with type 2	Community center, church, apartment building, or senior center.	40 participants.	Female: n=24(61) Male: n=16(39)	53±4.94	African American	Type 2 diabetes	Not mentioned	Purposive sample Focus group

	diabetes and understand their perceptions of the solutions for enhancing adherence.'	Two different cities within the state (Suburbs and Urban City) US							Qualitative content analysis
Sapkota *et al*., (2018)[358]	'To explore medication-taking behaviour in Nepalese patients with type 2 diabetes, specifically investigating anti-diabetic medication initiation and implementation and their reasons for cessation and persistence with therapy.'	Public places Australia and Nepal*	48 participants. 18 participants in Sydney. 30 participants in Kathmandu	Female: n=6 (33.3) Male: n=12 (66.7)	54.2(24 -73)	Nepalese	Type 2 diabetes	Anti-diabetic medication	Snowball sampling. Face-to-face interview. Thematic analysis.
Bockwoldt *et al.,* (2017)[350]	'To describe the experiences of taking diabetes medications among midlife (35-	Hospital-based clinic. Chicago	15 participants.	Female: n=9(60) Male: n=6(40)	51.7±5.7	African American	Type 2 diabetes	Insulin and/or oral antidiabetic drugs	Purposive sample Semi-structured interviews.

	59) African American men and women with type 2 diabetes and to identify factors that influence these experiences.'	US							Thematic analysis
Patel *et al*., (2016)[346]	'To explore the role of social networks and beliefs about diabetes in British South Asians, to better understand their management behaviours whilst holidaying in the East.'	Greater Manchester UK	44 participants.	Female: n=21(48) Male: n=23(52)	61±12.5	British South Asians: Indian Pakistani Bangladeshi Nepalese	Type 1 or Type 2 diabetes	Insulin and/or oral antidiabetic drugs	Random sampling & Purposive sampling. Semi-structured face-to-face interviews. Thematic analysis using constant comparison approach
Joo & Lee, (2016)[351]	'To explore one research question: What barriers to and facilitators of type 2 diabetes (T2DM) self-management exist for elderly Korean American immigrants who	US	23 participants.	Female: n=11(48) Male: n=12(52)	68.5±2.5	Korean American immigrant	Type 2 diabetes	Insulin and/or oral antidiabetic drugs	Convenience and purposive sampling. Focus group. Standard content-based analysis.

	live in the Midwest.'								
Peeters *et al.,* (2015)[361]	'To explore perspectives of Turkish migrants with type 2 diabetes mellitus on adherence to oral hypoglycaemic agents.'	Primary care and community sources in Ghent, Belgium	21 participants.	Female: n=12(57) Male: n=9(43)	Not reported.	Turkish	Type 2 diabetes	Insulin and/or oral antidiabetic drugs	Theoretical sampling procedure. In-depth interview Grounded theory approach
Mohan *et al.,* (2013)[352]	'To conduct a qualitative evaluation to: 1) better understand medication taking practices among low-income Latinos; and 2) evaluate Latino patients' perceptions regarding PictureRx, specifically assessing whether PictureRx could address patients' challenges with medication taking	Two safety net clinics in Tennessee US	38 participants.	Female: n=24(63) Male: n=14(37)	49.1±9.9	Latino	Diabetes (not specified the type)	Not mentioned	Convenience sample Focus groups. Data analysis was not reported clearly

	and be a culturally appropriate tool to improve communication about medication information.'								
Lynch *et al.,* (2012)[353]	'To explore low-income minority patients' concepts of diabetes self-management and assess the extent to which patient beliefs correspond to evidence-based recommendations.'	Community and hospital-based safety-net general medicine and diabetes clinics in Chicago. US	84 participants 49 Mexican American 35 African American	Mexican American: Female: n=21(43) Male: n=28(57) African American: Female: n=17(48) Male: n=18(52)	Mexican American: 55±10.8 African American: 57.6±10.7	Mexican American African American	Type 2 diabetes	Not mentioned.	Convenience sample Focus groups Grounded theory
Singh *et al.,* (2012)[347]	'To explore barriers to and support systems for optimizing diabetes mellitus in samples of British	Hillingdon Hospital Outpatient clinic.	20 participants. (12 British South Asians and	British South Asians: Female: n=6(50)	52.6±13.3	British South Asian British White	Diabetes (Type1 & 2)	Not mentioned.	Sampling was not reported clearly Semi-structured interviews.

	South Asian and White outpatients with optimal and suboptimal diabetes control.'	Uxbridge, UK	8 British Whites)	Male: n=6(50) British Whites: Female: n=4(50) Male: n=4(50)					Interpretative Phenomenological Analysis
Barko *et al.,* (2011)[354]	'To compare and contrast Slavic immigrant women and non-Hispanic, nonimmigrant White American women regarding (a) diabetes and cardiovascular health symptoms; (b) self-management of diabetes, including dietary and physical activity approaches; and (c) perceived educational needs.'	US	20 participants. Russian-speaking Slavic immigrant American women (10) Non-Hispanic, non-immigrant White	Female: n=20(100)	63.8±10.58	Russian-speaking Slavic immigrant American women non-Hispanic, non-immigrant White American women	Type 2 diabetes	Not mentioned.	Convenience sample. Semi-structured interview. Data analysis was not reported clearly

			American women (10)						
Noakes (2010)[348]	'To explore perceptions of insulin treatment among black African and African-Caribbean people with type 2 diabetes, to gain insight into the barriers to treatment and strategies to overcome resistance.'	Diabetes outpatient clinics at a South London NHS hospital trust UK	13 participants.	Black African Female: n=5(38) Male: n=0(0) African-Caribbean Female: n=3(24) Male: n=5(38)	62±8.2	Black African African-Caribbean	Type 2 diabetes	Insulin and/or oral antidiabetic drugs	Purposive sampling. Focus groups Data analysis was not reported clearly
Ho & James (2006)[360]	'To determine some of the cultural barriers to initiating insulin therapy among Chinese individuals with type 2	Ambulatory centre for diabetes in Toronto, Ontario, Canada.	5 participants.	Female: n=1(20) Male: n=4(80)	54.2±9.4	Chinese	Type 2 diabetes	Insulin therapy	Sampling was not reported clearly

	diabetes living in Canada.'								Intensive semi-structured interviews Framework analysis
Lawton *et al*., (2005)[349]	'To explore British Pakistani and British Indian patients' perceptions and experiences of taking oral hypoglycaemic agents (OHAs).'	Primary care and community sources in Edinburgh, Scotland. UK	32 participants.	Female: n=17(53) Male: n=15(47)	Not reported.	British Pakistani and British Indian	Type 2 diabetes	Oral hypoglycemics agents.	Face to face recruitment and snowballing In-depth interviews Grounded theory.
Key	* Data from the Nepal site were excluded because our inclusion criteria focused on high-income countries. Only data from Australia were included.								

3.3.3 Study quality

According to the CASP checklist, 17 studies met the criteria related to the clarity of the research aims, ethical issue consideration, recruitment, data collection, analysis, and reporting of study results.[199, 287, 315, 330, 346, 349-351, 353-356, 359, 360, 362-364] However, 19 of the studies did not provide sufficient detail about the relationship between the researcher and the participants.[199, 313, 315, 330, 346, 348-353, 355, 356, 358, 359, 361-364] The details of the quality appraisal using the CASP tool for qualitative studies are described in Table 11.

3.3.4 Synthesis finding

Three third-order constructs (overarching themes) were developed in this review, with two encompassing specific subthemes. The first overarching theme is cultural underpinnings, which include the following subthemes: perspectives of prescribed medicine and preferences for alternatives, social stigma of the condition, family and social support, and religious beliefs and practices. The second overarching theme is communication, which involves the following subthemes: language barriers and building relationships. The third overarching theme is managing diabetes during visits to home countries, which stands alone without subthemes because the factors associated with it were directly cohesive, eliminating the need for additional subthemes. These three overarching themes and subthemes are outlined in Figure 4. The qualitative data synthesis is described in Tables 12, 13, and 14, with each table representing one of the three third-order constructs.

Table 11: Results of the risk of bias assessment of the qualitative studies

Critical Appraisal Skills Tool Screening Questions	Study citation																			
	Jamil *et al.,*2022	Timsina *et al.,* 2022	Parkin *et al.,* 2021	Ahmad *et al.,*2021	Omodara *et al.,*2021	Pardhan *et al.,*2020	de-Graft Aikins *et al.,* 2019	Jaam *et al.,*2018	Shiyanbola *et al.,* 2018	Sapkota *et al.,*2018	Bockwoldt *et al.,*2017	Patel *et al.,*2016	Joo & Lee, 2016	Peeters *et al.,* 2015	Mohan *et al.,*2013	Lynch *et al.,* 2012	Singh *et al.,* 2012	Barko *et al.,*2011	Noakes ,2010	Ho & James ,2006	Lawton *et al.,*2005
1- Was there a clear statement of the aims of the research?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2- Is qualitative methodology appropriate?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3- Was the research design appropriate to address the aims of the research?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No	No	Yes
4- Was the recruitment strategy appropriate to the aims of the research?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5-Was the data collected in a way that addressed the research issue?	Yes	Yes	Can't tell	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6- Has the relationship between researcher and participants	Can't tell	Can't tell	Can't tell	Can't tell	Can't tell	Can't tell	Can't tell	Can't tell	Can't tell	Can't tell	Can't tell	Can't tell	Can't tell	Can't tell	Can't tell	Can't tell	Can't tell	Yes	Can't tell	Yes	Can't tell

been adequately considered?																					
7- Have ethical issues been taken into consideration?	Yes	Yes	Yes	Yes	Can't tell	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
8- Was the data analysis sufficiently rigorous?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9- Is there a clear statement of findings?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
10- How valuable is the research?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Comments	-	-	Q5: No discussion around data saturation	-	Q7: No statement around approval of the ethics committee	Q5: No discussion around data saturation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

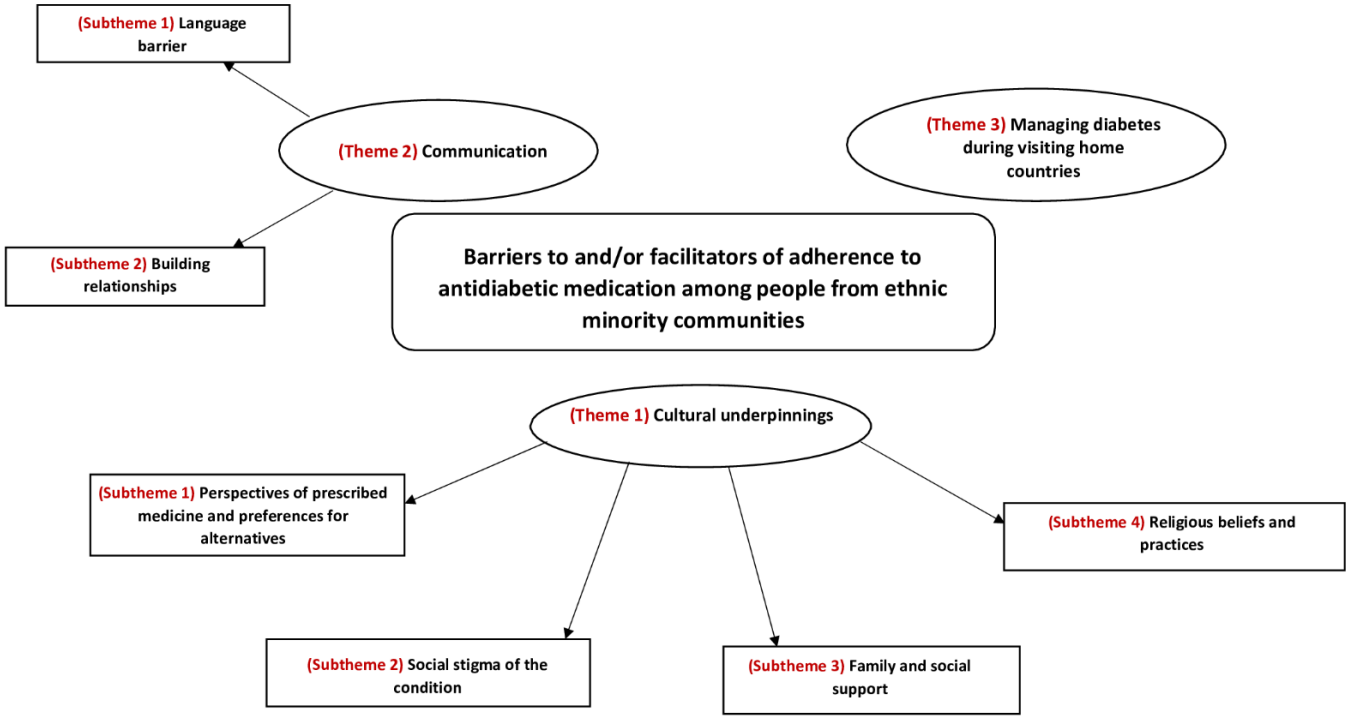

Figure 4: Developed themes and subthemes for the barriers to and facilitators of adherence to antidiabetic medication among people from ethnic minority communities.

Table 12: Theme 1: Cultural underpinnings

Synthesised themes (third order constructs)	Sub-themes	Second order constructs: the author's interpretations of the original findings	First Order constructs: examples of direct quotations from the participants of the study
CULTURAL UNDERPINNINGS	***Preference for alternative medicines***	Efficacy of alternative remedies	*'If I keep using the herbs, I'm using now, which I know it's working for me, I know I will soon stop taking my medication completely'. [364]* *Black sub-Saharan African*
			'I believe in traditional remedies, and I know some of them works for diabetes. My mother has diabetes as well, and she usually uses herbs and bitter kola … She usually gets from Nigeria to manage her sugar level, so I use it as well'. [364] *Black sub-Saharan African*
			'I use Aloe Vera to lower my blood sugar…'. [364] *Black sub-Saharan African*
		Alternative treatments	*'When I first became a diabetic, I didn't consult with a doctor, I took a treatment of nopal that a nutritionist gave me, and this immediately made me lose weight'. [353]* *Mexican American*
		Religious beliefs and spirituality	*'It is part of our tradition in South Africa; we use oils, plants, and herbs for treatment alongside prayers…'. [364]* *Black sub-Saharan African*
		Initiation of antidiabetic medications	*'I avoided (insulin) for almost 2–3 years…That time once I had taken Ramdev's (Ayurvedic) medication…'.[358]* *Nepalese*

			'… Let's say because of the family pressure I started from there (Ayurvedic medications)'. [358] *Nepalese*
			'My relatives from Nepal suggested me to take Ram Dev's (Ayurvedic) medications … then after I started taking them'. [358] *Nepalese*
		Implementation of antidiabetic medications	*'if you take this English medicine, there will be side effect …. You should not take English medicines…'. [358]* *Nepalese*
		Long term cessation of antidiabetic medications	*'I took the medication for 1 month,…Yes, then I started on herbs. I kept myself on herbs for 4 years'. [358]* *Nepalese*
		Adherence to medication	*'I take bitter gourd with pieces in water and aloe veera'. [330]* *South Asian*
		Social network and social support	*'Lots of people in the family have it so they used to tell me…. try karela juice…'. [346]* *British South Asian*
		Beliefs about oral hypoglycaemic agents	*'They (family members) told me that karabaş would be good. My son has brought these herbs from Turkey. I boiled and drank them but it didn't help…'. [361]* *Turkish*
		International travel to visit friends and relatives	*'I take [name of country] medicine. When I am in [name of the country], I take it because it is more effective and has fewer side effects'. [199]*

			Sri Lankan
			'Our grandparents, they teach us these are good and they come from nature, so they are good'.[199] Sri Lankan
		Fear of medication side-effects	'*….it was suggested by my brother to take ayurvedic medication, he told that its really effective and no side effects'.[363]* *Indian*
			'... my friend brought from India ayurvedic medication... I didn't see much benefit out of it'.[363] *Indian*
			'*... 1 year no medication taking and manage well with his healthy diet, exercise and meditation with some herbs'.[363]* *Indian*
		Fear of side effects and medication dependency	'*Want to be away from all these strong drugs [because of side effects] and make addicted... going to start natural method such as ayurvedic medication'. [363]* *Indian*
		Negative belief about medicines	'*My colleague in Australia said allopathic medications have lots of side effects… she insisted to take ayurvedic medication because her mother using it and benefitted in India, ... , so I decide to initiate ayurvedic medication instead of metformin'.[363]* *Indian*

		Distrust of Western medicine	*'… Chinese herbalist would weigh each serving. So, Western medicine is powerful, best to be avoided'.[360]* *Chinese*
			'They always say Western medicine makes you very weak'.[360] *Chinese*
			'How long has insulin been around?... versus 2000 years of Chinese history…'. [360] *Chinese*
			'…When I talk to my herbal doctor, he says Chinese medicine restores the balance of your system'.[360] *Chinese*
		Self-management of diabetes	*'I want to know about herbs because my doctor gives me pills, but they are all chemical based. They cause me to either sleep too much, or not enough. My stomach and liver started to hurt'.[354]* Russian-speaking Slavic immigrant American
		Complementary and alternative medicines augmented Western medicines	*'…people say, cinnamon is very good for diabetes and tamarind is very good, so one time I start taking those... '.[356]* *South Asian*
		Medication management	*'Herbal medicine is very effective in treating diabetes, when you take the western medicine in excess you can get other complications'.[362]* *Ghanaian migrants*
	Perspective of prescribed medicine	Perceptions of oral hypoglycaemic agents (OHA)	*'See, in Pakistan, the medications are not right, they're just a waste of time, waste of money. I mean these [referring to OHAs] are the real stuff. These are what really work'.[349]*

			British Pakistani
			'I don't think you can get the same kinds of medicine that you can get here, you know, like metformin. This is one of the most important drugs to take for it'.[349] *British Indian*
	Social stigma	Social stigma and other cultural pressures	*'The biggest obstacle is the stigma around diabetes. There are not a lot of people, family friends who know that we (brothers) are diabetic... no one is going to marry him because he is a diabetic'.[313]* *South Asian*
			'*… I mean you try and hide your illness; no one should know that you have any illness'. [313]* *South Asian*
			'… it is more because of our culture and community. People look at you and go, 'Oh God! Is he taking insulin?' … people feel that you have a very dangerous kind of disease … it is really embarrassing'.[313] *South Asian*
			'If I am going around somebody's house for a meal, they make me do the injection before I go'.[313] *South Asian*
		Culture	*'The reason why my mother suffers with it, is that she is a very conservative, proud woman. She finds it hard to tell people she's on insulin'.[348]* Black African

		Social pressure	*'She got married and pregnant, and she did not tell her husband she is diabetic'.[199]* Sri Lankan
			'*Honestly, I intentionally sometimes not take [injections] it in front of people […] I remember I was once taking insulin, and someone got up […] and from far he screamed […] hey heroine!'.[199]*
		Stigma related diabetes	'*Initially I met my GP in Australia and [was] diagnosed with type 2 diabetes and started with metformin but I did not inform my wife, and even to my parents that I am diabetic, So I do not take medicine in front of her [wife]...wherever we go in social or religious gatherings, I used to take same food as no one knew that I am diabetic ... the problem in Indian community they will show pity'.[363]* *Indian migrant*
		Greater familiarity with/easier access to traditional Chinese medicine	'*The more Chinese you are, you're really more attuned to what you can take and how to go about taking it, and how regular and so forth'.[360]* *Chinese*
			' *[Chinese patients] go for certain herbal medicines just to get away from the need to receive needles'.[360]* *Chinese*
		Cultural factors contributing to barriers	' *My family views people taking insulin as more of a handicap...'.[360]* *Chinese*
		Social stigma	*'Once people see you are taking insulin, especially in my culture and community [sigh] they put on this sympathy look; people think you have a killable disease'.[364]* *Black sub-Saharan African*

			'Diabetes is a big stigma-related problem in our community, especially among the Black African community…'. [364] *Black sub-Saharan African*
	Family and social support	Perceived solutions for improving adherence	*'[…] my church try to bring somebody in to talk to us about it (diabetes) […] …come and meet and just sit down and discuss the problems that you're having with your diabetes. Maybe somebody can help you'.[315]* *African American*
			'[…] in the high black areas, in the neighbourhood centers, they bring in people […] they try to help them to be a self-advocate for themselves. They teach them that if you're going to stay healthy, you're going to have to do it […] you've got to put the work into it to find out, what is happening with your body and what it is that the black people experience versus the white people's experience and the doctors'.[315] *African American*
			'…Knowledge is power, and you have to have a support group…'.[315] *African American*
		Difficulty in knowing how to access and understand the available information	*'I don't know who to ask – I sometimes ask my friend who is also a diabetic'.[330]* *South Asian*
		Limited role perceived for GPs/Practice	*'My family and friends can support me when there are new developments, like my cousin called me last week to inform me about new insulin which you only have to take once and told me to ask my GP...the GP doesn't have enough time…'.[346]* *British Pakistani*

		Social networks and social support	*'...when I go to the mosque to pray other people that have diabetes they talk about it…'. [346]* *British Bangladeshi*
		Immediate/close family members	*'I feel there is no life without wife. After a certain age there is a desperate need for a partner … they will remind you and say, 'have you taken your insulin?'.[313]* *South Asian*
		The message	*'They'll welcome you more because they will see you as one of theirs and you're not likely to lie to them, you know … And because of that culture thing whereby they don't open up enough to see their own kind being open they will feel relaxed'.[348]* *Black African*
		Social support	*'.. (…) When I travel to Turkey my daughter is always with me. She takes care of my insulin and my pills'.[361]* *Turkish*
		Open communication improved medication adherence	*'...Daughters remind me did you take it?... The other day, I ate out with friends and then forgot to take my medicine'.[356]* *South Asian*
	Religious beliefs and practices	Patients' individual characteristics	*'There is one-month fasting but not complete; we can use vegetable, not non-vegetable. Light food and I do not use insulin. Only vegetable, so I do not think this will increase my sugar'.[199]* *Indian*
			'I change the dose in Ramadan by myself […] It's two times […] morning and evening same […]'. [199] *Pakastani*

		Religiosity in combination with psychological problems	*'There is nothing you can do about it. I'm religious, everything comes from Allah. So there is nothing you can do about it'.[361]* *Turkish*
		Beliefs about diabetes	*'Of course, I accept it (his diabetes). Because Allah gave it to me. My faith makes it easier to deal with it'.[361]* *Turkish*
		Adjustment of oral hypoglycaemic agents during Ramadan fasting	*' I: 'But you have to take three pills (OHA) a day?' 'I take one at sun dawn and one at sunset.'* *I: 'Does your doctor know? 'I decide this myself'.[361]* *Turkish*
		Supportive relationships have an impact on medication adherence	*'I'm gonna say that my faith helps me get through the hardship of being a diabetic'. [350]* *African American*
		Religion	*'… Whatever the doctor or nurses prescribed is helped through God's mercy. Sometimes it not helps everybody, but God isn't in control of these things … As far as he concerned, God helps me through them'.[348]* *African-Caribbean*
			'I know there is people that would say they can't do insulin because they say they would rather God help them'.[348] *African-Caribbean*
		Religious beliefs and values	*'There is a lot of power in a prayer. He has given me this condition so he knows about it'.[313]* *South Asian*

			'Prayers give me a lot of support…Prayers have a lot of healing power'. [313] *South Asian*
		Belief in health care	*'God gave you six senses. Right? And so if the doctor tell you you sick, and he tell you you must take this medicine to stay alive, better use your common sense. It's a wonderful thing to pray and have faith, but God gave you six senses. He told you to listen and learn'. [315]* *African American*
		Religious beliefs and spirituality	*'You put everything in prayers. Even though I don't use medication to control my glucose level, I still put other remedies I use in prayer'.[364]* *Black sub-Saharan African*
			'Most times when I fast and pray, I always feel better with my diabetes'.[364] *Black sub-Saharan African*
			'Prayer is my main key to my strength and managing my diabetes…'. [364] *Black sub-Saharan African*
		Faith-based coping	*'I know prayer can cure diabetes; it all depends on the faith you have'.[362]* *Ghanaian migrants*

1) Cultural underpinnings

- *Perspectives of prescribed medicine and preferences for alternatives*

The preference for alternative medicines was reported mainly as a barrier for adherence to antidiabetic medication amongst ethnic minority communities. For many people, alternative medicine preferences arose from distrust of Western medicine, fear of adverse effects, or dependency.[354, 357, 360, 362] Some people also reported that religious and cultural beliefs around the effectiveness of alternative remedies support their use alongside or instead of antidiabetic medication.[345, 353, 354] Social networks of people from ethnic minority communities also played a role in the use of herbal medicines over prescribed antidiabetic medication, with some people recommending products they have previously tried or have found successful.[331, 346, 356, 358, 361]

'How long has insulin been around?... versus 2000 years of Chinese history…'.[360]

'Want to be away from all these strong drugs [because of side effects] and make addicted... going to start natural method such as Ayurvedic medication'.[357]

'I use Aloe Vera to lower my blood sugar…'.[345]

'Lots of people in the family have it so they used to tell me... try karela juice…'.[346]

'….people say, cinnamon is very good for diabetes and tamarind is very good, so one time I start taking those...'.[356]

'Herbal medicine is very effective in treating diabetes, when you take the western medicine in excess you can get other complications'.[362]

Perspectives about prescribed medicines were demonstrated to be both a barrier to, and a facilitator of, adherence among some people from ethnic minority groups. In one study by Lawton *et al.*, one participant discussed views that the antidiabetic medications in their home country were less effective or of lower quality than the medications in their country of residence; in turn, this was seen to create a barrier to adherence when they returned home for holiday celebrations.[349] In contrast, the same participant described perspectives of trust when considering the effectiveness of antidiabetic medication in their country of residence, which motivated their adherence.[349]

'See, in Pakistan, the medications are not right, they're just a waste of time, waste of money. I mean these [referring to OHAs] are the real stuff. These are what really work'. [349]

- *Social stigma of the condition*

Social stigma was reported to have a negative influence on adherence to antidiabetic medication, namely amongst participants from Black, Chinese, and South Asian minority ethnic communities.[331, 347, 348, 360] Some individuals reported hesitance to disclose their diabetes to their families and community. This affected the use of antidiabetic medication in public, particularly an avoidance of injecting insulin therapies due to concerns about being stigmatised for drug use.[331, 347, 357]

'Honestly, I intentionally sometimes not take [injections] it in front of people […] I remember I was once taking insulin, and someone got up […] and from far he screamed […] hey heroin!'.[331]

Moreover, participants in the study by Singh *et al.,* reported instructing their relatives with diabetes not to tell anyone about their condition or whether they are taking insulin. In South Asian communities, where family elders arranged most marriages, diabetes was considered a sign of physical inadequacy that adversely affected marriage prospects.[347] Consequently, the impact of this stigma meant it was difficult for patients to adhere to their medication, particularly during social gatherings.

'My family views people taking insulin as more of a handicap….'. [360]

- *Family and social support*

Family and social support appeared a crucial facilitator of adherence to antidiabetic medication; in particular, this was noted amongst the studies involving people from African American, South Asian, and Turkish minority communities.[330, 332, 347, 361] Supportive mechanisms were also identified as positive influencers, particularly forms of social support provided by the community centre, religious groups, and other social support groups.[332, 346] Specifically, peer-led education was deemed beneficial.[330, 332, 346, 348] In South Asian and Turkish communities, the family members also appeared to facilitate a person's adherence to their antidiabetic medication.[347, 361] Some participants indicated that their

close family members supported their diabetes self-care by helping them take their medication; this was deemed a facilitator of adherence to antidiabetic medication.

'.. (…) When I travel to Turkey my daughter is always with me. She takes care of my insulin and my pills'.[361]

'… When I go to the mosque to pray, other people that have diabetes, they talk about it…'.[346]

'...Daughters remind me did you take it?... The other day, I ate out with friends and then forgot to take my medicine'.[356]

- *Religious beliefs and practices*

Religious belief and practices were perceived as both barriers to, and facilitators of, antidiabetic medication adherence in people of South Asian, Black, or Turkish ethnicity.[331, 332, 345, 347, 348, 350, 361] For some participants, they found praying was beneficial in finding emotional support for managing their diabetes.[332, 345, 347, 348, 350, 361] However, some people described depending on prayer, instead of medication, for the complete management of diabetes.[345, 348, 362] According to some participants, religious practices such as fasting had a negative impact on adherence to antidiabetic medication since fasting and eating 'light' food (diet high in vegetables and low in carbohydrates and fat) were believed to eliminate the need to take the medications.[361]

'Prayer is my main key to my strength and managing my diabetes…'.[345]

'You put everything in prayers. Even though I don't use medication to control my glucose level, I still put other remedies I use in prayer'.[345]

'I know prayer can cure diabetes; it all depends on the faith you have'.[362]

'There is one-month fasting but not complete; we can use vegetable, not non-vegetable. Light food and I do not use insulin. Only vegetable, so I do not think this will increase my sugar'.[331]

Table 13: Theme 2: Communication

Synthesised themes (third order constructs)	Sub-themes	Second order constructs: the author's interpretations of the original findings	First Order constructs: examples of direct quotations from the participants of the study
COMMUNICATION	***Language barriers***	Patient–provider communication barriers	*'There are those who have language issues, so they do not understand, they receive the medicine, but they do not know how to take it'.[199]* *Pakistani*
		Language issues	'…..But it is still difficult to talk in English about my diabetes symptoms and questions'.[351] *Korean American immigrant*
		Limited role perceived for GPs/Practice	*'My GP in Pakistan I talk to him and get advice over the phone about my diabetes'.[346]* *British Pakistani*
		Challenges to proper medication taking	*'The problem is that, for example....for someone who does not speak adequate English who goes to a doctor, how can you explain yourself to the physician?'.[352]* *Latino*
		Language barriers	*'I sometimes can't understand what the GP/nurse is explaining about my diabetes as they do not speak Urdu'.[330]* *South Asian*
		Lack of information from health care providers	*'I sometimes can't understand what the GP is explaining'.[330]* *South Asian*

		Access to diabetes-related information	*'We find it difficult to understand English. Information (is) not provided in local language'.[330]* *South Asian*
		Healthcare team and diabetes-related literature	*'… the SA nurse can understand our language and she is a very nice lady. She is worth all the praise. Doctors here talk in English … he (a consultant) is also nice but most of the time he cannot understand my English'.[313]* *South Asian*
		Patient–health care provider relationship	*'I did (want to ask for more information) but I don't know the language.'[361]* *Turkish*
		Medicines	*'I have tried to get it on the phone, but they never answer... a machine answers in English and I don't understand anything'.[353]* *Mexican American*
		Family and community support invaluable for health	*'Our doctor helps a lot. We are so happy that he can speak and understand our language (Nepalese language) '.[355]* *Bhutanese*
	Building relationships	Seeing multiple physicians/care provider	*'I saw so many doctors here. I once told my friend […] I told him in [name of the clinic], it's like the United Nations […]'.[199]* *Indian*
		Patient–provider communication barriers	*'There is not really enough time, actually there is never enough time, but you also can't do it all in one visit'.[199]* *Pakistani*

			'There is no time to even deal with him... much, given the pressure here in this center'. [199] *Pakistani*
		Perceived solutions for improving adherence	*'Get educated about black people. Education about the clientele you serve. So you have to know the cultures that you serve […]'.[315]* *African American*
		Limited role perceived for GPs/Practice.	*'...you can't blame them because they are seeing so many patients a day, they haven't got the time to spend 20 minutes or half an hour to talk and tell you things...'.[346]* *South Asian*
		Language barriers	*'...they won't tell you anything in depth as appointments are limited to only few minutes'.[330]* *South Asian*

2) Communication

- ***Language barriers***

Language barriers between patients and healthcare providers were seen to negatively influence how people from ethnic minority communities communicate and understand information on diabetes management, this impacted adherence to antidiabetic medication. One of the language-related issues reported for people from ethnic minority communities was difficulty in understanding health providers' consultations about diabetes management.[330, 331] This challenge was specifically reported among people from South Asian ethnic minority community participants who found difficulty in understanding the information provided during consultations with their English-speaking healthcare providers.[330]

'I sometimes can't understand what the GP/nurse is explaining about my diabetes as they do not speak Urdu'.[330]

Another language-related issue was the difficulty experienced by people from ethnic minority communities in asking their healthcare professionals for information about diabetes management. A lack of fluency or inability to speak the primary language of their country made it difficult for people from South Asian, Korean American, Latino, and Turkish ethnic minorities to ask or explain their concerns about their diabetes and its management.[330, 347, 351, 352, 361] Moreover, participants from studies by Singh *et al*., and Timsina *et al.,* reported that the presence of healthcare providers from their countries of origin who understand their language is preferable when communicating about diabetes.[347, 355] Additionally, the availability of diabetes-related information in only one language is considered a barrier to accessing diabetes information.[353, 365] People from ethnic minority communities were directly affected by all these issues, which can result in reduced adherence to prescribed antidiabetic medication.

'I did (want to ask for more information) but I don't know the language'.[361]

'Our doctor helps a lot. We are so happy that he can speak and understand our language (Nepalese language)'.[355]

- *Building relationships*

The relationships between patients and healthcare professionals play an essential role in effective communication, which, in turn, is critical in promoting medication adherence. Healthcare providers' time constraints hinder building relationships with patients, resulting in suboptimal counselling on the treatment and thereby hindering medication adherence. Participants from South Asian ethnic minority communities described healthcare professionals' time constraints as a barrier to receiving detailed information during consultations and support from their healthcare providers regarding diabetes management.[330, 331, 346] As a result, people from the same ethnic minority communities also reported dependence on healthcare providers from their home country to seek further information on diabetes.[346] Consequently, inadequate interaction time between patient-healthcare providers led to limited information sharing regarding treatment benefits and listening to patients' concerns about medications, thus negatively influencing adherence to antidiabetic medication.

'...they won't tell you anything in depth as appointments are limited to only few minutes'.[330]

'...you can't blame them because they are seeing so many patients a day, they haven't got the time to spend 20 minutes or half an hour to talk and tell you things...'.[346]

Table 14: Theme 3: Managing diabetes during visiting home countries

Synthesised themes (third order constructs)	Second order constructs: the author's interpretations of the original findings	First Order constructs: examples of direct quotations from the participants of the study
MANGING DIABETES DURING VISITING HOME COUNTRIES	Beliefs about diet and diabetes management	*'...no electricity for about 8 hours...so in the summer it's very difficult and because I take insulin I have nowhere…'.[346]* *British Pakistani*
	Healthcare system	*'... And it's expensive and you have to keep it in the fridge. In Jamaica some people don't even have a fridge in the house'.[348]* *African-Caribbean*
	Changing time zones	*'…some days I was completely forgetting them for days on end. Cause you were travelling for 24 hours'.[359]* *Non-Māori non-Pacific*
	Beliefs about diet and diabetes management	*'When I go there my diabetes is gone...'.[346]* *British Pakistani*
		' I: Did you take all your medication with you? *...I never take any medicine when I am there...for 6 or 7 weeks that I am there, I never take'.[346]* *British Pakistani*
	Impact of causal beliefs about diabetes (stress, Belgian climate) on medication adherence	*'In Turkey I don't take it (his OHA) at all. I sometimes measure my sugar and it is always lower than (when I am) over here'.[361]* *Turkish*

		'Once a year I go to Turkey for 5 to 6 weeks. Sometimes I don't inject (the insulin) at noon although I eat and drink a lot. Because I have no worries my sugar (blood sugar level) is very low'.[361] *Turkish*
	International travel to visit friends and relatives	*'…when traveling to his home country, he will get better and his health will improve'.[199]* *Indian*

3) Managing diabetes during visiting home countries

People from South Asian and Turkish minority ethnic communities had beliefs that their diabetes was temporarily cured (or their blood sugar levels improved) in their countries of origin and these beliefs appeared to negatively affect adherence to antidiabetic medication.[331, 346, 361] This can be attributed to the strong belief among some participants about the perceived benefits of returning to a hot climate, which they believed improved their diabetes control or provided a temporary cure through sweating[346, 361], leading them to either alter their antidiabetic medications or stop using them entirely.[331, 346, 361] Moreover, some participants viewed their cultural holiday in their home countries as a break from taking medication, so they stopped taking their antidiabetic medication.[346] Changing time zones during their travels was also described as a challenge when using antidiabetic medications.[359] The practical issues related to medication storage in native countries of people from ethnic minority communities were also acknowledged as a barrier to taking antidiabetic medication during holidays.[346, 348] For example, several participants mentioned the inability to store insulin at a suitable temperature due to a lack of electricity and refrigerators in their home countries.[346, 348]

'In Turkey I don't take it (his OHA) at all. I sometimes measure my sugar and it is always lower than (when I am) over here'. [361]

'When I go there my diabetes is gone....'. [346]

3.3.5 Confidence in the synthesised findings

According to the GRADE-CERQual methods [344] applied to the review findings, all the subthemes under the overarching theme 'Cultural underpinnings' were appraised as high confidence except for the subtheme 'Social stigma of the condition' graded as moderate confidence. The second overarching theme 'Communication' was appraised as moderate confidence, and theme 'Managing diabetes during visiting home countries' as high confidence. The confidence ratings indicate that these themes are likely to be reasonable representation of the barriers to, and facilitators of, adherence to antidiabetic medication among ethnic minority groups in high-income countries. The summary of findings is presented in Table 15.

Table 15: CERQual assessments for the included studies

Review Finding		CERQual Assessment of Confidence in the Evidence	Explanation of CERQual Assessment	Studies Contributing to the Review Finding
Finding 1: Cultural underpinnings	Perspectives of prescribed medicine and preferences for alternatives	High confidence	**Assessment of methodological limitation** Minor concerns because most of the studies were unclear regarding relationship between researchers and participants, one study had unclear recruitment strategy, and one paper didn't provide in-depth description of the analysis process.	[330, 331, 346, 347, 350, 354, 355, 357-359, 361, 362]
			Assessment of coherence No/very minor concerns, as the studies had clear underlying data supporting the finding.	
			Assessment of adequacy Minor concerns regarding adequacy because there were 12 studies out of 21 supporting the finding.	
			Assessment of relevance	

			Very minor concerns, as one study included participants from low-income countries and high-income countries.	
	Social stigma of the condition	Moderate confidence	**Assessment of methodological limitation** Minor concerns because most of the studies were unclear regarding relationship between researchers and participants, and one study had no clear statement of findings.	[331, 347, 348, 357, 360]
			Assessment of coherence No/very minor concerns as there were clear data supporting the finding.	
			Assessment of adequacy Moderate concerns because only five studies contributing to this finding.	
			Assessment of relevance Very minor concerns, as this finding covered different settings and different ethnic groups.	

	Family and social support	High confidence	**Assessment of methodological limitation** Minor concerns because most of the studies were unclear regarding relationship between researchers and participants.	[330, 332, 346-348, 366]
			Assessment of coherence No/very minor concerns, as the studies had clear underlying data supporting the finding.	
			Assessment of adequacy Minor concerns because six studies contributing to this finding.	
			Assessment of relevance Minor concerns, as four out of six studies contributing to this finding conducted in one high income country.	
	Religious beliefs and practices	High confidence	**Assessment of methodological limitation** Minor concerns because most of the studies were unclear regarding relationship between researchers and participants, and one study was unclear regarding ethical considerations.	[331, 332, 345, 347, 348, 350, 361, 362]
			Assessment of coherence	

			No/very minor concerns, as the studies had clear underlying data supporting the finding.	
			Assessment of adequacy Minor concerns regarding adequacy because there were 8 studies out of 21 supporting the finding.	
			Assessment of relevance Very minor concerns, as this finding covered different settings and different ethnic groups.	
Finding 2: *Communication*	Language barrier	Moderate confidence	**Assessment of methodological limitation** Minor concerns because most of the studies were unclear regarding relationship between researchers and participants.	[330, 331]
			Assessment of coherence No/very minor concerns, as the studies had clear underlying data supporting the finding.	
			Assessment of adequacy	

			Moderate concerns because only two studies contributing to this finding.	
			Assessment of relevance Very minor concerns, as this finding covered different settings and different ethnic groups.	
	Building relationships	Moderate confidence	**Assessment of methodological limitation** Minor concerns because most of the studies were unclear regarding relationship between researchers and participants.	[330, 331, 346]
			Assessment of coherence No/very minor concerns, as the studies had clear underlying data supporting the finding.	
			Assessment of adequacy Moderate concerns because only three studies contributing to this finding.	
			Assessment of relevance	

			Minor concerns, as two out of three studies contributing to this finding conducted in one high income country.	
Finding 3: *Managing diabetes during visiting home countries*		High confidence	**Assessment of methodological limitation** Minor concerns because most of the studies were unclear regarding relationship between researchers and participants, and one study had unclear statement of data collection.	[331, 346, 348, 359, 361]
			Assessment of coherence No/very minor concerns, as the studies had clear underlying data supporting the finding.	
			Assessment of adequacy Minor concerns because five studies contributing to this finding.	
			Assessment of relevance Very minor concerns, as this finding covered different settings and different ethnic groups.	

3.4 Discussion

This is the first meta-ethnography systematic review to explore the barriers to and facilitators of adherence to antidiabetic medications in people from ethnic minority communities, living in high-income countries. Following a comprehensive search that identified 13,958 potential studies, 21 articles were included in this review and synthesised using a meta-ethnographic approach.[342] The main themes included: 1) cultural underpinnings, 2) communication, and 3) managing diabetes during visiting home countries. Two subthemes under the synthesised overarching theme, cultural underpinnings, were identified to be both barriers and facilitators of adherence to antidiabetic medication, encompassing perspectives of prescribed medicine and preferences for alternatives and religious beliefs and practices.

The cultural underpinnings of the preference for traditional medicine among people from ethnic minority communities were considered mainly to be a barrier of adherence to antidiabetic medications. This review indicated that negative beliefs and fears about the adverse effects of antidiabetic medication result in a preference for using alternative treatments. These findings are consistent with the broader literature considering the cultural misconceptions of Western medicine in people from South Asian and Black ethnic groups.[337, 367, 368] However, in this review the perception of people from South Asian ethnic minority groups about the higher quality and effectiveness of prescribed medicines in the UK compared to those available in their home countries was demonstrated as contributing to adherence toward antidiabetic medications. Therefore, developing educational programmes tailored to ethnic minority communities might be worthwhile to correct the negative beliefs about their antidiabetic medication and alternative medicine.

The social stigma related to diabetes in people from ethnic minority communities was also considered to be a significant barrier to adherence to antidiabetic medication. Stigma affected adherence in these groups if their diabetes was disclosed to their communities or even to their families, resulting in missing doses or in difficulty taking medications during social gatherings. This theme is supported by the findings of a qualitative review that explored beliefs about medicines in people of South Asian origin with diabetes and cardiovascular diseases, which concluded that the cultural stigma associated with diabetes presented a barrier of adherence to medication.[369] Social stigma has been linked to misconceptions, lack of awareness, and

local health beliefs about diabetes in some ethnic groups.[348, 370, 371] Increasing the awareness and management of diabetes among people from minority ethnic communities could reduce the fear of stigma and improve medication adherence.

This review identified that social and family support play a crucial role in enhancing adherence to antidiabetic medication among people from minority ethnic groups. Social networks of South Asian and Black ethnic groups support increasing self-management knowledge of diabetes through social groups and faith-based organisations. Moreover, family members supporting people from South Asian ethnic minority communities played a significant role in enabling medication adherence. The positive association between medication adherence and social support was also reported in a meta-analysis examining the impact of patients' social support for adherence to medications in people with hypertension.[372] Faith-based organisations can be helpful support systems for the dissemination of information related to diabetes and its management for ethnic minority groups.

One interesting finding of this review is that religious beliefs played a vital role in helping people from ethnic minority communities to adhere to their antidiabetic medication. These beliefs contributed to emotional support for taking medication in people from South Asian minority communities and helped people from Black minority communities in their decisions to use medication to manage their diabetes. This finding is supported by the results of a previous review, which suggested that patients' religious beliefs did help with type 2 diabetes management among people from the Caribbean region.[373] However, religion-related practices, such as fasting, were identified in this review as a barrier to antidiabetic medication adherence, mainly among people from South Asian and Turkish minority groups. Members of these groups often modified their doses or stopped taking antidiabetic medications altogether influenced by the beliefs transmitted within their communities that fasting and eating 'light food' eliminates the need for medication.

Language barriers were identified by this review to impede effective communication and relationships between healthcare providers and people with diabetes from ethnic minority groups. Lack of language concordance results in difficulty understanding the provided information and having questions about diabetes management potentially unanswered as well as reluctance to seek more information. These finding are supported by a recent systematic review of 14 studies conducted across different countries, which found that language barriers

led to miscommunication between healthcare professionals and patients.[374] Another study, conducted in the US, examined the influence of language concordance between patients and physicians on medication adherence, and revealed that language concordance was significantly associated with medication adherence.[375] Limited consultation time with medical professionals also hindered adherence to antidiabetic medication among people from minority ethnic groups. This finding was also reported by Jin *et al*., who found that patient motivation for adherence to therapy is compromised by limited time spent with healthcare professionals.[376]

People from minority ethnic communities indicated in this review that they have difficulty adhering to antidiabetic medication in their home countries. This is mainly attributed to casual beliefs that a hot climate and low stress they find at home results in their diabetes being well controlled without the need for medication.[346, 361] Additionally, the lack of availability of facilities to store insulin in the native countries of people from South Asian and African Caribbean minorities was reported as a challenge.[346, 348] Given the negative beliefs about diabetes management among people from minority ethnic communities during their holidays, a pretravel tailored education programme could improve patients' adherence to antidiabetic medications and, accordingly, their health outcomes.

Considering these findings, it is unclear whether the reported findings about the barriers and facilitators of adherence to antidiabetic medication in people from minority groups are due to being from a minority ethnic group or to socioeconomic deprivation. Since there is evidence that people from socioeconomically deprived areas reported lower adherence to antidiabetic medication,[216] people from majority populations from these areas could also exhibit some of these findings. Consequently, there is a need for future research to explore the barriers and facilitators of adherence in people from both minority and majority populations within contexts of similar socioeconomic status. By doing so, researchers can better identify and understand ethnicity-related factors influencing medication adherence, ensuring that interventions are effectively tailored to each group's unique needs.

3.4.1 Strengths

This review has several strengths. Firstly, it is the first meta-ethnography systematic review to provide a comprehensive qualitative synthesis of the barriers to, and facilitators of, adherence

to antidiabetic medications in people from ethnic minority communities in high-income countries. Another strength of this review is that the systematic search was not limited by language or date, and complementary searches, such as backward and forward citation searching and grey literature searches, were undertaken to ensure a robust literature search (Table 7, 8, and 9).

3.4.2 Limitations

Despite the strengths, some limitations should be acknowledged. One limitation is that few qualitative studies explored the perspectives of healthcare professionals on the barriers and facilitators of supporting adherence to antidiabetic medications amongst minority ethnic communities. Future studies are needed to explore the barriers and facilitators of adherence to antidiabetic medication in minority ethnic groups from the healthcare professionals' perspectives. Another limitation is that since this meta-ethnography focused primarily on minority ethnic groups living in high-income countries, and more than half of the included studies were conducted in the UK and the United States, our findings may not be generalisable to minority ethnic communities living in other high-income countries due to variations in healthcare systems. The findings of the review may not necessarily apply to different types of diabetes and second/third-generation migrants, as most included studies focused on people with type 2 diabetes and migrants or refugees. Notably, few studies clearly differentiated whether participants were first-generation immigrants or later-generation migrants. Consequently, it remains unclear whether the observed barriers and facilitators of medication adherence can be generalised to second/third generation migrants, a limitation that should be addressed in future research. The last limitation for this review is that all ethnic minority groups have been considered as one group, overlooking the potential variations and complexities among different groups. In future studies, it would be valuable to investigate the barriers to and facilitators of adherence to antidiabetic medications in each ethnic group to gain a deeper understanding of the diverse experiences within these communities.

3.4.3 Implications of findings for practice, policy and future research

The review findings on the barriers and facilitators of adherence to antidiabetic medication among people from minority ethnic communities in high-income countries have significant implications for clinical practice and public policy. Healthcare professionals should recognise

the impact of cultural-related factors on medication adherence among minority ethnic communities. By providing culturally sensitive care, healthcare professionals can build trust and rapport with patients, resulting in improved patient-provider communication and greater adherence to antidiabetic medication. Understanding the barriers and facilitators of medication adherence can also lead to developing patient-centred approaches, tailoring medication adherence interventions based on individual needs, preferences and cultural backgrounds. It is also important for healthcare professionals to receive communication training, especially in cross-cultural situations, to improve patient-provider interactions and medication adherence. It is important for future polices in this area to recommend the development of culturally and socially relevant interventions, tailored to the needs of minority ethnic communities, to improve adherence rates and diabetes outcomes. Addressing medication adherence disparities contributes to health equity promotion, necessitating public health policies prioritising culturally competent interventions. Further research is also essential to understand the cultural underpinnings influencing medication adherence within different minority ethnic communities. Qualitative research helps to understand the experiences and perspectives of individuals from minority ethnic communities regarding medication adherence. This research may lead to developing targeted interventions tailored to these populations based on their cultural context. Moreover, intervention studies can help in developing these interventions and examine their effectiveness in improving adherence among people from minority ethnic communities.

3.5 Conclusion

This meta-ethnographic systematic review is one of the first to explore barriers to and facilitators of adherence to antidiabetic medication in people from ethnic minority communities in high-income countries. Several barriers and facilitators have been identified among people from ethnic minority communities. The findings of this meta-ethnographic synthesis provide an explanation of why people from ethnic minority communities reported a lower adherence rate to antidiabetic medications compared to the majority population. Tailored medication adherence interventions to overcome these barriers are vital for improving the diabetes care of people from these groups.

3.6 Summary of Chapter 3

The work in this chapter employed a systematic methodology to synthesise existing primary qualitative data using a meta-ethnography approach. By applying this systematic and interpretive approach, the researcher contributed new insights to the limited literature available. This inductive and interpretive method facilitated the translation of existing research papers, allowing for the integration of themes and metaphors across studies. The themes developed identified multiple barriers to and facilitators of adherence to antidiabetic medication among people from minority ethnic communities in high-income countries. Furthermore, the findings from this review also revealed a gap in the literature concerning ethnicity-related factors from the perspectives of both minority ethnic communities and the majority population within the context of socioeconomic deprivation. It is logical to explore this further to gain an in-depth understanding of how ethnicity influences adherence to antidiabetic medication from the perspectives of both groups.

The following chapters of this thesis (Chapters 4 and 5) aim to introduce research that centres around the perspectives of people with type 2 diabetes from both minority ethnic groups and the majority. More specifically, it focuses on exploring the views and experiences of these populations within the context of socioeconomic deprivation, with the goal of gaining a deeper understanding of how ethnicity influences adherence to antidiabetic medication. This work will examine minority ethnic groups and the majority from two different settings: the UK and Saudi Arabia. The upcoming empirical studies will focus on four groups in these settings: people of South Asian origin as minority ethnic groups in both locations, people of White British ethnicity as the majority in the UK, and people of Saudi Arabian origin as the majority in Saudi Arabia.

The decision to focus on these groups in two settings, within the context of socioeconomic deprivation, was made for several reasons: firstly, conducting empirical work in two different settings helps to gain insights from the perspectives of people within varying healthcare systems and cultural contexts; secondly, focusing on people of South Asian ethnic backgrounds as a minority group is due to the higher prevalence of diabetes and its related complications among this group;[23, 377] thirdly, studying groups in the context of socioeconomic deprivation is critical, as this represents a gap in the literature and adherence rates are low among these groups;[317] finally, by studying the barriers and facilitators of adherence among

both ethnic minorities and majorities, this can help in the identification of ethnicity-related factors influencing adherence.

The next chapter will describe the study design, methodology, and findings of a qualitative study exploring barriers and facilitators of antidiabetic medication adherence among 40 White British and South Asian participants from socioeconomically deprived communities.

Chapter 4. A qualitative study exploring the barriers and facilitators of adherence to antidiabetic medication among people of South Asian and White British origin from socioeconomically deprived communities

4.1 Introduction

The previous chapters outlining the literature review and the two systematic reviews have shown significant disparities in adherence to antidiabetic medication between different ethnic groups, with these variations being primarily observed between minority ethnic groups and majority populations. After considering the key findings of these studies, it becomes evident that these differences in adherence to antidiabetic medication are influenced by both socioeconomic factors and ethnicity, rather than ethnicity alone. Consequently, it is necessary to study two groups from similar socioeconomic backgrounds, one from minority ethnic communities and one from the majority, to explore their experiences and identify any differences, which may then be areas for further investigation. This approach allows identifying ethnicity-related factors and better understanding their influence on medication adherence. Therefore, the researcher conducted a qualitative study to understand how ethnicity influences adherence to antidiabetic medications by exploring the barriers and facilitators of adherence to antidiabetic medication among people of White British and South Asian origin from socioeconomically deprived communities. This chapter describes the research methods and findings of a qualitative research study conducted in the UK. The chapter will start by outlining the rationale, research question, aim, and objectives of the study, followed by details of the methodological approach used, and conclude with the study findings and discussions. The methodology and methods discussed in this chapter will be applied and adapted to the study based in Saudi Arabia (Chapter 5), except for ethical approval, data collection and eligibility criteria, which will be described in Chapter 5.

4.2 Overarching research question

How does ethnicity influence adherence to antidiabetic medication among people from minority and majority ethnic groups in socioeconomically deprived communities?

4.3 Aim and objectives

4.3.1 Aim

This study seeks to understand how ethnicity influences adherence to antidiabetic medications by identifying barriers to and facilitators of adherence in socioeconomically deprived communities of South Asian and White British ethnicity.

4.3.2 Objectives

1. To explore the views and perspectives of White British and South Asian people from socioeconomically deprived communities regarding the barriers to and facilitators of adherence to antidiabetic medications.
2. To make recommendations based on the identified barriers of adherence to antidiabetic medications about developing patient-centred medication adherence interventions to support minority ethnic groups.

4.3.3 Research questions

The key research questions of this study concerned:

What are the barriers to and facilitators of adherence to antidiabetic medication among people of White British and South Asian origin from socioeconomically deprived communities?

Specifically:

- How does ethnicity influence medicines adherence amongst socioeconomically deprived patients who take medications for type 2 diabetes?
- What aspects of care could be improved to positively influence medicines adherence in these groups?

4.4 Methodological approach

To effectively explore how ethnicity affects adherence to antidiabetic medication, a qualitative methodology was chosen to address the aims and objectives of this research project. Using a qualitative methodology enabled a detailed exploration of participants' experiences, attitudes, and opinions regarding the barriers to and facilitators of medication adherence.[378] The richness and depth of data that qualitative research can collect helps to inform an understanding of the influence of ethnicity on medication adherence. The researcher believed this approach would best address the 'what' and 'how' research questions. This qualitative methodological approach was chosen over a quantitative one. While quantitative research might have helped to measure outcomes from a hypothesis, it would not have provided the deeper insights and understanding sought into participants' perspectives on the barriers to and facilitators of adherence to antidiabetic medications.[379] An interpretivist approach was adopted by the researcher, which assumes that reality is constructed through social

interactions and experiences. This perspective acknowledges that meanings and understandings can be influenced and shaped by historical experiences.[380, 381] As a result, data were collected using semi-structured interviews to capture participants' subjective perspectives, and analysis was carried out inductively, allowing themes and meanings to emerge directly from the data rather than being shaped by preexisting theories. This approach enabled the researcher to gain a deeper, contextually ground understanding of participants' lived experiences.[382]

4.5 Qualitative methods for data collection

The researcher evaluated various qualitative methods, including surveys and questionnaires, focus groups, and observations, to determine which approach would best address the research objectives and align with the paradigms outlined above.[383] Surveys and questionnaires that include text-based responses can provide some useful information about participants' experience and perception regarding barriers and facilitators of adherence to antidiabetic medication. However, these methods do not necessarily provide the opportunity to inquire further based on participant responses.[384] Additionally, potential limitations of this method include a low response rate, non-response bias among sampled participants, and language barriers, which, given that the study involves participants from minority ethnic communities, could lead to misunderstandings of the questions, inaccurate responses, or even discourage participation, thereby affecting the reliability and validity of the collected data. [384-386] In addition, since the study aimed to explore participants' perspectives regarding the barriers to and facilitators of adherence to antidiabetic medication, performing observations would not be especially relevant or useful.[387] Moreover, focus groups could produce detailed narratives,[384, 385, 388] but given the sensitive and confidential nature of the research topic, participants may be reluctant to openly share their emotions, feelings, and experiences with others.[384, 385, 389] Therefore, the researcher selected semi-structured interviews in this qualitative study for data collection because they provided flexibility and the opportunity for rich narrative development.[384, 385] This method, along with its advantages and disadvantages compared to alternative options, is described in further detail below.

4.5.1 Semi-structured interviews

Semi-structured interviews were chosen for this research over structured or unstructured interviews due to their flexibility.[384] This method is typically based on a flexible topic guide that provides structure to the conversation, while the use of open questions allows respondents to fully express their opinions and focus on the aspect that is important to them.[390] The flexible design of semi-structured interviews allows for in-depth exploration of topics without constraints we see with questionnaires or surveys.[378] The ability to adapt questions based on participant responses was deemed critical, particularly given the diversity of participants in this study, including those from minority ethnic groups who may have different native languages or varying levels of English fluency. The diversity of their experiences increases the likelihood that there will be significant differences in experiences that will require clarification or rephrasing to ensure mutual understanding. A structured interview would limit the interviewer's ability to establish rapport, which is critical in the context of this study involving participants from minority ethnic communities, because it would not accommodate the diverse ways people use language (e.g., dialects, colloquialisms, and indirect communication) or nonverbal cues, potentially leading to insufficient responses. Conducting unstructured interviews would not provide the essential focus for addressing the specific research questions. Furthermore, they are usually lengthy, making them impractical given the time constraints of participants.[391] Therefore, the semi structured interview approach was deemed most appropriate for this study , as it balances the flexibility needed to explore participants' unique experiences, allowing for deeper engagement by adjusting language, clarifying questions, and responding empathically to cultural cues, while ensuring that all relevant topics are covered.[392]

An interview schedule was developed and used for all semi-structured interviews conducted as part of the two qualitative studies in this project. The schedule outlined the topics to be discussed during the interview, as well as potential example questions to be asked or modified. It also acted as a plan for the interview, giving the researcher a logical sequence and flow to ensure all key areas were addressed. The researcher carefully developed this interview schedule based on pilot interviews conducted with three participants from each ethnic group and by considering the key findings identified in the introductory work, particularly the meta-ethnography (Chapter 3). After piloting in the UK and Saudi Arabia, some modifications were

made to enhance clarity and cultural sensitivity. For example, in the UK, terminology was simplified to improve understanding, while in Saudi Arabia certain questions were rephrased and reordered to better align with local cultural norms. Despite these site-specific adjustments, the overall structure of the interview schedule remained consistent to ensure data comparability. The interview schedule covered topics that focused on the study participants' experiences with taking antidiabetic medication, with the main emphasis on the barriers to and facilitators of adherence to their antidiabetic medications (Appendix 6).

4.6 Ethical approval

The study was conducted according to the ethical principles that have their origin in the Declaration of Helsinki,[393] the principles of Good Clinical Practice,[394] and the Department of Health Research Governance Framework for Health and Social Care 2018.[395] This study received favourable NHS ethics approval on 10/10/2022, (IRAS Project ID: 318913, reference: 22/NE/0206, see Appendix 7).

4.7 Eligibility criteria

The selection criteria for this study have been carefully designed to align with the research aim of exploring the barriers to and facilitators of adherence to antidiabetic medication among people of South Asian and White British origins from socioeconomically deprived communities. Firstly, the inclusion criteria necessitated participants to have type 2 diabetes and an active prescription for at least one antidiabetic medication (see Appendix 8). This requirement ensured the study focused on individuals actively managing the condition. Secondly, participants were required to live in the 20% most deprived areas of North-East England, as the study aims to explore the influence of ethnicity on adherence to antidiabetic medication within the context of socioeconomic deprivation. To ensure this, potential participants were asked to provide their residential postcode during recruitment. This information was then cross-checked against the 2019 Index of Multiple Deprivation (IMD) ,[396] a comprehensive measure used in the UK. The IMD assesses various factors, such as income, employment, health, education, housing, and crime, to rank areas based on deprivation levels.[397] This index provides a detailed understanding of the socioeconomic challenges faced by communities, making it a suitable tool for identifying the most deprived areas in the North-East of England for this study.

Thirdly, participants were required to be of South Asian and White British ethnic backgrounds, allowing the study to explore perspectives from both minority and majority populations. 'South Asian' usually refers to people from the Indian subcontinent. The South Asian ethnic group was chosen as the minority group because they have been shown to have higher rates of diabetes complications, lower medication adherence, and poor outcomes.[41, 62, 63, 337, 398] In the UK, South Asian minority groups include Indians, Pakistanis, Bangladeshis, as well as people from Sri Lanka, Nepal, Bhutan, and the Maldives.[399] Additionally, English proficiency was not required for people of South Asian ethnicity, and participants could use their preferred language, with translators provided for South Asian languages if needed. Finally, participants were required to be adults over 18 and to have had the capacity to consent to taking part in the study; ensuring participants had the capacity to consent protected their rights and upheld ethical standards. These criteria were summarised in Table 16.

Table 16: Summary of participant inclusion criteria

Inclusion criteria
1. Participants must have type 2 diabetes and an active prescription for at least one antidiabetic medication.
2. Participants must be living in the 20% most deprived areas of North-East England.
3. Participants must be of South Asian or White British ethnic backgrounds.
4. Participants must be adults over 18 years old.
5. Participants must have the capacity to consent to taking part in the study.

4.8 Recruitment of participants

Participant recruitment was conducted by the researcher. Each participant received a recruitment pack, which included a Participant Information Sheet (Appendix 9) and a consent form (Appendix 10). Each participant had the opportunity to ask questions about the study. If they agreed to participate, they were asked to sign the consent form. Participants were informed that participation was entirely voluntary and that they could withdraw at any time. Participants were recruited from ten community pharmacies in the North East of England, common city organisations, community support groups, and social media platforms as described below.

4.8.1 Community pharmacies

Initial participant screening and selection were carried out by the community pharmacy team. Potential participants were identified by the pharmacy team based on prescribed antidiabetic medication and postcodes of residence, in accordance with a list of postcodes/areas of potential participants pre-provided by the researcher to the pharmacy team. Once participants were identified, the community pharmacists provided them with a Participant Information Sheet (Appendix 9). The role of the community pharmacy team was to provide details about the study to potential participants; they did not have to consent to participate at this stage. If potential participants were interested in participating or wanted more information about the research from the research team, they could consent to pass their contact details to the researcher. Once the potential participant consented for their details to be passed on, the researcher could answer any questions or concerns they had about the research. If the potential participant was interested in taking part, arrangements convenient for them were made to complete the consent process and interview. The consent process was fully informed.

4.8.2 Social media platforms

The study poster was posted on social media platforms (Appendix 11). The poster included information about the study, potential participants' eligibility criteria (including the postcodes of deprived areas from which participants were being recruited), and the researchers' contact information. If someone was interested in further information about the study or in participating, a Participant Information Sheet (Appendix 9) was emailed to them. If they consented to participate, the researcher contacted them to organise consent and schedule the interview.

4.8.3 Common city organisations, community support groups, and leaders

To further publicise this study, established partners in common city organisations, community support groups, and community leaders were engaged. Through these organisations and groups, posters highlighting the potential participants' eligibility criteria, including the postcodes of deprived areas from which participants were being recruited, were circulated along with the researcher's contact details for those interested in participating or needing more information about the study. If someone was interested in further information about the study or in participating, a Participant Information Sheet (Appendix 9) was emailed to them. If

they were interested in participating, the researcher contacted them to organise consent and schedule the interview.

4.9 Sampling

A range of sampling techniques were considered to ensure alignment with the type of study and the research question. In line with common practices in qualitative research, a purposive sampling approach was employed for this programme of work.[400] Approximately 85 individuals initially expressed interest in participating. Each potential participant was assessed for eligibility based on predefined criteria, including duration since diabetes diagnosis, gender, age, and specifically for the South Asian group, included various subgroups such as Indian, Pakistani, and Bangladeshi. Only those who met these criteria were selected for the final sample, ensuring that the sample accurately reflects diverse and representative sample of participants from the studied ethnic groups was included.

4.10 Conducting the interview

Participants were interviewed either face-to-face in their homes, at the university, in their community pharmacy, by telephone, or through call-based software at a convenient time and date. The duration of the interviews was generally 30–60 minutes; however, this depended on each participant and the details they provided when answering questions or elaborating on topics. Participants took part in one interview. All interviews were conducted by a single researcher (RA), audio-recorded, transcribed verbatim, and analysed.

4.11 Qualitative methods for data analysis

The researcher conducted a reflexive thematic analysis(rTA) for the two qualitative studies in this programme of work separately analysing the South Asian minority and majority groups within the UK and Saudi Arabian settings to capture themes unique to each ethnic group. According to Braun and Clarke, thematic analysis encompasses various approaches that aim to identify patterns in data.[401] Rather than being a single approach of analysing data, reflexive thematic analysis refers to a group of approaches for the purpose of capturing and identifying patterns.[401] Reflexive thematic analysis is an appropriate analytical approach for addressing the aims, objectives, and research questions of this study since it is particularly suitable for addressing broad or narrow research questions about experiences, views, and perceptions. In

comparison with other approaches to thematic analysis, rTA is distinguished by its process of theme development and data coding. This approach identifies patterns within and across datasets through the rigorous steps of data familiarisation, coding, theme generation and development, and continual review.[401] The analytical approach is interpretative, inductive, and continuously reflexive.[401, 402] rTA acknowledges researcher subjectivity, emphasising the importance of reflexivity in analysis.[401, 402] This method also allows for a comprehensive and in-depth understanding of the data, which makes it ideal for exploring the complex and multifaceted nature of participants' perspectives, views, and experiences.[401, 402] By adopting the interpretative and reflective nature of rTA, the researcher can facilitate a comprehensive and insightful analysis that aligns with the study's aim. The rTA analysis process involves six phases for data familiarisation, coding, and theme development – these are described in the following sections[402]

4.11.1 Step 1: Familiarisation with the data

Familiarisation with data was facilitated by transcription; all interviews were transcribed by the researcher in this work programme. Along with the process of transcription, the researcher read and re-read the transcripts continuously to support in gaining familiarity with the data namely, the key perspectives and opinions shared by participants.

4.11.2 Step 2: Data coding

After the researcher became familiar with the data, the transcripts were printed on A4 paper and annotated by hand; these annotations were used to identify the initial descriptive ideas and codes. While these were not the final codes, this step allowed the researcher to identify the key ideas before stepping back to identify the overarching findings. Before conducting the following interview, the researcher worked through each transcript individually, iteratively and inductively. Once the descriptive codes were developed, the researcher was able to construct underlying descriptions that were more profoundly connected to the transcripts.

4.11.3 Step 3: Generation of the initial themes

In this phase, the researcher engaged in an iterative and reflective process to develop initial themes from the coded data. This involved thoroughly examining the descriptive codes and collated data to identify significant patterns of meaning that aligned with the research

question. By continuously reviewing and refining these patterns, the researcher constructed overarching themes that captured the participants' complex and multifaceted perspectives. Throughout this process, the research question was carefully considered, guiding the development of themes in alignment with the study aim. As theme development occurred concurrently with data review, the researcher maintained a flexible approach, allowing for the continuous development and refinement of themes to ensure a comprehensive and insightful analysis. Finally, the list of main and sub-themes was assembled and systematically applied to the entire dataset.

4.11.4 Step 4: Reviewing and developing themes

During this phase, the preliminary themes identified in Step 3 are reviewed, modified, and developed. To unpick and understand the nuances within the perspectives shown, the researcher compiled and reviewed the data relevant to each theme. After identifying the main themes, the researcher discussed them with the supervisory team and further refined them. The researcher focused on whether each theme's data related meaningfully to one another by thoroughly exploring the connections in the data and explaining why those connections existed. To enhance understanding and clarity, these connections were illustrated on a series of maps. The researcher then started developing explanations for the recurring patterns and associations found in the data. Throughout the data analysis process, NVivo 14 software was used for data management.

4.11.5 Step 5 and 6: defining and naming the themes and writing the analysis report

The final refinement of each theme was carried out in this phase, which involved the detailed analysis of each theme. The researcher read all the data within each theme more than once and identified the essence of each theme and its relationship to the other themes. After that, each theme was defined and named based on the narrative that was present within the data. Finally, the write-up of the generated themes is presented and includes a narrative analysis with embedded data extracts.

4.12 Reflexivity

The concept of reflexivity involves recognising the potential influence of a researcher and the research process itself on the data collected.[403] Reflexivity considers how the researcher's

previous experiences might influence their interpretation of the data.[401] The researcher had considerable experience working as a hospital pharmacist and had also conducted several literature reviews as part of this programme of work exploring how ethnicity is associated with medication adherence. As a result of this, the researcher was able to construct an understanding and meaning from the data that potentially differed from the understanding and meaning constructed by a non-clinical researcher. It is important, however, that the researcher be aware of their role in the co-construction of knowledge. Therefore, the researcher maintained a research journal while collecting and analysing data, recording personal reflections and noting any biases or preconceptions she may have had to ensure these factors were considered during data analysis and interpretation. Regular journaling enabled the researcher to critically examine her initial assumptions, document emerging themes, and revisit interpretations iteratively. By systematically noting her reflections, queries, and decisions made throughout the research process, the journal actively informed and shaped the analysis, ensuring a continuous and transparent consideration of personal influences on data interpretation.

4.13 Results

This section outlines the demographic characteristics of participants from South Asian and White British backgrounds, followed by an in-depth analysis of the main themes identified through data analysis for each group individually.

4.13.1 Participant characteristics (South Asian group)

Twenty participants from the South Asian ethnic group were recruited through community pharmacies (n=12) and social media (n=8) and interviewed between December 2022 and May 2023; each interview lasted between 17 and 46 minutes, with an average duration of 32 minutes. Of these, seven participants were Nepalese (35%), six were Bangladeshi (30%), four were Indian (20%), and three were Pakistani (15%). The average age of participants was 47 years (SD: 9.28), and twelve of the 20 participants (60%) were male. The time since diabetes diagnosis varied from one year to 35 years, and six participants reported as having comorbid conditions alongside their diabetes. Most of the participants (60%) were on a combination of oral antidiabetic medication and insulin. Participants were predominantly married, with the majority having completed secondary school as their highest level of education. Among the 20

participants, religious backgrounds varied with 12 identifying as Muslim, six as Christian, and two as Buddhist. Ten of the interviews with participants were conducted in person, while the remainder were conducted online, according to the participants' preferences. Of the in-person interviews, four took place at the participants' homes, and six were conducted in a community pharmacy consultation room. There were no refusals to participate, no dropouts, and no interviews that needed to be repeated. The characteristics of each of the participants are described in Table 17.

Table 17: Participant characteristics (South Asian group)

Participant number	Sex	Age (years)	Marital status	Ethnic origin	Religion	Time since diagnosis (Years)	Treatment regimen	Presence of multiple long-term conditions (Yes/No)
1	Female	26	Married	Bangladeshi	Muslim	1	Oral antidiabetic medication	Yes
2	Male	43	Married	Bangladeshi	Muslim	2	Oral antidiabetic medication and insulin	No
3	Female	54	Married	Pakistani	Muslim	4	Oral antidiabetic medication	Yes
4	Female	66	Married	Pakistani	Muslim	35	Oral antidiabetic medication and insulin	Yes
5	Male	65	Married	Pakistani	Muslim	17	Oral antidiabetic medication and insulin	Yes
6	Male	38	Single	Indian	Buddhism	3	Oral antidiabetic medication	No
7	Male	36	Married	Nepalese	Christian	2	Oral antidiabetic medication	Yes
8	Male	56	Married	Bangladeshi	Muslim	20	Oral antidiabetic medication	Yes
9	Female	44	Married	Nepalese	Christian	1	Oral antidiabetic medication and insulin	No
10	Male	43	Married	Indian	Muslim	4	Oral antidiabetic medication	No
11	Male	59	Married	Bangladeshi	Buddhism	3	Oral antidiabetic medication and insulin	No
12	Male	47	Married	Nepalese	Muslim	4	Oral antidiabetic medication and insulin	No
13	Male	43	Married	Bangladeshi	Muslim	3	Oral antidiabetic medication and insulin	No

14	Male	55	Married	Nepalese	Christian	3	Oral antidiabetic medication and insulin	No
15	Female	41	Divorced	Bangladeshi	Muslim	5	Oral antidiabetic medication and insulin	No
16	Male	43	Married	Nepalese	Christian	3	Oral antidiabetic medication and insulin	No
17	Male	38	Single	Bangladeshi	Muslim	3	Oral antidiabetic medication	No
18	Female	48	Married	Indian	Christian	5	Oral antidiabetic medication and insulin	No
19	Female	50	Married	Nepalese	Christian	2	Oral antidiabetic medication and insulin	No
20	Male	40	Single	Indian	Muslim	5	Oral antidiabetic medication	No

4.13.2 Participant characteristics (White British group)

Twenty participants from the White British group were recruited through community pharmacies (n=15) and social media (n=5) and interviewed between December 2022 and May 2023. Each interview lasted between 22 and 44 minutes, with an average duration of 31 minutes. The average age of participants was 51 years (SD: 7.71), and twelve of the 20 participants (60%) were male. The time since diabetes diagnosis varied from one year to 14 years, and six participants reported having comorbid conditions alongside their diabetes. Most of the participants (55%) were on oral antidiabetic medication. Participants were predominantly married, with the majority having completed secondary school as their highest level of education. Among the 20 participants, 19 identified as Christian, while one reported having no religious affiliation. Eight of the interviews were conducted in person at the participants' community pharmacy consultation room, while the remainder were conducted online according to the participants' preferences. There were no refusals to participate, no dropouts, and no interviews that needed to be repeated. The characteristics of each participant are described in Table 18.

Table 18: Participant characteristics (White British group)

Participant number	Sex	Age (years)	Marital status	Religion	Time since diagnosis (Years)	Treatment regimen	Presence of multiple long-term conditions (Yes/No)
1	Male	58	Married	Christian	5	Oral antidiabetic medication and insulin	No
2	Female	76	Married	Christian	3	Insulin	No
3	Male	53	Single	No religion	5	Oral antidiabetic medication	Yes
4	Female	48	Married	Christian	3	Oral antidiabetic medication	No
5	Female	37	Single	Christian	6	Oral antidiabetic medication	No
6	Female	51	Married	Christian	5	Oral antidiabetic medication and insulin	No
7	Male	42	Married	Christian	1	Oral antidiabetic medication	No
8	Female	48	Married	Christian	5	Oral antidiabetic medication	No
9	Male	50	Married	Christian	5	Insulin	Yes
10	Male	49	Married	Christian	3	Oral antidiabetic medication	No
11	Male	47	Married	Christian	2	Oral antidiabetic medication	No
12	Male	50	Divorced	Christian	5	Oral antidiabetic medication and insulin	No
13	Male	45	Married	Christian	2	Oral antidiabetic medication and insulin	No

14	Male	49	Divorced	Christian	5	Oral antidiabetic medication and insulin	No
15	Male	53	Divorced	Christian	2	Oral antidiabetic medication and insulin	No
16	Female	60	Married	Christian	2	Oral antidiabetic medication and insulin	No
17	Male	60	Married	Christian	14	Oral antidiabetic medication	Yes
18	Female	56	Divorced	Christian	14	Oral antidiabetic medication	Yes
19	Female	55	Married	Christian	7	Oral antidiabetic medication	Yes
20	Female	56	Married	Christian	2	Oral antidiabetic medication	Yes

4.13.3 Development of the themes (South Asian group)

Five overarching themes were developed from the data to highlight the perceived barriers and facilitators affecting adherence to antidiabetic medication among people of South Asian ethnic background. These themes centred around (1) challenges relating to the individual; (2) perceptions related to medications; (3) perceptions relating to condition; (4) beliefs and social influences; (5) influences relating to healthcare systems (as demonstrated in Figure 5). Each theme and subtheme are discussed in turn, using pseudonymised verbatim interview quotes to reflect participants' perspectives. Non-identifiable pseudonyms, such as Participant 1, Participant 2, and so forth, are used throughout following each quote.

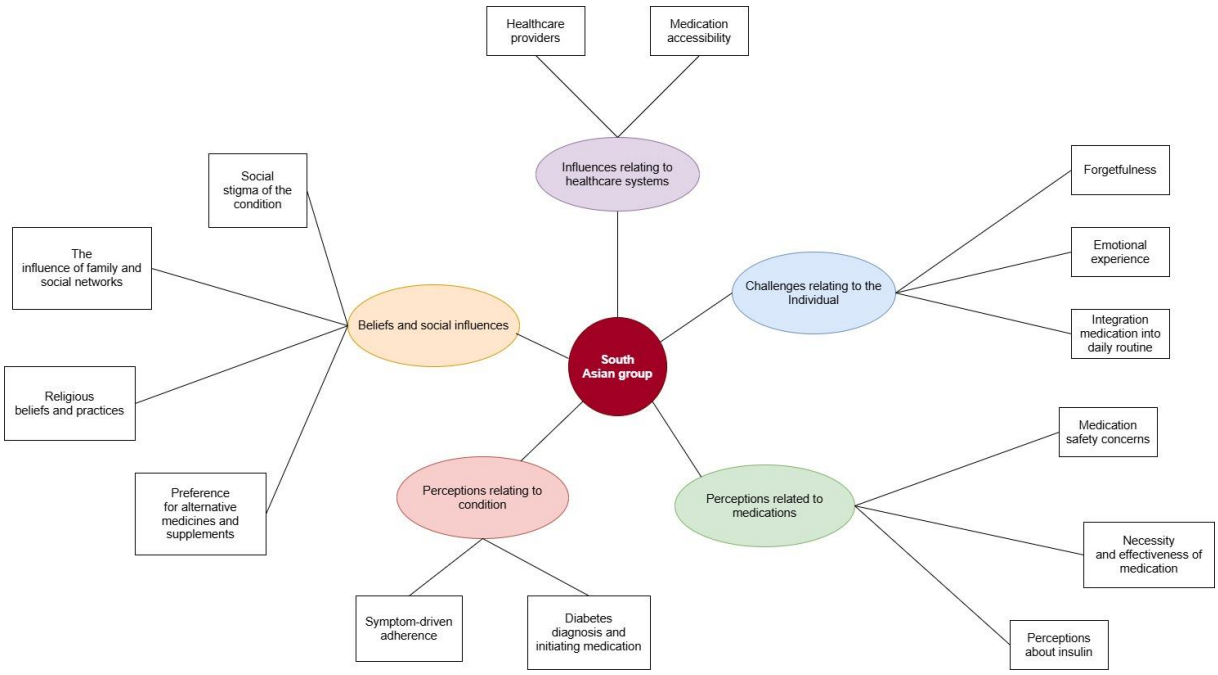

Figure 5: Developed themes and subthemes around the barriers and facilitators of adherence to antidiabetic medications among people of South Asian origin in socioeconomically deprived communities in the UK

Theme 1: Challenges relating to the Individual

1) Forgetfulness

Forgetfulness was reported mainly as a barrier to adherence to antidiabetic medication. Many participants highlighted their difficulties in consistently remembering to take their medication. For instance, one participant stated, *"I'm very forgetful, that's what makes it very difficult"* (Participant 1, Bangladeshi female), and another added, *"…at some moments I actually skip it, maybe it actually slips my memory"* (Participant 17, Bangladeshi male). There were a variety of situations shared among the participants that contributed to their forgetfulness, including busy schedules, tiredness, and disruptions to their routine. Three interviewees shared that their busy schedules frequently led them to forget to take their medication. One participant stated, *"Sometimes you just forget to take the medication because maybe busy schedule, you know, trying to make up with work and stuff like that"* (Participant 10, Indian male). Additionally, another participant mentioned, *"…I forget taking the medication maybe because of a busy day or maybe because I'm just tired and, you know, just eventually I forget to take it, maybe my wife can't even remind me of taking it"* (Participant 8, Bangladeshi male). The other two participants acknowledged routine disruptions, such as missing a meal, falling asleep, and feeling tired, as the main reasons for forgetting to take their medication, as one explained:

"…the only thing that can make it difficult is if I kind of miss a meal or don't eat, or maybe I forget and sleep off due to tiredness and stuff like that, so I might miss my dosage"
(Participant 19, Nepalese female).

2) Emotional experience

Emotional responses to medication taking were demonstrated to be both barriers to and facilitators of adherence to antidiabetic medication. Several participants expressed emotional challenges associated with sticking to medication and managing their diabetes as well, which can hinder adherence. They discussed their discomfort with the daily routine of taking medication and found it to be stressful and intrusive for them. One participant, for instance, stated, *"I'm not happy, it's not pleasing at all, this is not who I am, you know, it's never comfortable having to take medication, whatever you are doing, you have an alarm, you having to remind you of there is a medication somewhere you need to take"* (Participant 10, Nepalese female), and another participant added, *"…you know, actually being consistent with*

your diabetes medication can be a kind of stressful thing and challenging thing to do" (Participant 6, Indian male). These negative feelings during the time of recent diagnosis were described by one participant who was stressed by having to take medication every day, which made her feel *"I'm sick and tired of it, and I don't want to take them, I don't want to live this life that is stuck to me"* (Participant 18, Indian female). Additionally, another participant described feeling uncomfortable, particularly when away from home because of the ongoing necessity to carry medication and how it has become a part of her everyday life:

"…when I'm leaving my house and I know I'm gonna spend a lot of time out of my home, I go with my medication, I just find sometimes for me uncomfortable because it has been part of me so I cannot do without it" (Participant 15, Bangladeshi female).

There was also an emotional strain associated with diabetes management, particularly when additional long-term illnesses were present. For instance, one participant expressed feeling overwhelmed and worthless while treating diabetes and other long-term diseases, complaining about having to rely on *"bags upon bags of drugs to live on"* (Participant 4, Pakistani female). Furthermore, another participant expressed a negative perception, which was exacerbated by the need to follow a strict diet and use medication:

"I sometimes have negative thoughts about myself, and these thoughts psychologically affect me particularly knowing that I have to stick to a diet and medication" (Participant 20, Indian male).

On the other hand, two participants described finding self-motivation and resilience as facilitators of adhering to their medication. They stressed the importance of setting personal goals and keeping self-motivated, without being negatively influenced by others, to facilitate adherence to medications. One of them noted, *"I don't allow anybody to say, you know, you don't feel well, don't have to take it. You have to have it inside yourself that I need to take it and it make me feel better"* (Participant 3, Pakistani female), and another participant echoed, *"…setting maybe goals for yourself like motivating yourself and staying focused on treatment, I think things like that actually gives you self-motivation to keep on taking your medication"* (Participant 6, Indian male).

3) Integration medication into daily routine

Integrating medication into a daily routine appeared to be a crucial facilitator of adherence to antidiabetic medication. Some participants emphasised the importance of maintaining a routine in facilitating medication adherence and described how they keep this routine by linking medication time with spiritual practice time or keeping their medication in a particular place and integrating it into their mealtimes. One participant stated, *"…it's like prayer, I have set time with the morning prayer, the evening prayer to take it"* (Participant 3, Pakistani female), and another mentioned, *"I have my box beside me, then as I'm eating, I'll put the medication there and I'll take it through the meal"* (Participant 5, Pakistani male). Additionally, using technological aids such as mobile phone reminders or visual pictures in the usual place was described by some participants to promote this routine. One participant explained, *"I have schedule on my phone that I actually set a reminder to help me when the time is getting ready for me to take my medication"* (Participant 10, Nepalese female), while another shared:

> *"What I did was paste that drawing in my kitchen, at the same spot where the kitchen cabinet is, where I keep my provisions and other stuff. So, each time I go to the kitchen, to probably make breakfast, and I see it, there's no possible way that I'll forget, this reminds me, I have to take my medication"* (Participant 19, Nepalese female).

However, work may disrupt the daily routine and negatively influence adherence to antidiabetic medication for some participants. They described situations that make it difficult for them to take their medication during their working time, such as work schedules interfering with their ability to take medication, forgetting to bring their medication to the workplace, or difficulty taking the medication in a public workplace. One participant stated, *"I have to work the evening shift at the restaurant as a chef, from four in the afternoon until late at night. This schedule makes it difficult for me to take my medication on time"* (Participant 8, Bangladeshi male), and another shared, *"When I have an evening service, and this also affects me not being very regular on my medication especially if that's in a public space"* (Participant 14, Nepalese male).

Theme 2: Perceptions related to medications

1) Medication safety concerns

Concerns about the safety of antidiabetic medication were perceived to be mainly barrier of adherence. Some interviewees reported experiencing adverse effects such as stomach pain, diarrhoea, weight gain, and headaches, making them reluctant or unwilling to continue taking their medications. One participant shared, *"There are several situations that actually stop me from taking my medication. I will start by saying side effects, these diabetes medications have some side effects, and you come to realise you end up having some kind of stomach pain, sometimes you may have diarrhoea, as well headache. So, when I remember the past experiences that I have due to the side effects of it, it's always made me feel reluctant to take it"* (Participant 6, Indian male), and other participant stated, *"…after having the stomach upset and diarrhoea, I somehow feel I wouldn't wanna experience it, I wouldn't want this"* (Participant 9, Nepalese female).

After experiencing adverse effects, participants may take different actions to avoid this experience. Two participants mentioned that they continued their medication after receiving support about how to manage it or counselling from their healthcare providers. For example, one participant explained, *"…I've been experiencing things like that, but I, I explain it to my, um, physician, and he actually helped me in terms of trying to manage the side effects and then I continue to take it"* (Participant 10, Indian male). Conversely, other interviewees decided to stop or reduce medication dosage on their own to avoid the adverse effects, as one participant shared:

"…I took one that actually made me to start gaining weight, because of that, I felt like instead of me to, you know, cause some extra damage to my health I stopped taking it for a while" (Participant 6, Indian male).

Moreover, concerns about long-term medication use are also discussed by some participants, which can negatively influence adherence. Two of them expressed their concern about the cumulative effect and toxicity of medication use over a long period of time on the body's organs, especially the kidneys and liver. One participant stated, *"…I've been taking it for about four years. So, I don't know what long-term problems it will cause me because it's a lot to do with your inside as well, kidneys, liver, stuff like that…"* (Participant 3, Pakistani female), and

another participant mentioned, *"I'm afraid of being addicted to these drugs, and one day can't do without these drugs. So, for that, I tried to take it like four times a week"* (Participant 15, Bangladeshi female).

2) Necessity and effectiveness of medication

Some participants regarded their antidiabetic medication as necessary, which can be critical in promoting medication adherence. These participants held strong necessity beliefs, as they expressed, *"…medication is very essential, I can't miss the medication"* (Participant 3, Pakastani female), and *"I actually wanted to always take my medication to stay healthy"* (Participant 13, Bangladeshi male). In addition to being deemed necessary, medications were also viewed as effective. For instance, an interviewee recognised the effectiveness of the medication in managing symptoms and improving their health:

> *"…you come to realize that this stuff is actually managing your blood sugar level, and you are trying to live a normal life because of this medication"* (Participant 6, Indian male).

Furthermore, observable improvements in their condition motivated continued medication use, as a few participants were encouraged after realising that the medication was effective in reducing their blood sugar levels and helping them to lose weight. One participant shared, *"since I've started taking metformin, even though in the beginning I wasn't happy, everything is changed, like my health, like, I used to be like really big, really big, and now that I'm finally getting the medication I need, I'm so much more healthier, I work a lot more, I feel so much more healthier, I feel better, I feel like now that I'm finally getting the medication that I need for my body, it's finally working out"* (Participant 1, Bangladeshi female), and another participant echoed , *"Once I look at my physical body, my health status, um, as I'm losing weight, so this really keeps me, um, motivated that I need to take my medication"* (Participant 13, Bangladeshi male).

3) Perceptions about insulin

Negative perceptions about insulin were reported by three participants to be both a barrier and a facilitator to adherence to antidiabetic medication. In one aspect, two participants who were on oral antidiabetic medication expressed significant reluctance to progress to insulin due to several perceived drawbacks. These participants believe that once insulin treatment is

initiated, it becomes a permanent, irreversible part of diabetes management and is also viewed as a last resort and as a sign of disease progression, as one participant shared, *"there's a lot of people say once you're on insulin, you are on it for life. So that's sort of like the very end consequence. I don't really want to get to that"* (Participant 2, Bangladeshi male), and another echoed, *"I would rather to take this medication for a life and it wouldn't progress to insulin because that would make life a bit more difficult"* (Participant 3, Pakistani female).

Additionally, the practical challenges and inconveniences associated with insulin use, especially during travel, such as the need for special requirements to carry and store the insulin, were highlighted by one participant as a barrier to progressing to insulin therapy. This participant explained, *"You would always need to have a cool bag to take the insulin along with you. Let's say we go make many, holidays in Pakistan. So, the refrigeration is a problem there because we have power cuts"* (Participant 3, Pakistani female). Consequently, the participants' desire to avoid the need for insulin can motivate them to adhere to their oral antidiabetic medications, while simultaneously acting as barriers in the case of transitioning to insulin. On the other hand, one participant on insulin expressed great dissatisfaction with insulin injections and its burden, highlighting a desire to discontinue it. She further emphasised the emotional relief she would feel if she could eliminate the need for insulin. This participant stated, *"…if there is something that I could come off my injections this will help"*, and added, *"…if I can get rid of my injections, I would love to"* (Participant 4, Pakistani female).

Theme 3: Perceptions relating to condition

1) Diabetes diagnosis and initiating medication

The initial emotional responses to a diabetes diagnosis and the initiation of antidiabetic medication were discussed by participants as barriers to adherence. Many of them experienced considerable distress and denial following their initial diagnosis, as one participant shared, *"I think when I first got diagnosed with diabetes, I was very upset. I was crying, and I said no, like, I think I was in denial, and I didn't start my medication straight away"* (Participant 1, Bangladeshi female). Additionally, another interviewee perceived herself as an isolated case within her family and faced an additional emotional barrier: *"I really felt down, I'm the only person in the family who has diabetes, none of my other siblings have it or anything, none of my close relatives or anything, they don't have it. It's just me"* (Participant 3,

Pakistani female). These negative emotions caused them to delay the initiation of their medication.

Moreover, once participants started their medication, they experienced physical difficulties that hindered adherence. These difficulties, including adverse effects such as nausea, made it hard to adhere to the medication. For instance, one participant stated, *"…It was very difficult at the beginning, you feel really, it, it does make you feel unwell, you feel nauseous"* (Participant 20, Indian male). However, participants reported that adherence to antidiabetic medication improved over time with acceptance of the condition and adaptation to using medication long-term. Two participants described how their turning point from denial to acceptance of their condition enabled them to initiate medication, as one expressed *"…after I accepted it, I started taking it"* (Participant 1, Bangladeshi female).

Furthermore, participants felt more motivated to adhere to their medications once they understood they could live a normal and satisfying life with diabetes. One participant noted:

"I come to understand that there were people that actually live with diabetes and they're still living a normal life. They're still living good life. So, I wasn't very worried because I come to understand that if I follow proper precautions, I will also be able to live good life just as for the people who are out there living with diabetes" (Participant 10, Indian male).

Some participants also reported that their bodies gradually adapted to the medication after initial difficulties, making it easier to continue taking it, as one participant stated, *"…at some point, I think my system adapted to it, and I got very fine and okay with it"* (Participant 20, Indian male).

2) Symptom-driven adherence

Adherence to antidiabetic medication varied according to participants' experiences with either symptom improvement or severity as consequences of non-adherence, which were considered as barriers and facilitators of adherence, consecutively. Some participants mentioned that they sometimes skip their medication when symptoms temporarily improve, believing their condition is under control, which in turn leads to inconsistent medication use, as one participant explained, *"The situation that makes me skip my medication is if I have a little relief. I try to skip it"* (Participant 11, Bangladeshi male). Furthermore, after seeing

improvements in their blood sugar levels, some participants feel reluctant to continue with their medication. For example, one participant stated:

"After I do my blood test and I discover that my blood sugar level has reduced, I feel a reluctance to continue with the dose" (Participant 19, Nepalese female).

However, the recurrence of symptoms and the immediate discomfort associated with nonadherence served as motivators for some participants to resume their medication after a period of nonadherence. Two participants emphasised the need for medication after experiencing the return of symptoms like fatigue and frequent urination when they skip some medication doses:

"When I develop symptoms and challenges, when I feel discomfort, I remember that I have medications to fall back to" (Participant 20, Indian male), and *"…at times when I stay away from my medications, then I discovered that my blood sugar levels spiked up, and I was really scared. So, I saw my doctor, who advised me not to do such again. So, I listened, and ever since then, I've always been taking my medication as recommended"* (Participant 19, Nepalese female).

Theme 4: Beliefs and social influences

1) Preference for alternative medicines and supplements

Alternative medicine preferences were reported by nearly half of the participants, which in turn worked as a barrier to adherence to antidiabetic medication. Five interviewees preferred alternative medicine, including black seeds, Noni, bitter melon, vinegar leaves, and other herbs, based on their belief in their effectiveness. For instance, one participant stated, *"…I bought the tablets, the black seed tablets and I've taken that. I started about five, six weeks ago and it seems like helping in reducing my blood sugar"* (Participant 5, Pakistani male). Herbal medicine was used by two participants as a means of rapid relief, since they felt that prescribed antidiabetic medications did not provide them with the quick relief they sought, as one participant explained:

"At first to me I could not see effectiveness of the medication and I was needed [sic]*a very fast reduction in the blood sugar. So, I actually had to take herbal medication, which was being*

mixed from leaves and maybe squeeze out the water, and I was drinking that to help…" (Participant 13, Bangladeshi male).

Social networks also influenced the decision to use herbal medicines over prescribed antidiabetic medication. One participant mentioned that her friend recommended some herbs they had previously tried and found to be effective:

"When I had the diabetes earlier, there was one friend of mine who introduced me to, um, some herbal, like, um, some native, like some native medications to take, she said she had been taking them…" (Participant 18, Indian female).

Additionally, one participant described a situation where she relied on herbal medicine when she ran out of her antidiabetic medication as an alternative:

"The time when I have nobody around to actually go get me the medication. I just need to or try to use some nutritional medication rather than the main medication…..These are things like vinegar leaves, stuff that is actually what I was advised to use it, so that I would maybe take some, maybe have some herb that will, will actually help me in the reduction of the diabetes" (Participant 11, Bangladeshi male).

In a similar manner, some participants expressed a preference for natural supplements and diet over prescription medications, indicating distrust in prescribed medications. They describe using supplements including vitamins and managing their diet by avoiding carbohydrates and focusing on whole grains and vegetables:

"I do not really like taking synthetic drugs and I love living on taking mainly my supplements like some vitamins…" (Participant 20, Indian male).

2) Religious beliefs and practices

Participants' religious beliefs and practices have both positive and negative effects on their adherence to antidiabetic medications. For some Muslim participants, religious practices such as fasting interfere with adherence to antidiabetic medication since long fasting hours lead to delaying or reducing the doses of medication taken during the fasting period. One participant shared, *"I reduce the dose during the fasting period because it lasts a long period during the day. So, my dose is not going to be complete as it used to be"* (Participant 20, Indian male). Additionally, for these participants, adherence was also influenced by concerns about

medication Halal status (permissible under Islamic dietary law). One participant, for instance, mentioned:

"There were some tablets that were not halal and that you have to physically go to ask them if they halal. Fortunately, the ones I was taking were okay, but then some people with the statins as well, they said don't take statins because they aren't halal" (Participant 3, Pakastani female).

However, another participant was encouraged to keep taking his medication, especially when the religious leader (Imam) confirmed that the medication was halal:

"I haven't stopped taking anything or tried alternative after Imam, the Islamic teacher, he said that medication is halal" (Participant 8, Bangladeshi male).

Interestingly, a participant of Nepalese ethnicity discussed the negative influence of his Nepalese friends, who did not believe in Christianity and followed animistic traditions, advising him to sacrifice to spirits to cure his diabetes, as he shared:

"*I have got some negative aspects from Nepalese friends, my friends do not believe in Christianity, so they actually advise me to seek some traditional remedy for my illness, these people are an animistic people that they are building this thing can be cured by making some sacrifices to spirit… there was a time I didn't want to take medication because of what I had heard from my friend"* (Participant 7, Nepalese male).

Religious beliefs also play a role in participants' health practices. One participant expressed the belief that black seeds were effective in treating various diseases because the Prophet Muhammad endorsed their health benefits. As a consequence of this strong belief in the efficacy of black seeds, the participant sometimes prioritises their use over his prescribed medications:

"I tried sometime black seeds I heard it is mentioned by our Prophet Muhammad black seeds is good for our health. Our Prophet told us black seeds is good for all kind of problems, only, only not for death and the rest is help our body" (Participant 5, Bangladeshi male).

On the other hand, religious beliefs provided substantial support, which contributed to adherence to antidiabetic medication. Some participants reported that their faith provided them support and encouragement. In addition, their religious obligation to care for their

health drove them to take their medication. Furthermore, faith also gives a sense of hope and psychological comfort, which all indirectly influenced adherence positively. For example, one participant stated, *"I believe God wants us to help ourselves. If there's anything to help me, I will take it"* (Participant 4, Pakistani female), and another expressed:

"*I also get support from the Almighty God, because he's the one who gives life and he's also the one who takes it. So, I feel supported by him, giving me life. So, I also find that as the greatest support ever"* (Participant 19, Nepalese female).

Religious leaders and communities also offered emotional support and guidance that aligned religious beliefs with medical advice, ensuring people that taking prescribed medicine was consistent with their religion. One interviewee, for instance, mentioned the topic of health discussions following religious events, emphasising the importance of maintaining good health and strength while also highlighting that religious beliefs should not hinder one's ability to live a healthy life:

"We have a lot of health talks after religious gatherings, we talk about health and how you need to stay strong. We emphasize not letting your religious sentiments prevent us from having a healthy life" (Participant 20, Indian male).

3) The influence of family and social networks

Family and social networks appeared to be crucial factors influencing adherence to antidiabetic medication, mainly in a positive way. Many of the participants frequently emphasised the positive effect that family members and friends have on reminding and encouraging them to take their medications on a regular basis. For instance, one participant mentioned how her parents and close friends frequently checked up on her and inquired if she took her medication consistently:

"…if I do see my mum, if I do see my dad, they are always asking me if I'm taking my medication, always asking me if my health is okay" (Participant 1, Bangladeshi female).

Moreover, the support from family members who also have diabetes provided some participants with more emotional support and shaped their attitudes toward medication. One participant shared that both her mother and other family members have diabetes, which created a sense of shared experience and understanding. As a result of this family connection,

the participant's mother frequently calls to check on her health, highlighting the need to take medications regularly:

"…my mum has also diabetes. So, most of the time my mum calls to know how I'm doing and how I'm faring with my condition" (Participant 15, Bangladeshi female).

Having family members, especially parents, who successfully manage diabetes with medication can serve as a source of inspiration and motivation. According to a participant who observed that her parents effectively managed their diabetes through medication, this encouraged her to adopt the same approach:

"I've got diabetes, and I can't do this; I can't do that and look to my parents. They're very inspirational to me because they've had diabetes and managed it with medication" (Participant 3, Pakistani female).

A few participants also indicated that the love for their family and the desire to witness their future, alongside a sense of responsibility to stay healthy and care for their loved ones, kept them motivated to adhere to their medication:

"When I think about my family, um, I love my family so much, I want to live, to see what they will becoming[sic] *in life. So that is a great motivation for me to fight diabetes and take medication"* (Participant 7, Nepalese male).

Adherence can be positively impacted by social networks in the workplace or religious communities outside of the immediate family. For instance, one participant mentioned how a colleague at work regularly reminded them to take their medication, which was especially helpful during busy workdays:

"I have a colleague at work. We do not work every day together, but each time we actually work together, he reminds me that I need to take my drug. And at some point, he encouraged me to be practical about that. So, I put my drug in my bag, and I go with it to work every day" (Participant 17, Bangladeshi male).

Similarly, one participant noted that a friend from his religious community has been supportive and encouraging, helping him adhere to medication:

"My friends from the Muslim community had been actually doing very well, supporting me and encouraging me to keep take my medication" (Participant 20, Indian male).

However, the impact of family and social networks was not always positive. Family responsibilities due to cultural expectations created additional challenges, according to one participant, as she discussed how difficult it was to balance her own health needs with responsibilities for her husband, which sometimes led to forgetfulness in taking her medication:

"I'm just going about my day and I'm also taking care of my husband, that's the reason why that I sometimes forget because of course l like I have responsibilities. I want to make sure I'm okay and like that, but I also have to take care of my husband" (Participant 1, Bangladeshi female).

Additionally, another participant mentioned difficulties due to the lack of family support because of changing his religious beliefs. As his family believed that this religious change caused the participant's diabetes, they did not encourage him to take his medication:

"My family have actually discouraged me in terms of see it to be because of my change in religious belief that made me to actually have diabetes. So, they have actually not been able to encourage me in terms of taking my medication" (Participant 13, Bangladeshi male).

4) Social stigma of the condition

The social stigma associated with diabetes was reported to affect adherence to antidiabetic medications negatively. One participant mentioned that in her community, people tend to avoid discussing their experiences with diabetes and their medications due to stigma, like the taboo surrounding mental health issues, especially among the Muslim community, as she stated:

"I find it very difficult sometimes because there's not many Asians want to talk about it. it's like the same stigma when you have if say you've got depression, people don't want to talk about that. It's like a taboo subject, meaning we are lacking in some way, it does in Muslims anyway" (Participant 3, Pakistani female).

Moreover, three participants reported that they avoided taking their medication in front of others or in public settings to prevent revealing their medical condition, fearing it could lead to stigmatisation or judgment from others. One participant explained:

"I think when I was single, I used to have some forms of stigma, stigmatisation of taking that medication because I actually didn't want people to know I'm a diabetic patient. I didn't want to feel actually more embarrassed. So, I think during that time I had some level of stigma because people around I don't want to take my medication in front of people" (Participant 10, Indian male).

This reluctance affected the use of antidiabetic medication in public, leading them to skip or delay some doses, especially if their medication time coincided with being in a public place. As one participant noted:

"Sometimes I skip the medication maybe due to activity or my current location because I don't, um, love to really express myself for people to see me taking medication" (Participant 14, Nepalese male).

However, the availability of a private space can help reduce concerns and enhance adherence. One participant described how marriage gave him a sense of understanding and privacy, and how not living in a shared housing arrangement helped reduce the stigma associated with taking medication.:

"...after marriage it's your home, so you are with a person that can understand you, but when you are not married, so many people don't know about your life, so maybe you are not in a comfortable place. I was not in a comfortable place, I was living with people, so it was not comfortable for me. So that was the stigmatization I was feeling because I know definitely people start making me feel ashamed or embarrassed" (Participant 10, Indian male).

Others mentioned that leaving work early or having access to private spaces at work made it easier to take their medication:

"Situations that really helped me, it's early closure from work and maybe having enough time from work or any public space, this really helps me more to follow my medications" (Participant 14, Nepalese male).

Theme 5: Healthcare system related factors

1) Healthcare providers

Healthcare providers, especially in terms of communication and support provided, were identified as both barriers and facilitators to medication adherence. Effective communication and support from healthcare providers can greatly facilitate adherence. One participant expressed appreciation for healthcare providers who listened actively, understood their concerns, and provided comprehensive information and assistance. In addition, she emphasised the significance of healthcare providers offering thorough support and encouragement to ensure patients adhere to their medication, especially in cases when adverse effects arise, as she explained:

"…my healthcare provider should give a listening to me and understand what my problems are, how I'm feeling, not just assuming my symptoms, get detail the information from me and also come to understand when I complain about side effects and to give me proper maybe orientation or something that give me motivations to keep on taking my medication" (Participant 3, Pakistani female).

Similarly, other interviewees shared their personal experiences, expressing that regular follow-up and advice from their healthcare provider serve as reassuring reminders that diabetes is not a death sentence, and one can live normally by taking medication; this encouragement keeps them motivated to adhere to medication. For instance, another participant shared:

"I get a lot of advice and support from my healthcare providers. They try to tell me that diabetes is not just a disease; it's not a death sentence, it's not a termination of life, and all of that. You just need to live your normal life and just be on medication" (Participant 20, Indian male).

However, language barriers can negatively affect communication between patients and healthcare providers, as one participant noted:

"Sometimes as people can't speak the language, I'm very lucky I am able to, cos we are born here and be able to speak the language. A lot of people come and can't speak the language, so that makes them not want to go to the doctors" (Participant 3, Pakistani female).

Additionally, the limited time allocated for appointments also meant that patients' concerns about medications were not always addressed, and limited information was shared regarding treatment benefits. As one participant mentioned:

"I've asked the doctors, but you can appreciate they've got a little bit of time for each appointment, they can't really go through a lot of things" (Participant 3, Pakistani female).

2) Medication accessibility

Although diabetes is one of the medical exemptions eligible for free NHS prescriptions, five participants reported that the medication cost was one of the barriers to adherence to antidiabetic medication. Two of these participants described the difficulties of balancing daily expenses with the cost of their medication, as they often had to allocate their money to other essential living needs. This financial strain led to delays or avoidance in purchasing their antidiabetic medication, skipping some doses, and relying on regular diet plans and other management forms, as one participant explained:

"*Financial barrier is a problem, it's not all the time I don't have the money for medication, even though sometimes I do have the money, it may be for another kind of budget and I do not want to cut out on my plans, initial plans because of medications, So, I tend to avoid medical treatment, maybe cope with my regular diet plans and all the forms of management I have got instead of spending the money for medical treatment"* (Participant 7, Nepalese male).

When asked if they were aware of their eligibility for an exemption from prescription charges under the diabetes medical exemption, three participants were unaware. One participant revealed that she was initially unaware of the free medication available and experienced significant financial difficulties, going months without her medication due to a lack of funds. She eventually learned about the exemption and accessed it with guidance from her doctor and a diabetes organisation. Reflecting on this experience, she stated:

"When it started earlier, like when my doctor prescribed medication to me, it was quite expensive. I couldn't afford that. I wouldn't be able to keep buying this constantly. It's actually reducing my money. I can't be spending this much. So, due to those difficulties, I stayed for some months without taking that medication. I didn't buy it because I never had enough

funds to get it. But then, I never needed to buy it, there was medication given for free" (Participant 18, Indian female).

Another participant acknowledged being aware of the free availability of diabetes medications, but highlighted challenges in accessing them. She commented on the complicated registration process required to become eligible for free medication, stating:

"…not everywhere, you have to get some kind of complicated registration before you actually, to be eligible for it" (Participant 10, Indian male).

Additionally, geographical barriers were noted as a factor influencing adherence to medication. One participant discussed the challenge of the distance to the nearest pharmacy and the need to travel far to obtain medications, which often led to delays in getting medications and missing some doses, as he shared:

"*Another difficulty I used to encounter is access to medication where I live is far away from the pharmacy, so I normally have to travel for some distance before go get the medicines, so sometimes I missed some medication doses cos I cannot just immediately walk to the pharmacy and get medication"* (Participant 7, Nepalese male).

4.13.4 Development of themes (White British group)

Five overarching themes were developed from the data to highlight the perceived barriers and facilitators affecting adherence to antidiabetic medication among people of White British ethnic background. These themes centred around (1) challenges relating to the individual; (2) perceptions related to medications; (3) perceptions relating to condition; (4) beliefs and social influences; (5) influences relating to healthcare systems (as demonstrated in Figure 6). Each theme and subtheme are discussed in turn, using pseudonymised verbatim interview quotes to reflect participants' perspectives. Non-identifiable pseudonyms, such as Participant 1, Participant 2, and so forth, are used throughout following each quote.

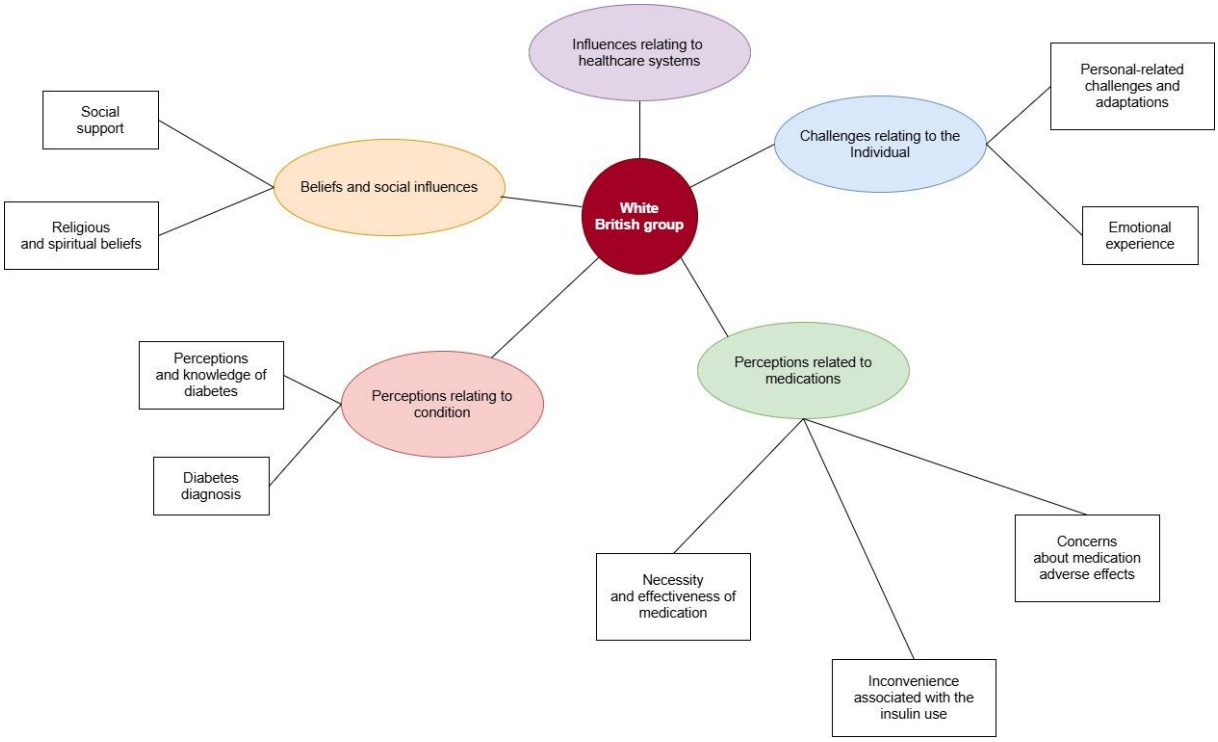

Figure 6: Developed themes and subthemes around the barriers and facilitators of adherence to antidiabetic medications among people of White British origin in socioeconomically deprived communities

Theme 1: Challenges relating to the Individual

1) Personal-related challenges and adaptations

Several personal-related challenges, including forgetfulness, work, and difficulties integrating the medication into daily routines, were identified as barriers to adherence to antidiabetic medication by some participants. One major difficulty was forgetfulness, which participants frequently attributed to the stress associated with busy work schedules and family responsibilities, a new experience of incorporating medication into their daily routines, or the absence of a partner's reminders. As one participant described, *"Sometimes I tend to forget taking my medication because it's not something you were used to"* (Participant 11, male), highlighting the impact of forgetfulness due to altered daily routine on medication adherence.

Additionally, a number of participants identified challenges related to taking medications during typical working hours as a factor influencing their adherence, particularly when multiple doses per day were required, stating, *"The only thing that did hinder me from taking my medications was my work time"* (Participant 7, male) and *"The only difficulty I can say that sometimes I forget cos of stress from the day work"* (Participant 12, male). Knowledge around the safe and appropriate administration of insulin injections at work was considered

important, with one participant describing this to be a significant reason for their non-adherence: *"I didn't even carry it (insulin injections) to the place where I work to give (administer myself) ... because I don't know who is medically inclined to hold the needle* ... so, *I just don't take it at all"* (Participant 14, male). Although this participant mentioned challenges with administering insulin injections at work, these difficulties may more broadly relate to the discomfort of injecting in public or social settings, where concerns about privacy or stigma arise, potentially negatively influencing adherence.

Looking broadly, some participants also described wider-ranging aspects of their lifestyles, which they attributed as influencing factors upon adherence to their antidiabetic medication, such as a lack of motivation or fatigue. One participant expressed, *"It's probably my laziness, actually, there's no other problem with it, anything like that"* (Participant 17, male). Other participants described similar feelings and offered their perceptions, or self-justification, when it came to the consequences of missed doses of antidiabetic medication. One male participant reported *"…a missed dose doesn't actually hurt, so let's just go on"* (Participant 14, male), illustrating that possible misunderstandings around adherence could be further addressed.

Despite these examples, the remaining participants described using various approaches to facilitate adherence to their medication. As one participant described, *"Actually, I set alarms every day, like a daily alarm, so when I do this, I know that each day I've got to take my medication, just like a simple reminder"* (Participant 12, male). Setting a reminder emerged as a common strategy across the interviews, with many participants using mobile phone alarms to help them remember to take their medication. Beyond alarms, participants described integrating visual cues into their living spaces, such as placing posters or placards near frequently visited areas, to remind them to take their medication, as one participant illustrated:

"Initially, I thought of creating a reminder, like a placard, actually, it was my little daughter who designed it for me. She made a placard and on it was written, 'dad, take your medications.' I placed this placard near the table in my room where I usually sit to read. So, every time I sat there, it reminded me to take my medication" (Participant 15, male).

Recognising non-adherence because of lifestyle and personal influences, participants described the importance of establishing set routines to ensure consistency with medicines-taking. One participant expressed:

"I'm in sort of a routine now. I was in a routine right from the very beginning. I take one tablet in the morning, and I take the other tablet on the right time before I'm just going to bed" (Participant 19, female).

Similarly, other participants also noted that, over time, habit formation made taking medication an automatic part of their daily routine. As one participant noted:

"I think because I've taken it for so long now, it just happens automatically, I've taken it for so long now it's just automatic" (Participant 18, female).

2) Emotional experience

Emotional responses toward medication taking were found among many participants to act as barriers and facilitators to adherence to antidiabetic medication. Participants exhibited a range of emotions, encompassing feelings of disappointment and fatigue as well as moments of motivation. Several of the participants reported that they had periods of low mood and a lack of motivation, which frequently resulted in thoughts of resistance towards medication adherence, as one participant expressed:

"I suffer far from a little bit depression at first and there were times when I just fought myself. I didn't want play by the rules, I didn't want indeed, just cos I was feel down in the dumps, you're low and you just sometimes you just think, I don't want to play in the game anymore, I don't want to do it" (Participant 1, male).

Additionally, mood fluctuations were recognised to influence medication adherence, as some participants acknowledged the effect of their emotional state on their motivation to take medications, as one participant explained:

"My mood at a particular time, sometimes I have I don't know if it's called mood swings and sometimes, I'm not happy, sometimes I'm just neutral, I don't want to talk to anybody. I think my mood can influence how I take my medication" (Participant 5, female).

Further, the physical presence of medical devices, such as insulin pumps, served as a continual reminder of the illness, intensifying feelings of restriction and intrusion. For instance, one participant discussed the struggles with the insulin pump:

"Now, having this pump on your body, you become cautious, constantly reminded that it's there. This reminder of your condition can be intrusive, affecting your daily life" (Participant 14, male).

Notwithstanding these difficulties, participants also recognised factors that contribute to their ability to feel motivated to take their medication. One participant expressed that she derived strength from acknowledging the significance of medication for their overall health, as she articulated:

"I really know personally, like, within me, that this is important for my health, considering my current situation. So, I know it is vital and important that I take my medication" (Participant 16, female).

In addition, the possibility of a better quality of life and improved health outcomes were essential motivators for some interviewees to take their antidiabetic medication. One participant emphasised that anticipation of positive changes serves as a driving force, motivating her to commit to her medication routine despite any emotional challenges she may encounter, stating that:

"Knowing that there's a condition that I really need to see through and get a positive reaction from. The outcome, the improvements, there should be a change. So, with that feeling that I actually have to dive in and make it worthwhile" (Participant 19, female).

Likewise, with encountering multiple responsibilities and difficulties in life, some participants showed a prioritising attitude towards adherence to medication. One participant stated that despite *"having a lot on my plate"*, she prioritised adhering to medication instead of allowing these to hinder her medication routine, "*But I don't let it bother me, so I just take them as I'm supposed to"* (Participant 18, female).

Theme 2: Perceptions related to medications

1) Concerns about medication adverse effects

Concerns regarding the safety of antidiabetic medication were seen by some participants to be barriers to adherence, especially at the initiation, although they showed adaptation and acceptance over time. Among participants, one expressed dissatisfaction with the adverse effects associated with metformin, describing it as causing stomach discomfort and stating, *"I'm not so sure how metformin, just seems to make it very windy, gives you awful, tummy ache and make you go toilet a lot"*, and perceived the higher doses of metformin as dangerous, *"I think the very high doses of metformin are very dangerous"* (Participant 1, male). Additionally, the concerns regarding the recurrence of adverse effects over time were discussed by a few participants, with one revealing that he has struggled with adverse effects, despite the initial reassurances he received from his physician, stating:

"I think that the doctor did say I would have side effects, but side effects would have disappeared after maybe a week, two weeks and I just struggled on with it made my life misery because I was ill at work" (Participant 7, male).

However, some participants reported instances of improvement with the transition of metformin formulations based on the recommendation of their healthcare provider and adaptation to medication. For example, one participant described finding relief with a slow-release formulation after experiencing discomfort with metformin, indicating:

"At first when I started taking the medication, the metformin, it was giving me kind of side effects like I was feeling sick and kind of diarrhoea, so I had to contact my GP, I explained that to him, so he said I should go for a slow release of metformin, I got on okay with the slow-release metformin" (Participant 6, female).

Similarly, two participants described the initial difficulties associated with medication adverse effects but also reported their gradual adaptation and acceptance of these effects as part of their diabetes management as one commented *"...it's now just a part of the game"* (Participant 1, male).

2) Necessity and effectiveness of medication

Perceptions of medication necessity and effectiveness influenced adherence to anti-diabetic medications positively according to most participants. They recognised the significance of regularly taking their medication to maintain their health and keep their diabetes controlled. One participant, for instance, highlighted a clear understanding of the need to take medication: *"I know it's something that I need to take for help with my diabetes"* (Participant 19, female). Additionally, the belief in the benefits of the medication enhanced the sense of necessity for the medication, as two participants described, *"I actually think the medication is gonna help me"* (Participant 5, female), and *"...it's the medication that keeps you alive, isn't it? All the medication you take"* (Participant 17, male).

Furthermore, belief in the effectiveness of antidiabetic medication was a significant motivator for adherence. Although a few participants initially questioned the effectiveness of their medication and sought medical advice to do so, as one participant described:

> *"At first, when I started taking the drugs, it looked as if it was not working. So, I had to discuss that with my GP though; he said that to some extent, it looks as though it's not working, but you have to continue taking it, then I continued"* (Participant 6, female).

Many participants mentioned the positive outcomes and improvements in their condition over time with their commitment to taking the medication. One interviewee observed *"Since I started taking my diabetes medication, I've actually seen a lot of improvements"* (Participant 14, male), while another stated, *"It's actually working. Sometimes I was thinking it wasn't going to work, but I've seen it. I'm seeing the progress"* (Participant 8, female).

3) Inconvenience associated with the insulin use

One participant reported several significant challenges preventing consistent use of the insulin pump. Fear and discomfort caused by wearing the pump during sleep resulted in missed doses; as the participant *explained, "I get scared wearing my pump to sleep, so I usually take it off to sleep. I feel pressing it, though I've been advised I can actually sleep with it, but I, I don't know, so I actually take it off to sleep and I miss a couple of doses"*. The participants also faced practical challenges, such as *"I tend to forget to install the pump on time, to refix, reconnect the pump on time, and miss those one or two, and when I do connect it, I connect it out of*

reluctancy". Moreover, the presence of the pump also had negative psychological effects, as the participant described:

"Now, having this pump on your body makes you cautious and constantly reminded that it's there. This reminder of your condition can be intrusive, affecting your daily life. It also has a bit of a negative impact. It can reduce your social lifestyle, knowing that you have something delicate in your body, you always have to be alert and constantly aware of it, it keeps you always very alert" (Participant 14, male).

Theme 3: Perceptions relating to condition

1) Diabetes diagnosis

Some participants shared different emotional responses to their diagnosis, which can negatively influence their medication adherence in an indirect way. The diagnosis of diabetes was met with confusion and disbelief by some participants, with one participant disbelieving the diagnosis because he didn't meet the stereotypical description of an individual diagnosed with diabetes:

"I keep thinking why me because every other person I know who's got diabetes a big, massive fat people and you think, well, but that's why you got diabetes cos you're big, massive, and you're fat, but I do load of exercise, and I'm not fat, I've never drunk, I've never smoked, so I was just bemused how I got it" (Participant 1, male).

Similarly, another participant described his disbelief upon receiving a diagnosis, which led him to question the necessity of medications and stop taking them:

"There was a time, I think that was when I was first diagnosed, I didn't really believe that I had diabetes because I used to think diabetes is like very chronic, so something that can lead to death, but I discovered that as time went by I was still feeling agile, I was still feeling active, my muscle mass didn't reduce at all, I didn't feel any weakness. So, I was like, what is the use of me taking this drug, so I just dropped it there" (Participant 12, male).

Furthermore, lifestyle changes, particularly dietary restrictions after diagnosis, were identified as being difficult to cope with, adding an emotional burden to the diagnosis of diabetes as one participant illustrated:

"When he confirmed that I had diabetes, since then, it's been hell because I've been limited to some kinds of food, drinks, life has just changed from frequent outings and frequent happiness to isolation and all that" (Participant 7, male).

Despite the initial shock to diagnosis, the positive view *"I wouldn't even believe even if I was told, so I am trying my best and I know everything will balance so well, that's because there's no reason to be nervous or negative, I'm okay and I believe all will be well"* (Participant 4, female), and acceptance of illness *"...then, when you think about it, it's got a few harmful things, what can happen at the end and that's it about it"* (Participant 3, male) , can act as way to cope with their condition, facilitating adherence to some extent by establishing a sense of control and optimism.

2) Perceptions and knowledge of diabetes

The awareness of the consequences of uncontrolled diabetes was shared by several participants as a motivator for adherence. Two participants mentioned their fear of serious complications, such as amputations *"...when you hear about people getting their ankles and their feet, and all that, chopped off because of diabetes"* (Participant 17, male), or deterioration of the condition *"If I didn't take it, worse things could happen, so I just take it"* (Participant 3, male), when discussing the situation that facilitates adherence. Furthermore, the desire to avoid progressing their illness and escalating the medication regimen to a more complex regimen and insulin enhanced adherence, as one participant described:

"I'm just hoping that my diabetes doesn't get worse and that I've got go on more tablets, that's why I take me medication every day because I don't want to go on more tablets or end up having injecting myself" (Participant 20, female).

However, a few participants believed the disease might be managed only with lifestyle changes. Two participants, for example, attempted to control diabetes through dietary changes, believing that limiting carbohydrate *"I decided I could just cut down on this, that would be enough"* (Participant 4, female), and calorie intake would eliminate the need for medication *"I stop taking the medication, then I concentrate on limiting my food portion size"* (Participant 8, female). Two other participants were unaware of the long-term nature of diabetes, with one of them describing a time when he believed his diabetes had been cured, resulting in a brief cessation of insulin, which his wife corrected:

"I thought the diabetes might have gone, I kind of shut down in taking the insulin but later on, my wife advised me that it's not proper, that I should keep taking it, and that diabetes don't go like that" (Participant 9, male).

Theme 4: beliefs and social influences

1) Social support

Social support from family members and friends predominantly functioned as facilitators for adherence to antidiabetic medication among nearly all the participants. They frequently emphasised the positive effects of supportive family members who provide emotional and practical support on adherence to their medication. The presence of consistent reminders and support from family members, highlighting the importance of medication for health, was found to motivate individuals to adhere to their medication significantly as one participant mentioned:

"*My wife and daughter are helping me; they are always saying, listen, you have to take it for your health, you've got to do it; you want to be around, like, see your grandchildren grow up"* (Participant 1, male).

The support extended beyond reminders to include emotional encouragement to assist participants in dealing with the daily demands of diabetes management. According to one participant, she was motivated to keep taking her medication because of her husband's encouragement and care for her health:

"My husband is a whole lot of [sic] *at some point, I might just want to give up, or it's enough for the drugs, enough for all of this, but I have him around me. He doesn't want to miss me for anything. So, he does the longest to motivate and encourage me to do what I need for myself. So, I'm encouraged by his words and his attention to my health"* (Participant 4, female).

Likewise, another interviewee shared how her family and friends provided emotional support to help her stay consistent in taking his medication without missing any doses:

"I have emotional support, I have it from family and friends, this helps me to keep going and make me to continue taking my medication without skipping" (Participant 8, female).

Additionally, the practical assistance that family members provide is another vital motivator for adherence. One participant shared that her husband organised her medications in a separate pillbox, which helped her remember to take them as she detailed:

"…my husband uses a separate pill box, and he puts my pills in there. Then I know whether I've taken them or not. So, because when I first started, I forgot to take them as I wasn't really used to it. But now, that's what my husband is doing for me. He's put them in a separate pill box. Then I knew those were the tablets that I had to take during the day. So now, I've never missed one" (Participant 20, female).

Another participant also mentioned how her sister's regular reminders help her avoid missing doses:

"…sometimes I do sleep before it's time for my medication, and it's my sister who helps me just, she just wakes me up to take my medication" (Participant 5, female).

Furthermore, the shared experience of having multiple family members with diabetes created a more supportive environment as one participant described:

"My family is quite supportive. It's like a family, you could probably call it, where four out of five of us have diabetes. I've also got my husband, my brothers, and my sisters to make sure that I'm taking medication. Obviously, they keep an eye on me anyway to make sure I'm alright, not just taking the medication but also eating the right stuff" (Participant 19, female).

2) Religious and spiritual beliefs

Nearly half of the participants perceived religious and spiritual beliefs to provide significant emotional support, which can, in turn, facilitate adherence to antidiabetic medication. For some participants, faith and belief in spiritual healing may offer comfort and influence adherence, as one participant stated, *"…since I'm a Christian, I believe my God will heal me"* (Participant 6, female). In addition, family and church members' prayers further strengthened this belief, creating a supportive network that potentially encouraged adherence as one participant noted:

"…my bishop prays for me, my wife prays for me, my children pray for me, and everyone around me pray for me. So, I think God will hear our prayers to take me off this border" (Participant 9, male).

Moreover, one participant mentioned that belief in spiritual healing didn't interfere with taking medication:

"I'm a Christian, and I naturally pray. It is innate in my inner nature to pray to God and ask for guidance, help, and strength. So, I seek for a spiritual help as a Christian through prayers and worship. On the other hand, we still believe medication heals; we know that God could heal us, but our religious belief doesn't affect us from taking our medication as we should" (Participant 10, male).

Additionally, two participants mentioned that the emotional support they receive from religious leaders is a significant source of motivation as they expressed, *"My bishop in the church, he tries as much to pray for me every day, gives me emotional support"* (Participant 12, male), *"...my pastor at church has been a great support. He prays for me and ensures that I'm okay. My fellow church members also pray for me and check up on me regularly"* (Participant 15, male).

Theme 5: Influences relating to healthcare systems

Some participants identified a number of healthcare-related factors as barriers and facilitators of adherence to antidiabetic medications. Healthcare providers' guidance and advice served as a facilitator. As one participant mentioned:

"I continued taking my medications because my doctor advised me to continue taking them, he explained the medical importance of it to me and I was now enlightened. So, right now I try to make sure that I always take my medications" (Participant 12, male).

Additionally, another participant emphasised the importance of ongoing support from healthcare providers through follow-up appointments:

"I believe having a follow-up would be preferable. I know it really depends on me, but if I could get a follow-up or have to visit the healthcare provider, getting accurate information and paying attention to what I need to do at any point in time could go a long way to help" (Participant 16, female).

However, only one participant mentioned the distance to medical facilities and changing appointment schedules as barriers, noting that he couldn't take insulin injections himself and relied on healthcare providers before using the insulin pump. This participant shared:

"Sometimes, knowing that you have to move a distance just to get a shot and then come back is very discouraging", and "…you make an appointment, and then sometimes you go there, and she's not available, maybe due to an emergency. I wish I wasn't taking this all with due to the whole scene of events. I just said one missed shot won't kill, I can take the next shot" (Participant 14, male).

4.14 Discussion: contextualising the findings into current literature

This qualitative study explored the barriers and facilitators of adherence to antidiabetic medication among people of South Asian and White British ethnic origin both groups from socioeconomically deprived communities. By collecting the perspectives of people from minority ethnic groups and the majority, five key themes for each group were developed related to the factors perceived as barriers or facilitators of adherence to antidiabetic medication. It is crucial to note that the thematic analysis for each group was performed independently using an inductive approach. Therefore, the overlap in themes indicates real similarities in experience instead of reflecting a predetermined framework. These main themes and subthemes developed among both groups were summarised in Table 19. The emerging themes included subthemes considered barriers, facilitators, or both of adherence to antidiabetic medication. The summary of the key findings for both groups will be discussed and compared in relation to existing literature below.

Table 19: Developed themes and subthemes around the barriers and facilitators of adherence to antidiabetic medications among people of South Asian and White British origin in socioeconomically deprived communities in the UK

Group	Developed themes	Subthemes
South Asian group	1. Challenges relating to the Individual	Forgetfulness
		Emotional experience
		Integration medication into daily routine
	2. Perceptions related to medications	Medication safety concerns
		Necessity and effectiveness of medication
		Perceptions about insulin
	3. Perceptions relating to condition	Diabetes diagnosis and initiating medication
		Symptom-driven adherence
	4. Beliefs and social influences	Preference for alternative medicines and supplements
		Religious beliefs and practices
		The influence of family and social networks
		Social stigma of the condition
	5. Influences relating to healthcare systems	Healthcare providers
		Medication accessibility
White British group	1. Challenges relating to the Individual	Personal-related challenges and adaptations
		Emotional experience

	2. Perceptions related to medications	Concerns about medication adverse effects
		Necessity and effectiveness of medication
		Inconvenience associated with the insulin use
	3. Perceptions relating to condition	Diabetes diagnosis
		Perceptions and knowledge of diabetes
	4. Beliefs and social influences	Social support
		Religious and spiritual beliefs
	5. Influences relating to healthcare systems	

4.14.1 Challenges relating to the Individual

Forgetfulness was considered as a barrier to adherence to antidiabetic medications among participants of South Asian and White British ethnic backgrounds. This finding is consistent with previous studies across different long-term conditions among people of South Asian ethnicity,[404, 405] as well as among other ethnic groups.[406-408] Participants from both groups attributed their forgetfulness primarily to disrupting daily routines, tiredness, busy schedules, or newly integrating medication into their routine. The impact of routine disruptions on forgetting to take medication, as highlighted by participants, has been noted in the literature. Studies indicated that changes in routine due to work schedules or other life events can lead to forgetfulness and affect adherence.[199, 408, 409] Further, integrating medication as a part of daily routine can be challenging for some participants and influence adherence. Kvarnström *et al.,* also reported this finding in a scoping review investigating the factors contributing to medication nonadherence in people with long-term conditions. Their review found that people who have difficulty integrating medication into their daily lives may be less likely to take their medication as prescribed.[185] Additionally, participants from both studied groups reported difficulties in adhering to their medication during work due to conflicting work hours with medication schedule, like what was reported in the other studies in the literature.[185, 410] Another work-related barrier was the inability to take medication in the workplace, which a few participants in both groups reported due to different reasons. For the White British group, participants related this to either the lack of availability of a suitable place to store medication or for one participant on insulin an inability to administer it himself, but as a consequence of being at work no one was available to help However, this difficulty in the South Asian group could be explained by perceiving diabetes as a stigmatising condition,[369, 411] which in turn can influence taking medication in public places.

Consistent with previous research that studied the association between medication adherence and diabetes distress,[412] many participants from both groups expressed their negative emotions associated with need for taking of their medication daily and other aspects of diabetes management, such as following a strict diet. This can act as a barrier to medication adherence by reducing motivation for self-care, which often results in poor physical and emotional well-being, suboptimal diabetes management, and lower medication adherence

among people with diabetes.[413-415] This emotional distress was also raised by participants managing diabetes with other long-term conditions. In accordance with this result, previous studies have shown that the psychological distress was significantly associated with comorbidity including diabetes, heart disease, stroke, and cancer.[416, 417] Nevertheless, self-motivation that arose from self-awareness about the importance of medication for diabetes management and achieving better health outcomes was mentioned by some participants, predominately from the White British group, as facilitators of adherence to medication. This finding reflects those of Ainiyah *et al*., who also found a significant relationship between motivation and adherence to medication in people with hypertension, as people with higher motivation had about five times higher odds of adhering to their hypertension medications.[418] Furthermore, a practical approach was taken to enhance adherence among participants from both groups. This entailed the use of reminder tools, such as alarms and visual aids, and the practical incorporation of medication into daily routines. These findings are consistent with previous research that has demonstrated the effectiveness of reminders and medication integration into daily routine in improving medication adherence. Previous research has shown that the use of technological reminders can greatly increase adherence. [419, 420] For instance, a study by Vervloet *et al.,* found that electronic reminders can increase adherence by 15% among individuals with long-term conditions, specifically on a short-term basis (less than six months).[419] Phone alarms provide consistent and timely reminders may be contributing to this improvement, as they reduce forgetfulness, a barrier to adherence reported by some participants. Additionally, integrating medication into daily routines might be an effective strategy. This approach can significantly improve medication adherence by linking routine behaviours with medication intake.[420]

4.14.2 Perceptions related to medications

Similar to what is reported by previous studies,[336, 421, 422] some participants from both groups reported concerns about the adverse effects of antidiabetic medication mainly metformin as barriers to adherence. Experiencing adverse effects led some participants from the South Asian group to decrease doses and discontinue their medication. This result was also reported by people of the same ethnic group with rheumatoid arthritis, who encountered the adverse effects of disease-modifying antirheumatic drugs, leading them to discontinue their medication.[423] These findings are also in agreement with those obtained by Rezaei *et al.*

and Habte *et al.* in two different settings, which showed that experiencing adverse effects increased the likelihood of discontinuing medication or decreasing dosages.[422, 424]

Moreover, concerns about medication safety in the South Asian group are not just limited to the adverse effects, but also negative beliefs about medication, including worries about the long-term toxicity of medication on body organs, which can negatively influence adherence. A similar finding has been reported in a systematic meta-synthesis review that explored the beliefs and attitudes towards medication among people of South Asian ethnicity with cardiovascular disease and diabetes. This review recognised beliefs about medication toxicity can hinder adherence to medications.[369] Uniquely, the fear of antidiabetic medication dependency was expressed by just one participant of South Asian ethnic background, resulting in a reduction in the frequency of taking the medication. A similar result was observed in recent qualitative research conducted in Australia to explore medication adherence and factors influencing it among Indian migrants, in which they mentioned fears of being addicted to antidiabetic medication, which negatively influenced adherence.[363]

Nevertheless, receiving support and reassurance from healthcare providers about the potential adverse effects of medication and how to manage them led some participants from both groups to adapt and continue their medication. This finding emphasised that disclosing potential adverse effects should be a standard practice during patient counselling, as a recent study suggested informing patients about some adverse effects can improve medication adherence.[425] However, if patients encounter adverse effects they were not informed about before, they tend to become more nonadherent to the medication and develop fears about it.[107]

On the other hand, the beliefs about the necessity and efficacy of antidiabetic medication among some participants in both groups positively impact adherence to antidiabetic medication. This finding aligns with existing literature, which has consistently shown that patients' beliefs regarding the necessity, and efficacy of their medication are strong motivators of adherence to medication.[130, 424, 426, 427] According to the necessity-concerns framework, adherence is higher when patients have stronger beliefs about the need for the medication and have fewer concerns about its side effects. Stronger necessity beliefs in people with long-term conditions were significantly associated with higher adherence, according to a meta-analysis of 94 studies (OR = 1.7, 95% CI [1.56, 1.93], $p < 0.0001$).[130] Additionally, the

relationship between belief in the effectiveness of antidiabetic medication and improved adherence could be explained by the health belief model, a theoretical framework to predict and understand health behaviours, including medication adherence.[428] There are several components in this model, including perceived susceptibility, perceived severity, benefits and barriers, and self-efficacy.[429] So, in support for this result, if the perceived benefits outweigh the barriers to taking medications, the health belief model predicts that adherence to medication will increase.[430] A meta-analysis also found that a strong perceived benefit of antihypertensive medication was associated with about t twice the rate of adherence than for a low perception of benefit (AOR = 1.60; 95% CI = 1.06 to 2.41; p = 0.020).[431]

In addition, one of the factors that also motivated adherence to oral antidiabetic medication among a few participants from the South Asian group was the perception of insulin as a last resort or as treatment for more advanced stages of diabetes. Consequently, participants may feel more willing to adhere to oral medications to avoid reaching this stage. This is in line with the concept of downward comparisons,[432] in which people assess their present health situation against a worse condition (like moving to insulin treatment) and act to avoid that (by adhering to their current oral medication). Although this perception can enhance adherence, it might be presented as a barrier to adherence for these participants once they move to insulin therapy, especially at the initiation phase. The negative self-perceptions about insulin, such as perceiving it as a treatment for more severe disease, were reported by a systematic review along with other components to cause psychological insulin resistance and, in turn, cause a delay in the initiation of insulin.[433]

Furthermore, one participant from the same group reported an emotional burden associated with insulin therapy, which might negatively impact adherence. A similar result has been seen in previous studies as well, which shows that people who are on insulin often experience emotional distress because of insulin demands.[434, 435] Uniquely, only one participant of White British ethnicity reported barriers associated with using an insulin pump that influenced consistent use of it. These challenges mainly centred around the fear and discomfort caused by wearing the pump during sleep, and practical challenges. This barrier was also reported in a meta- ethnographic systematic review, which explored the psychosocial effects of insulin pump therapy on individuals with type 1 diabetes.[436] Another study further highlighted that this barrier contributed to discontinuation of insulin pump therapy.[437] Additionally, the

complexity of the various tasks associated with using insulin pumps, such as changing pump sites, maintaining supplies, and administering boluses, can negatively affect insulin pump adherence.[438] The participant also mentioned the emotional impact of using an insulin pump, in line with previous studies,[439, 440] as the constant presence of the device serves as a continuous reminder of illness, which leads to frustration, social discomfort and negative impact on the quality of life.

4.14.3 Perceptions relating to condition

This study highlighted that some participants from both groups reported several barriers related to their illness perceptions and initial reaction to diagnosis. The initial denial and disbelief of the diagnosis led them to either delay the medication initiation or question its necessity and discontinue it. According to literature the negative emotional responses ,including self-denial to diabetes diagnosis, can significantly interfere with treatment adherence.[441-443] Similar to a study by Kalra *et al.*,[442] the denial of a diabetes diagnosis in a few participants of white British origin was attributed to their perception of the absence of significant physical symptoms, or complications, despite the presence of the condition. Additionally, only one participant from the same group described the self-denial due to the belief that he didn't fit the stereotypical description of a person with diabetes. A possible explanation for this misperception might be that people with type 2 diabetes are usually negatively stereotyped because their illness is deemed as a lifestyle-related condition.[444] However, the acceptance of diagnosis was appeared to be a facilitator to adherence among some participants from both groups. This finding supports previous research that found a significant positive association between accepting a type 2 diabetes diagnosis and adhering to medication.[445-447] Participants from the South Asian ethnic group mentioned accepting the condition once they realised they could live a fulfilling and normal life despite it after adhering to diabetes self-management, which motivated them to adhere to their medication, as they felt they could manage the condition effectively even if symptoms persisted. Studies by Alfian *et al.,* [448] and Majeed *et al.,* [449] both found a significant relationship between medication adherence and quality of life in people with type 2 diabetes, showing that those who adhered to their medication reported an enhanced quality of life.

For some South Asian participants, illness perceptions about diabetes symptoms also seem to negatively impact adherence to medication. In the absence of symptoms, some participants

discontinued medications and only restarted them when symptoms reappeared. These misconceptions may be linked to the belief, held by several minority ethnic groups, that diabetes is a short-term condition which could stem from a limited understanding of its chronic nature.[450-454] For instance, a recent qualitative study explored Indian women's cultural beliefs and practices in managing diabetes. The study revealed a perception that diabetes is a short-term condition as a barrier to diabetes self-management. This belief leads to inconsistent adherence to antidiabetic medication, as participants often only take their medication when they experience symptoms and discontinue use after experiencing relief.[451]

In contrast to the previous study,[452] two participants from the White British group reported lack of understanding of the long-term nature of diabetes and believing it could be cured in a moment of relief, leading to discontinuation of the medication. The inconsistency may be due to that the interviewees in this study were from socioeconomically disadvantaged communities, where research indicates that health literacy is lower in such communities.[219, 455, 456] In addition, a few participants from this group identified a new barrier to adherence, as they believed that antidiabetic medication would be unnecessary if lifestyle adjustments, such as limiting carbohydrate intake, were made to control the illness. This perspective may partly reflect confusion arising from NHS advice on managing type 2 diabetes through lifestyle modifications, which emphasises control alongside medical treatment rather than cure.[457] On the other hand, illness perceptions about the complications and seriousness of uncontrolled diabetes among some participants from the White British group were associated with strong perceptions about the necessity of medicines, which facilitated adherence to antidiabetic medication, similar to other studies on diabetes and other long-term conditions.[130, 361, 424, 426] This could be interpreted through the health belief model, according to which a higher perceived severity of a condition is associated with increased adherence to recommended health behaviours,[458] although over time, as individuals become more accustomed to their diagnosis, the perceived need to adhere to treatment may decrease, leading to reduced adherence.

4.14.4 Beliefs and social influences

Different factors related to the beliefs and social influences were reported by South Asian and White British participants as barriers or facilitators, or both, to adherence to antidiabetic

medications. Participants from both groups shared two factors: social and family influence and religious beliefs. Participants of the South Asian group reported two unique factors: the social stigma of the condition and the preference for alternative medicine.

Many participants in this study from both groups described how their family's support positively influenced their adherence to medication. Different forms of family support were discussed, including reminders about medication times, emphasising the importance of medication adherence, and providing emotional support. Numerous studies in the literature have consistently shown the positive impact of family support on medication adherence in people with different long-term conditions.[372, 459-465] In a recent umbrella review, Busebaia *et al.,* synthesised the findings of nineteen systematic reviews examining the role of the family in supporting diabetes self-care management practices, including adherence to antidiabetic medications. The results of this review showed that when families engaged positively with diabetes self-management, people with type 2 diabetes were more likely to adhere to it.[466]

This finding, however, contrasts with those of an earlier study by Singh *et al.*, particularly regarding the white British group. According to this study, family support was primarily significant for South Asians in managing their diabetes. The white British participants, however, relied more on healthcare professionals than on their families for support.[313] Moreover, the presence of other family members with diabetes provided additional encouragement and motivation for adhering to medication. In accordance with this result, previous study indicated that adhering to medication in people with long-term conditions was 38% more likely if both family members take the same medication for the same condition (adjusted relative risk 1.38, 95% CI 1.35-1.40).[467] A possible explanation for this could be that when family members share the same condition, they may provide encouragement, share knowledge about managing it, and offer practical assistance with daily routines.[468] Furthermore, people whose family members offer emotional or practical support rather than just structural support tend to have improved medication adherence.[468, 469]

Despite the family influence being mainly positive for both groups, some participants from the South Asian group described some negative aspects of it. The difficulty of balancing health needs with family responsibilities was expressed by two female participants as a barrier to adherence. It seems possible that these results are due to the prioritisation of family

responsibilities among South Asian women over their own health. Due to a strong sense of duty and family commitment, traditional gender roles in South Asian communities, women are often required to undertake household chores and care for family members. This can limit their time and ability to manage their own health, leading to neglect of their personal health needs, including taking medication as prescribed.[470] Furthermore, one participant explained how the absence of social support from family and friends due to religious conversion negatively influenced adherence. A study by Knight *et al*., that qualitatively examined religious disaffiliation (the process of individuals distancing themselves from or completely dissociating with their religious affiliation) in families supports this finding.[471] Disaffiliation causes a variety of issues within families, including lack of communication and understanding, absence from family gatherings, awkward interactions, and negative emotional responses. Additionally, disaffiliated family members often misperceive their experiences when disassociated from their faith.[472]

Consistent with previous research on different long-term conditions and settings,[322, 424, 473-475] nearly half of the participants from the White British group and some from the South Asian group reported that religion and religious practices such as praying provided them with emotional support and encouragement, which can positively influence adherence to antidiabetic medication. The positive psychological effect that participants experienced from religion may be related to reducing the stress associated with diabetes management, which some participants discussed to influence adherence in a negative way.[476] Additionally, faith in God gives participants a sense of hope, which can be understood through the theory that people's faith in God provides them with hope and confidence that they will be able to overcome the problems that come their way.[477] Moreover, this study is among the first to suggest that attending a faith-based organisation can expand social support networks, providing additional emotional support and guidance from religious leaders, which some participants from both groups reported as facilitating adherence. A previous study by Heward-Mills *et al.* highlighted the influence of religious leaders on health behaviour among Christians of Black African ethnicity in the UK. This study found that religious leaders can influence health behaviour significantly through scriptural influence, social influence, and role modelling.[478]

On the other hand, some religious-related practices were identified by participants from the South Asian group as a barrier to adherence to antidiabetic medication. According to Muslim

participants, the long period of fasting from early dawn to after sunset during the month of Ramadan made them more likely to delay, reduce or skip their medication dose, which can negatively influence adherence to antidiabetic medication. This has also been reported among people from South Asian, Turkish, Arab, and Black minority ethnic groups.[349, 361, 479] Self-adjustment and inconsistent medication use during fasting can be attributed to not discussing the dose adjustments of antidiabetic medication with healthcare providers before Ramadan.[480-482] People with diabetes may be reluctant to disclose their desire to fast in consultation since healthcare providers might lack adequate knowledge and understanding of Ramadan's significance for Muslims.[482, 483] Consequently, these individuals often do not receive advice on how to fast safely during Ramadan.[482, 483] Moreover, there was an inadequacy of cross-cultural understanding and communication between healthcare providers and their patients regarding diabetes and Ramadan fasting, as revealed by several qualitative studies.[482, 484-487]

Additionally, adherence to antidiabetic medication among some Muslim participants was influenced by the halal status of medication (permissible under Islamic law, which means medication not containing substances such as alcohol or pork derivatives) as it is considered a fundamental aspect of their faith.[488] This result is consistent with a previous study that examined how the Muslim faith may impact medication adherence from the perspectives of Muslim patients and general practitioners. In this study, 42% of patients reported that they would not take any medication that they were not certain was halal, and 29% stated they would stop taking medication if confirmed that it was not halal.[489] In order to confirm the permissibility of medication in Islam, a few participants mentioned that they rely on the Islamic religious leader (Imam). A survey-based study of a Muslim minority in the US found that they also sought assistance from an Imam due to a medication-related problem.[490] These findings may highlight the significance of considering religious leaders' involvement when developing targeted interventions for this group.

Further, only one participant described a religious practice for healing, the use of traditional medicine, namely black seed (*Nigella sativa*), as described in the hadith (prophetic traditions) of Islam. The belief in the effectiveness of black seeds, as prescribed by Prophet Muhammad's endorsement, which is reported to have said, "The black seed can heal every disease, except death",[491] can influence adherence to antidiabetic medication. This preference may lead to

reduced use or discontinued antidiabetic medications. One interesting finding was reported by only one participant from the South Asian group, of Nepalese ethnicity, who shared that his community believed that a diabetes diagnosis was a punishment from God for not following their ancestral religious practices. This belief acted as a barrier to adherence, resulting in discontinuing medication, and following animistic traditions, and sacrificing to spirits to cure his diabetes. This result aligns with Acharya and Butterworth's qualitative study in Nepal, which explored the views of people living with long-term conditions. They found that many of the people who took part in the study saw their illness as a curse or punishment resulting from past misdeeds.[492] Furthermore, as part of animistic practices in Nepal, sacrificing to spirits is a common way to please them and seek protection or cures for illnesses, reflecting the cultural and religious tradition of perceiving and managing long-term conditions.[493]

Nearly half of the participants from the South Asian group in this study described the preference for alternative medication over the prescribed antidiabetic medication due to their belief in its effectiveness and providing rapid recovery, which in turn worked as a barrier to adherence to antidiabetic medication. This result aligns with earlier research findings that documented the use of complementary and alternative medicine in addition to or instead of prescription medication among South Asians in the US and UK for conditions like diabetes and cardiovascular diseases.[356, 369, 494] This group's preference for alternative medicine was primarily influenced by recommendations from social networks, as reported in previous studies.[369, 494] Furthermore, a survey of 192 South Asian people in the UK revealed that approximately 82% of those who took prescription medications did not disclose the use of herbal medicines to their healthcare providers.[495] The consistent pattern of this group's use of alternative medicines throughout this and previous studies indicates that it's a cultural phenomenon rather than an individual case.

In line with previous research,[313, 363, 369] a few participants from the South Asian group expressed experiencing stigma related to diabetes in their communities. This stigma has a negative impact on their adherence to antidiabetic medication, as they did not prefer taking medication in public places in order to keep their diabetes private. The social stigma associated with type 2 diabetes can result from the perception that having diabetes or taking medication related to being 'unhealthy' or 'weak',[496] and the belief that diabetes is an indication of physical inadequacy in traditional marriage in South Asian communities.[313]

4.14.5 Influences relating to healthcare systems

A number of participants from the White British and the South Asian groups reported some factors related to a healthcare system that they perceived as barriers or facilitators to adherence to antidiabetic medication. Consistent with previous studies,[497-501] effective communication between patients and healthcare providers, which involves providing support and guidance on the importance of consistent medication intake and addressing medication-related concerns, motivated participants from both groups to adhere to their medication. This result adds to the findings of a meta-analysis of 106 studies examining the relationships between physician communication and patient adherence, which found that patients who rated physician communication poorly had a 19% higher rate of nonadherence than those with better communication.[502] Furthermore, a previous study indicated that providing insufficient information about medication benefits and adverse effects contributes to patients' poor adherence.[138]

However, effective communication between healthcare providers and patients was hindered by language barriers, preventing a few participants from the South Asian group from seeking or explaining their concerns about diabetes management, including medication, which can have a negative impact on medication adherence. Although this finding is reported only by a few participants in this study, it is consistent with previous studies in the South Asian minority ethnic community in the UK and Qatar.[199, 330] According to a recent systematic review of 14 studies conducted in different settings, it found that language barriers can result in miscommunication between healthcare professionals and patients, reduced access to routine healthcare services, a poor understanding of their disease and medication, and decreased satisfaction with healthcare.[374] In agreement with the findings of the previous studies among people from South Asian minority ethnic groups,[199, 330, 503] one participant mentioned that having limited time for consultations with healthcare providers can make it challenging to communicate effectively and express and ask about medication concerns, potentially affecting adherence to antidiabetic medication. This finding supports the idea that healthcare providers often do not have enough time to thoroughly evaluate and understand patients' medication-taking behaviour, mainly when dealing with a large number of patients. Thus, it may be difficult to discuss the importance of medication adherence with patients.[181]

A novel finding from this work related to medication accessibility was despite the availability of free prescriptions for people with diabetes in the UK, some participants from the South Asian group reported medication costs as a barrier to adherence to antidiabetic medication. Most of these participants reported that they lacked knowledge about free prescriptions or an understanding of how to obtain the eligibility certification necessary for getting them. A potential explanation for this could be the language barrier, which is commonly recognised in the literature as being associated with disparities in access to healthcare services among ethnic minority groups.[504-506] In addition, only two participants from each group reported that access to healthcare facilities for obtaining medication or administering insulin injections was a barrier to adherence. This result is contrary to that of Pednekar *et al.,* who found that distance to the pharmacy is not associated with adherence to oral antidiabetic medication.[507] The inconsistency between studies' findings could be attributed to methodology and setting differences.

4.15 Conclusion

This qualitative study explored the barriers and facilitators of adherence to antidiabetic medication from the perspective of the people of South Asian and White British ethnic origin from socioeconomically deprived communities in the North East of England. The results identified various barriers and facilitators, some unique to the participants from the South Asian group and others shared by both groups. For the South Asian participants, alternative medicine preference, some religious-related beliefs and practices, the social stigma of the condition, and unawareness about the availability of free prescription were notable barriers reported only by this group. It is clear from these insights that adherence to medications cannot be solely attributed to ethnicity, but rather to a complex interplay between individual, cultural, and socioeconomic factors. Future interventions aimed at improving medication adherence for people with diabetes from these group should consider a personalised approach that addresses individuals' specific needs and their cultural background influence.

To further gain insights from the perspectives of people with type 2 diabetes from both minority and majority ethnic groups from different healthcare system and cultural contexts, the next chapter (Chapter 5) of this thesis will introduce and describe the methodological approach and findings of the qualitative study that explored the barriers and facilitators of

adherence to antidiabetic medication among people of Saudi Arabian and South Asian origin from socioeconomically deprived communities in Saudi Arabia.

Chapter 5. A qualitative study exploring the barriers and facilitators of adherence to antidiabetic medication among people of South Asian and Saudi Arabian origin from socioeconomically deprived communities in Saudi Arabia

5.1 Introduction

Chapter 4 of this thesis explored the barriers and facilitators of adherence antidiabetic medication from ethnic majority and minority groups for people living in socioeconomically deprived communities in the UK. To gain further insight into the perspectives of people from minority ethnic groups and the majority population across different healthcare systems and cultural contexts, this chapter will explore the barriers and facilitators of adherence to antidiabetic medication among people of Saudi Arabian and South Asian origin from socioeconomically deprived communities in Saudi Arabia. Considering the composition of Saudi Arabia's population, which includes a significant minority of non-Saudi citizens primarily from South Asia, this focus is especially relevant.

Saudi Arabia has a diverse population composed of Saudi nationals and non-Saudi citizens who have migrated from other countries to live and work within the kingdom. According to the Saudi Census 2022, the total population is approximately 32 million, with Saudi nationals making up about 58.4% of the population.[508] The remaining 41.6% consists of non-Saudi citizens from various countries, predominantly from South Asia: Bangladesh (92.2%), India (90.9%), and Pakistan (90.8%), forming the largest minority group in Saudi Arabia.[508]

This chapter describes the research methods and findings of the qualitative research study conducted in Saudi Arabia. It will start by outlining the rationale, research question, aim, and objectives of the study, followed by the research methods specific to this study, and conclude with the study findings and discussions.

5.2 Overarching research question

How does ethnicity influence adherence to antidiabetic medication among people from minority and majority ethnic groups in socioeconomically deprived communities?

5.3 Aim and objectives

5.3.1 Aim

This study seeks to understand how ethnicity influences adherence to antidiabetic medications by identifying barriers to and facilitators of adherence in socioeconomically deprived communities of South Asian and Saudi Arabian ethnicity.

5.3.2 Objectives

1. To explore the views and perspectives of Saudi Arabian and South Asian people from socioeconomically deprived communities regarding the barriers to and facilitators of adherence to antidiabetic medications.
2. To make recommendations based on the identified barriers of adherence to antidiabetic medications about developing patient-centred medication adherence interventions to support minority ethnic groups.

5.3.3 Research questions

The key research questions of this study concerned:

What are the barriers to and facilitators of adherence to antidiabetic medication among people of Saudi Arabian and South Asian origin from socioeconomically deprived communities in Saudi Arabia?

Specifically:

- How does ethnicity influence medicines adherence amongst socioeconomically deprived patients who take medications for type 2 diabetes?
- What aspects of care could be improved to positively influence medicines adherence in these groups?

5.4 Methodological approach

The methodology and methods discussed in Chapter 4 were adapted and applied to this study, except for the ethical approval, study site, eligibility criteria, recruitment of participants, and conducting the interview which will be described in the following sections.

5.4.1 Ethical approval

The study was conducted according to the ethical principles that have their origin in the Declaration of Helsinki,[393] the principles of Good Clinical Practice,[394]and the Department of Health Research Governance Framework for Health and Social Care 2018.[395] The study received full ethical approval from the Newcastle University Faculty of Medical Sciences Ethics Committee (reference number of 33984/2023), and from the Research Ethics Committee at King Khalid University (reference number of ECM#2023-2107) (Appendix 12).

5.4.2 The study site

This study was undertaken in the southern region of Saudi Arabia, specifically focusing on the Asir Region. Saudi Arabia consists of 13 administrative regions with distinct geographical and socioeconomic characteristics.[509] These regions are further subdivided into smaller administrative units called governorates.[509, 510] The southern region was selected since it constitutes the most socioeconomically deprived governorate than other parts of the country,[511] aligning with the study's aim to explore the barriers and facilitators of adherence to antidiabetic medication among both the majority Saudi Arabian population and minority communities of South Asian origin living in socioeconomically deprived areas.

5.4.3 Eligibility criteria

The selection criteria for this study were carefully chosen to address the research aim of the study. Firstly, the inclusion criteria necessitate participants to have type 2 diabetes and an active prescription for at least one antidiabetic medication (see Appendix 8). This requirement is critical because it ensures that the study is focused on people who are actively managing their condition. Secondly, according to the socioeconomic class indicator developed for the Saudi Arabian population, as proposed by Alomar *et al*, participants should live in lower middle-class or deprived areas.[511] The work by Alomar *et al.,* used latent class analysis to create a socioeconomic class indicator using national census data and various household indicators such as education, employment, housing type, home ownership, car ownership, and material possessions. The index categorised the governorates into four socioeconomic classes: affluent, upper middle, lower middle, and deprived. However, one limitation of this index is the possibility of governorate-level misclassification bias because categorising entire governorates, such as assigning the Eastern region to the affluent class, incorrectly assumes that all residents are affluent, ignoring the socioeconomic diversity within each governorate.[511] Therefore, socioeconomic deprivation in this study was also determined by individual-based data, including household income and educational level, the main socioeconomic indicators used in previous Saudi Arabian research, requiring participants' monthly household income to be equal or less than 5000 Saudi riyal (£1,050) and their education level to be lower than secondary school (equivalent to below the General Certificate of Secondary Education level).[511-514] Thirdly, Participants must be of South Asian and Saudi Arabian ethnic backgrounds, allowing the study to explore perspectives from both minority

and majority populations. 'South Asian' usually refers to people from the Indian subcontinent (include Indians, Pakistanis, Bangladeshis, as well as people from Sri Lanka, Nepal, Bhutan, and the Maldives).[515] Finally, participants must be adults over 18 and have the capacity to consent to taking part in the study; ensuring participants have the capacity to consent protects their rights and upholds ethical standards. These criteria are summarized in Table 20.

Table 20: Summary of participant inclusion criteria

Inclusion criteria	
1.	Participants must have type 2 diabetes and an active prescription for at least one antidiabetic medication.
2.	Participants must be living in lower-middle-class or socioeconomically deprived areas in the southern region of Saudi Arabia and demonstrate socioeconomic deprivation at an individual level, as determined by household income and educational attainment.
3.	Participants must be of South Asian or Saudi Arabian ethnic backgrounds.
4.	Participants must be adults over 18 years old.
5.	Participants must have the capacity to consent to taking part in the study.

5.4.4 Recruitment of participants

Participant recruitment was conducted by the researcher. Each participant received a recruitment pack, which included a Participant Information Sheet (Appendix 13) and a consent form (Appendix 14). These documents were originally prepared in English and then translated into Arabic to accommodate Saudi Arabian participants. They were also translated into Urdu, Bengali, Punjabi, and Hindi for South Asian participants. The English-to-Arabic translations were conducted by the bilingual researcher (RA) with the support of DocTransGPT, an advanced AI-powered translation tool capable of providing high-quality translations across more than 100 languages.[516] This tool was also used to translate the documents into the prevalent South Asian languages. To ensure accuracy and cultural appropriateness, bilingual South Asian individuals reviewed and verified each translated document.

Each participant had the opportunity to ask questions about the study. If they agreed to participate, they were asked to sign the consent form. For participants with low or no formal education, additional care was taken during the consent process. The researcher provided clear verbal explanations and used simplified language to ensure that these individuals understood the information provided. Participants were informed that participation was entirely voluntary and that they could withdraw at any time. Recruitment was conducted through three regional hospitals—one governmental hospital and two private hospitals

(Diabetes Centre in Aseer Hospital, Alarkan Medical Group, and Al Ahli Hospital)—as well as social media platforms. Including both private and governmental hospitals, due to the distinction between public and private healthcare services in Saudi Arabia, ensured appropriate recruitment sites. The Diabetes Centre in Aseer Hospital serves as the main diabetes centre in the Asir region, providing healthcare services to Saudi nationals with diabetes from various governorates within the region. It was chosen to recruit Saudi participants because it serves a diverse population from different governorates within this region, which aligns with the study's aim to reach participants from socioeconomically deprived areas. Public hospitals like Aseer Hospital offer comprehensive healthcare services funded by the government, ensuring that Saudi citizens receive free essential and specialised medical care.[517] Non-Saudi citizens primarily receive healthcare services from private hospitals and clinics, frequently through employer-provided health insurance plans.[518] Hospitals like Alarkan Medical Group and AL Ahli Hospital are among the private hospitals that provide healthcare services to non-Saudi residents through employer-based health insurance schemes, and they were selected because they hold health insurance for the majority of South Asian residents in the area. The detailed recruitment process is described below.

Hospitals

Recruitment of participants was done by the researcher after initial participant screening and selection by hospital clinicians. Separate consultation rooms within diabetes clinics were allocated to the researcher to discuss involvement in the research directly following routine clinical appointments. Potential participants were informed about the project verbally by the researcher and were provided with a Participant Information Sheet (Appendix 13). If they were interested in taking part, arrangements convenient for them were made for the consent and interview. The consent process was written and fully informed.

Social Media Platforms

The study poster was posted on social media platforms. The poster included information about the study, potential participants' eligibility criteria, and the researchers' contact information. If someone was interested in further information about the study or in participating, a Participant Information Sheet (Appendix 13) was emailed to them. If they consented to participate, the researcher contacted them to organise consent and schedule the interview.

5.4.5 Sampling

Various sampling techniques were considered to ensure alignment with the type of study and research question. For this program of work, purposive sampling was used in accordance with common practices in qualitative research. Approximately 68 individuals initially expressed interest in participating. Each potential participant was assessed for eligibility based on predefined criteria, including duration since diabetes diagnosis, gender, and age, and specifically for the South Asian group, included various subgroups such as Indian, Pakistani, and Bangladeshi. Only those who met these criteria were selected for the final sample, ensuring that a diverse and representative sample of participants from the studied ethnic groups was included. Conversely, those who did not meet these criteria, particularly individuals whose income and education levels did not align with the study's inclusion requirements, were excluded.

5.4.6 Conducting the interview

Participants were interviewed either face-to-face in their homes, in the hospital clinic, by telephone, or through call-based software at a convenient time and date. The duration of the interviews was generally 30–60 minutes; however, this depended on each participant and the details they provided when answering questions or elaborating on topics. Participants were offered the option of Arabic, Urdu, Bengali, Punjabi, and Hindi languages for interview. Participants took part in one interview. All interviews were conducted by the bilingual researcher (RA), audio-recorded, transcribed verbatim, translated into English, and analysed. The decision to translate the data before the analysis was based on the need to enable the non-Arabic supervisory research team to supervise and be involved in the analysis. The researcher employed for translation the approach defined by Esposito,[519] focusing on a 'meaning-based, rather than word-for-word interpretation' for the translations. Additionally, the translation was aided by DocTransGPT, an advanced AI-powered translation tool.[516] To ensure accuracy of the translation, preservation of linguistic meanings, and consistency, the researcher performed a comprehensive review of the translated transcripts, making corrections by comparing them with the original transcripts. The summary of this study methodology, encompassing participant recruitment through to data analysis, is illustrated in Figure 7.

5.4.7 Qualitative methods for data analysis

The data analysis approach discussed in Chapter 4 (Section 4.11) was adapted and applied to this study.

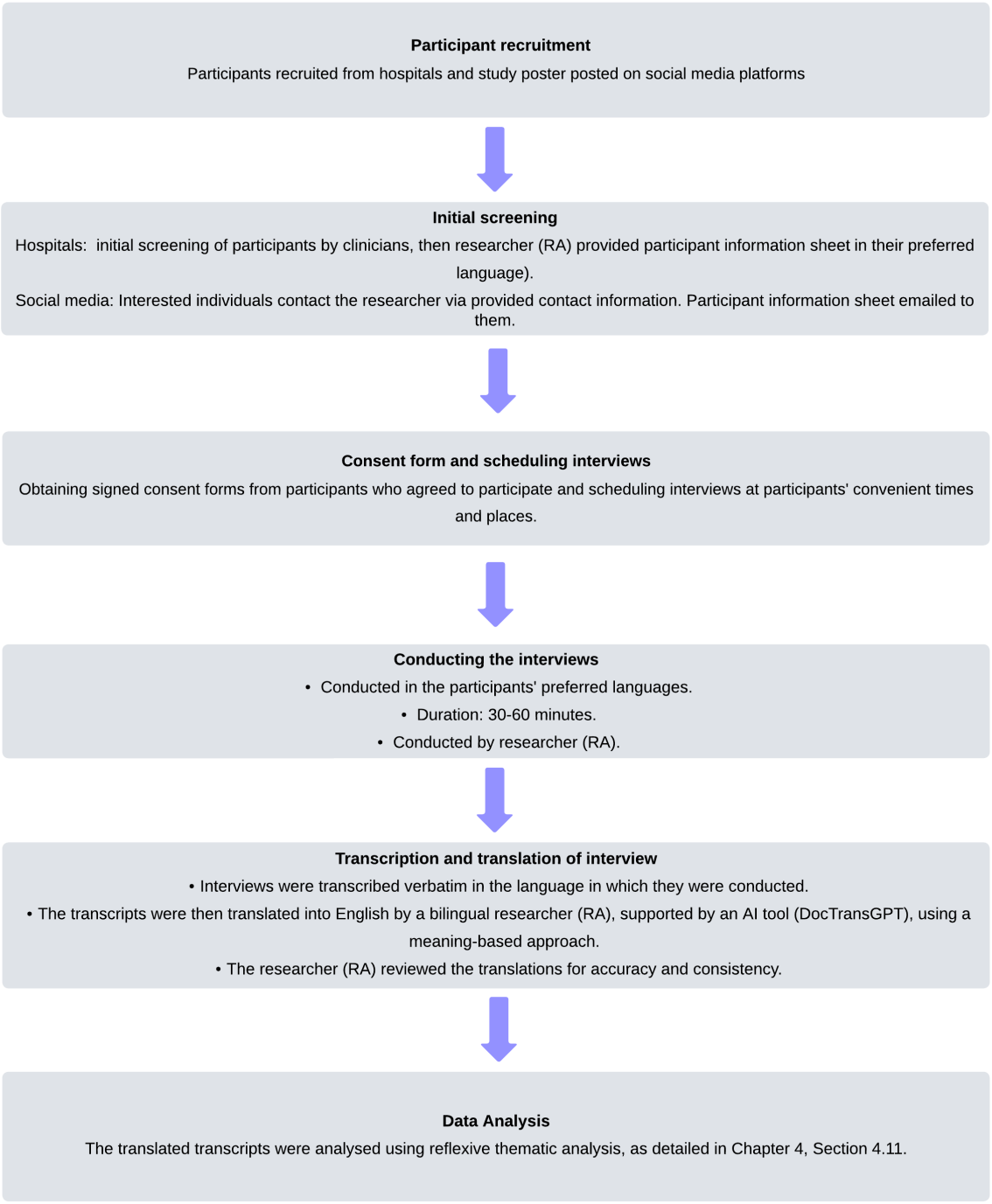

Figure 7:Process flow diagram from participants to data analysis

5.5 Results

This section will outline the participant characteristics of the South Asian and Saudi Arabian groups, followed by a detailed focus on the main themes generated from the data analysis of both groups separately.

5.5.1 Participant characteristics (South Asian group)

Nineteen participants from the South Asian ethnic group were recruited through hospitals (n=2) and social media(n=17) and interviewed between August 2023 and October 2023. Of these participants, 11 were Indian (58%), five were Pakistani (26%), and three were Bangladeshi (16%). The average age of participants was 48 years (SD: 6.82), and 17 of the 19 participants (89%) were male. The time since diagnosis varied from two years to 17 years, and nine participants reported having long-term conditions alongside their diabetes. Most of the participants (79%) were taking oral antidiabetic medication. All the participants were married, and in terms of education provision, ten out of 19 participants had received no formal education, six had attended primary school, and three had not completed secondary education. Among the nineteen participants, religious backgrounds varied, with 13 identifying as Muslim and six as Hindu. Each interview lasted between 22 and 47 minutes, with an average duration of 33 minutes. 15 of the interviews were conducted in person at the participants' homes, while the remainder were conducted through call-based software, according to the participants' preferences. All interviews were conducted in Arabic based on the participants' preferences, except for three that were conducted in English. There were no refusals to participate, no dropouts, and no interviews that needed to be repeated. The characteristics of each participant are shown in Table 21.

Table 21: Participant characteristics (South Asian group)

Participant number	Sex	Age (years)	Marital status	Ethnic origin	Religion	Time since diabetes diagnosis (Years)	Treatment regimen	Presence of long-term condition (Yes/No)
1	Male	53	Married	Indian	Hindu	7	Oral antidiabetic medication	No
2	Male	52	Married	Indian	Hindu	8	Oral antidiabetic medication	Yes
3	Male	55	Married	Indian	Hindu	9	Oral antidiabetic medication	No
4	Male	43	Married	Indian	Muslim	8	Oral antidiabetic medication	Yes
5	Male	47	Married	Indian	Muslim	4	Oral antidiabetic medication	No
6	Male	55	Married	Indian	Muslim	3	Oral antidiabetic medication	Yes
7	Female	36	Married	Indian	Muslim	8	Oral antidiabetic medication	Yes
8	Male	47	Married	Pakistani	Muslim	5	Oral antidiabetic medication	No
9	Male	46	Married	Pakistani	Muslim	2	Oral antidiabetic medication	Yes
10	Male	42	Married	Bangladeshi	Muslim	10	Oral antidiabetic medication	No
11	Male	50	Married	Pakistani	Muslim	15	Oral antidiabetic medication and insulin	Yes
12	Male	52	Married	Pakistani	Muslim	35	Oral antidiabetic medication	Yes
13	Male	38	Married	Pakistani	Muslim	5	Oral antidiabetic medication	No
14	Male	51	Married	Indian	Hindu	5	Oral antidiabetic medication	No

15	Male	54	Married	Indian	Muslim	5	Oral antidiabetic medication	No
16	Female	40	Married	Indian	Muslim	8	Oral antidiabetic medication and insulin	Yes
17	Male	57	Married	Indian	Hindu	15	Oral antidiabetic medication	No
18	Male	42	Married	Bangladeshi	Muslim	17	Oral antidiabetic medication and insulin	No
19	Male	50	Married	Bangladeshi	Muslim	11	Oral antidiabetic medication and insulin	Yes

5.5.2 Participant characteristics (Saudi Arabian group)

Nineteen participants from the Saudi Arabian group were recruited through hospitals (n=4) and social media(n=15) and interviewed between August 2023 and October 2023. The average age of participants was 53 years (SD: 11.11), and 14 of the 19 participants (74%) were female. All 19 participants were Muslim. The time since diabetes diagnosis varied from two years to 30 years, and nine participants reported having other long-term conditions in addition to diabetes. Over half of the participants (63%) were using oral antidiabetic medication. Participants were predominantly married, and in terms of education provision, 13 out of 19 participants had received no formal education, four had attended primary school, and two had not completed secondary school. Each interview lasted between 25 and 56 minutes, with an average duration of 35 minutes. Twelve interviews were conducted in person at the participants' homes, while the remainder were conducted through call-based software according to the participants' preferences. All the interviews were conducted in Arabic for the Saudi participants, as it is the first spoken language for both the researcher and participants. There were no refusals to participate, no dropouts, and no interviews that needed to be repeated. The characteristics of each participant are shown in Table 22.

Table 22: Participant characteristics (Saudi Arabian group)

Participant number	Sex	Age (years)	Marital status	Religion	Time since diabetes diagnosis (Years)	Treatment regimen	Presence of long-term conditions (Yes/No)
1	Male	69	Married	Muslim	15	Oral antidiabetic medication	Yes
2	Female	48	Married	Muslim	16	Oral antidiabetic medication	No
3	Female	60	Divorced	Muslim	9	Oral antidiabetic medication	No
4	Female	51	Married	Muslim	4	Oral antidiabetic medication	Yes
5	Female	47	Married	Muslim	16	Oral antidiabetic medication	No
6	Female	39	Married	Muslim	3	Oral antidiabetic medication and insulin	Yes
7	Female	63	Married	Muslim	8	Oral antidiabetic medication and insulin	Yes
8	Female	47	Married	Muslim	15	Oral antidiabetic medication	No
9	Male	85	Married	Muslim	20	Oral antidiabetic medication and insulin	No
10	Female	51	Married	Muslim	2	Oral antidiabetic medication	Yes
11	Female	49	Married	Muslim	13	Oral antidiabetic medication and insulin	Yes
12	Female	58	Married	Muslim	30	Oral antidiabetic medication and insulin	Yes
13	Female	55	Married	Muslim	2	Oral antidiabetic medication	No
14	Female	60	Married	Muslim	25	Oral antidiabetic medication and insulin	Yes

15	Female	52	Married	Muslim	4	Oral antidiabetic medication	Yes
16	Male	44	Married	Muslim	2	Oral antidiabetic medication	No
17	Male	48	Married	Muslim	2	Oral antidiabetic medication	No
18	Female	36	Married	Muslim	8	Oral antidiabetic medication and insulin	No
19	Male	51	Married	Muslim	2	Oral antidiabetic medication	Yes

5.5.3 Development of the themes (South Asian group)

Five overarching themes were developed from the data to highlight the perceived barriers and facilitators affecting adherence to antidiabetic medication among people of South Asian ethnic background. These themes centred around (1) individual challenges and adaptation strategies; (2) beliefs and experiences with medications; (3) perceptions related to diabetes management (4) social and cultural influences; (5) healthcare provider influences (as demonstrated in Figure 9). Each theme and subtheme are discussed in turn, using pseudonymised verbatim interview quotes to reflect participants' perspectives. Non-identifiable pseudonyms, such as Participant 1, Participant 2, and so forth, are used throughout following each quote.

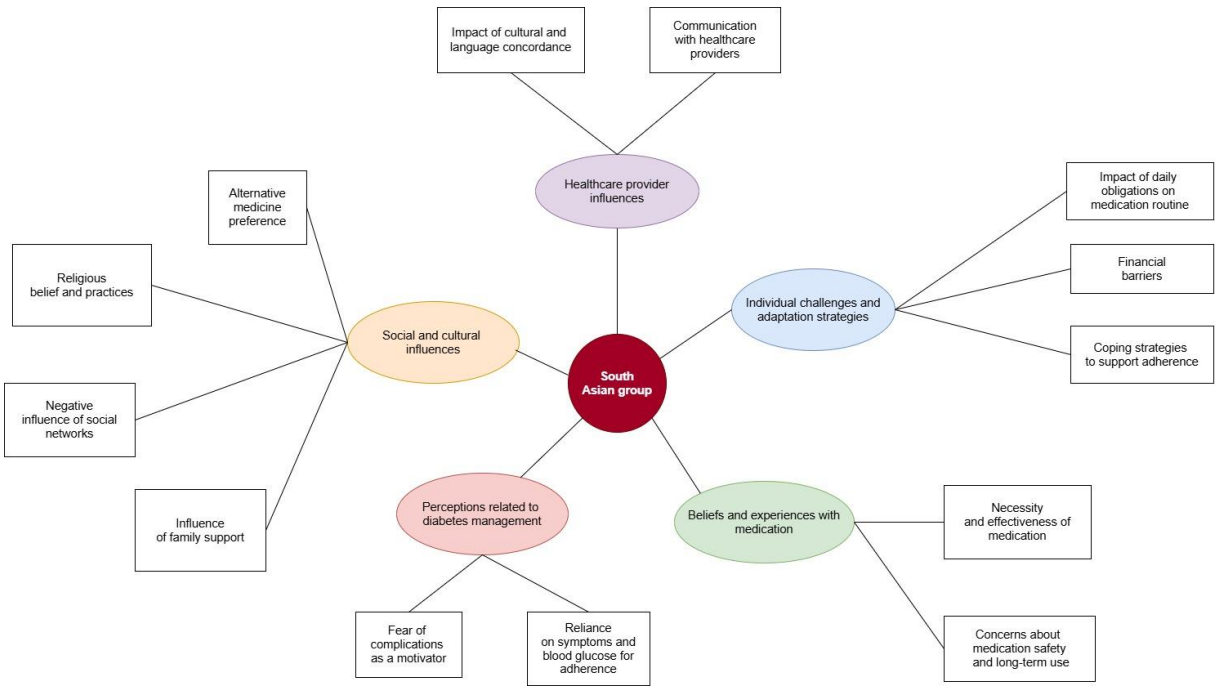

Figure 8: Developed themes and subthemes around the barriers and facilitators of adherence to antidiabetic medications among people of South Asian origin in socioeconomically deprived communities in Saudi Arabia

Theme 1: Individual challenges and adaptation strategies

1) Impact of daily obligations on medication routine

Various daily challenges that interfered with medication routines, such as work, busy schedules, and the unavailability of medication within reach, were reported by participants. These challenges often led to forgetting to take medication, becoming a significant barrier to adherence. Three participants shared that they forget to take medication due to their busy life schedule, as one participant noted:

"It is difficult for me to take the medication because I am always busy. So, sometimes I forget to take it" (Participant 17, Indian male).

Additionally, work-related stress was reported by three other participants as leading to forgetfulness and nonadherence. One participant shared how stress from work led to nonadherence:

"…a few months ago, I started suffering because there was a lot of stress at work, during that time, I wasn't taking care of myself and didn't take my medications" (Participant 18, Bangladeshi male).

Another participant mentioned a similar experience:

"One of the things that makes it difficult for me to take the medication on time is when I come back from work exhausted and immediately go to sleep and forget to take the medication" (Participant 14, Indian male).

Additionally, forgetting to bring medication during outings (work, travel, or social gatherings) was also reported by some participants to hinder adherence to antidiabetic medication. One participant stated, *"Sometimes I forget to take them at work because I forget to bring the pills with me"* (Participant 16, Indian female). Another participant added that:

"If we go to some friend's house or relative, or we go out to the park or somewhere, I cannot carry the medication with me, so, I end up missing my medication" (Participant 6, Indian male).

2) Financial barriers

Many participants identified financial constraints that prevented their ability to maintain continuous access to medication, which in turn acted as barriers to adherence. These barriers mainly centred around the inability to renew medical insurance and the consequent inability to afford medications without insurance coverage. One participant explained:

> *"If my health insurance expired and I can't renew it right away, I have to stop for a bit because I can't afford to buy it, but as soon as I get my insurance back, I can have my medication for free and start taking the medication again"* (Participant 1, Indian male).

Another participant shared a similar experience:

> *"It's easier for me if the medication is available for free because my insurance expired two months ago, so I have to buy the medication. When I don't have money and the medication runs out, I have to wait until I get paid to buy the medication and start taking it again"* (Participant 14, Indian male).

In such cases, some participants relied on bringing medications from their home countries, as one reported:

> *"I brought the medication from Pakistan because it is expensive. Medications are not free without medical insurance, and I don't have the financial ability to renew my medical insurance, so if the medication is available for free, it would greatly help me to take it. Sometimes it is not available, and I have to wait for my friend to come from Pakistan to bring me the medication"* (Participant 8, Pakistani male).

3) Coping strategies to support adherence

Incorporating medication into the daily routine and using reminders were found to be facilitators of antidiabetic medication adherence. Some participants reported enhanced adherence to medication when they integrated medication into their daily routines. One participant shared how establishing a daily routine, including medication as part of it, facilitates adherence to medication:

"What makes it easy for me to take my medication is having a routine. I take it in the morning before breakfast and in the evening before dinner, which helps me to remember" (Participant 5, Indian male).

Another participant commented that:

"It has become a part of life. Every morning, I wake up, have breakfast, take medicines, go to work, and come back. So that's a part of life" (Participant 7, Indian female).

Only two participants discussed using reminders, such as phone alarms, to avoid forgetting medication and improve adherence. One participant described how phone alarms help him remember to take his medication on time, *"... there is a specific alarm set for the times I need to take my medication, and this has helped me a lot"* (Participant 2, Indian male). Another shared a similar experience:

"I have an app on my mobile that my daughter has done for me. It's a very good thing, that reminder, the way it says, "It's your medication time." It's a bit of good motivation, and I think every patient should have it. Honestly, I feel this app is very important because we do forget medications. This app keeps reminding you, so I think everyone should use it" (Participant 7, Indian female).

Theme 2: Beliefs and experiences with medication

1) Necessity and effectiveness of medication

Beliefs in the effectiveness and need for antidiabetic medication mainly influenced adherence positively in this group. Some participants reported a positive perception regarding the efficacy of medication in managing diabetes and alleviating symptoms. One participant shared *"...if I take it immediately, the symptoms go away, and I feel better"* (Participant 3, Indian male). The perceived benefit of medication was echoed by other participants, who noted the recurrence of symptoms when they discontinued their medication. As two participants observed, *"If I don't take it for a week, the symptoms like fatigue and frequent urination return"* (Participant 10, Bangladeshi male), *"If I don't take the medication daily, my blood sugar levels immediately rise…."* (Participant 13, Pakistani male). Conversely, a few participants perceived that some prescribed medication was ineffective for managing their diabetes, as one explained:

"If they give me effective medication for diabetes, it encourages me to take the medication because most of the medications I have been prescribed are not very effective" (Participant 10, Pakistani male).

Additionally, several participants perceived the necessity of antidiabetic medication, which positively impacted on adherence. One participant, for example, demonstrated a clear understanding of the need to take medication, *"I know I have to take it because of my diabetes"* (Participant 9, Pakistani male). Additionally, the negative consequences of not adhering to medication confirmed the necessity for medication, as one participant indicated *"It is essential, I feel very tired, and my blood sugar levels rise if I don't take them"* (Participant 8, Pakistani male).

2) Concerns about medication safety and long-term use

Several interviewees reported concerns related to the long-term toxicity and adverse effects of antidiabetic medication, which acted as a barrier to adherence. The fear of long-term damage caused by the medication, primarily to their kidneys and other organs, was expressed by nearly half of the participants. These concerns often led participants to skip doses and avoid taking their medications regularly unless their blood sugar level was above a certain level and then discontinue it, as one participant shared:

"When I take medication every day for a year or ten years continuously, it causes kidney problems and affects my body. That's why when my blood sugar level is below 400, I don't take the medication" (Participant 2, Indian male).

Another participant expressed this fear, stated *"I am very scared of taking these medications because they can cause kidney problems"* (Participant 15, Indian male). Furthermore, some participants' perceptions of long-term medication use led to dependency, causing them to be inconsistent with their medication intake. One participant, for instance, discussed that:

"If I start taking diabetes medication regularly, my body gets used to it, and all my body systems become dependent on it, unlike when I use it only when my blood sugar level rises" (Participant 12, Pakistani male).

A further safety concern highlighted by some participants, which influenced adherence, was experiencing adverse effects with antidiabetic medication, which resulted in missing doses or

stopping the medication without consulting with their healthcare provider. One participant discussed how he coped when he experienced side effects:

"One of the things that makes it difficult for me to take them is that sometimes, when I take the medication, it causes problems and pain in the stomach, especially when I take them for several days in a row. So, I take them every other day to avoid causing problems in the stomach" (Participant 4, Indian male).

Similarly, another participant shared:

"The most trouble I had was with Trulicity, so I couldn't continue with it. I began noticing issues around a month or two ago, which led me to stop taking it" (Participant 6, Indian male).

Theme 3: Perceptions related to diabetes management

1) Reliance on symptoms and blood glucose for adherence

Many participants reported some misconceptions regarding medication use, linking adherence to specific blood sugar levels or the presence of symptoms. The most notable misconceptions were that people needed to take their medication based on their blood glucose level or the presence of symptoms. Participants linked medication taking with high blood sugar levels, one participant shared, *"I only take if my blood sugar is above 500 or 400 mg/dl"* (Participant 4, Indian male), another participant explained:

"...when my blood sugar level is high, I immediately start taking the medication for a week, and if my blood sugar level drops, I stop taking it" (Participant 2, Indian male).

Additionally, some participant shared that they skipped some doses based on blood sugar level, as one shared *"…if my blood sugar is low, I only take the morning pill and skip the evening one"* (Participant 11, Pakistani male). Furthermore, some participants reported that they adhere to their medication based on the presence of symptoms and stop it or reduce the dose if they feel relief. One participant, for instance, reported:

"Sometimes I take them regularly, and when I feel better, I stop them for a few days or reduce the dosage to once a day, because my blood sugar level is under control, and I know when to

start taking it again when I experience symptoms like body pain and frequent urination" (Participant 10, Bangladeshi male).

2) Fear of complications as a motivator

Some participants reported that perceptions of the severe complications of diabetes, based on personal experience or health care provider warnings, motivated adherence to antidiabetic medication:

"One of the things that encourages me to take diabetes medications is that I'm afraid of the complications of diabetes. I stopped taking them for three months once, and my cholesterol levels increased. The doctor told me that if I take my medications regularly, my cholesterol levels will decrease" (Participant 6, Indian male).

The fear of symptoms recurrence was also another motivator of adherence, as one participant described:

"What encourages me to take the medication regularly is when I think about the symptoms I experience if I don't take it, I'm afraid that symptoms will come back" (Participant 18, Bangladeshi male).

Uniquely, one participant shared that he kept taking his medication consistently as he worried about the negative influence of diabetes on fertility:

"Some people have told me that if my diabetes isn't controlled, it could cause fertility and reproductive issues, that's why I make sure to take my medication" (Participant 5, Indian male).

Theme 4: Social and cultural influence

1) Influence of family support

Adherence to antidiabetic medication was affected by the support and advice from family, which acted as mainly facilitators. Many participants highlighted their families' supportive role in facilitating adherence to their medication and managing their diabetes. For instance, one participant described how his family supported him in adhering to his medication:

"…I take so many medications, they usually take care of that because they organise the medication, what I take in the morning, which I take for diabetes, and I take it for hypertension, and I take something else also. So, this means I have to take the equivalent of a five-day supply of tablets each day…, my daughter, she takes care of my medication" (Participant 6, Indian male).

Some participants also mentioned the support provided by a family member who is also managing diabetes, as one participant noted:

"Most of my family members have diabetes, about eight of them. They always talk to me and ask how I am doing with diabetes, whether I am taking the medication or not" (Participant 8, Pakistani male).

Another participant mentioned the ongoing emotional support from his mother *"My mother has diabetes, and she's always checking in on how I'm doing"* (Participant 2, Indian male). Additionally, family support does not only extend to those in close contact with their family, as even distant family members in their country of origin can provide support that can impact adherence, as one shared:

"My family in Pakistan always calls to check if I'm taking my medications and if my sugar levels are stable" (Participant 9, Pakistani male).

Furthermore, several participants stated that their motivation for taking medication was to maintain their health so that they could continue to support their families. One participant explained:

"Thing that helps me is thinking about my health, I need to take care of myself because I have young children. I work here for them, so when I'm well, I can work and provide for them". (Participant 8, Pakistani male).

This was supported by another participant who stated:

"One of the things that motivates me to take the medication every day is when I remember that I am here to work and provide for my children. If my health is not good, I cannot continue working or secure a future for my children" (Participant 12, Pakistani male).

On the other hand, some participants mentioned that the limited family and social support made it challenging for them to adhere to their medication. One participant, for instance, mentioned:

"If my family lived with me in Saudi Arabia, it would help me a lot because they would prepare my meals and remind me of the medication" (Participant 17, Indian male).

Similarly, another interviewee added:

"My social life here in Saudi Arabia is quite limited; I have very few people in my circle, and none of them are diabetic" (Participant 7, Indian female).

2) Negative influence of social networks

Inaccurate information about managing diabetes and advice against medication by people in their social circle hindered some participants' adherence to antidiabetic medications. One participant noted, *"I have many people around. So, every one of them gives a different opinion. Some they advise against insulin injections"* (Participant 6, Indian male). Two participants also shared that they discontinued their medication based on family recommendation, as one shared:

"I took the medication for two weeks when I was diagnosed with diabetes, and then I talked to my mother and she said your blood sugar level is not too high, it was just 250 mg/dl, she said don't worry, you don't need medication" (Participant 5, Indian male).

Disseminating misinformation about the safety of antidiabetic medications within their community also acted as a barrier to adherence, as one participant reported:

"Sometimes I stop taking them for a week because I'm afraid when I remember what people say about the side effects of these medications on the body's organs" (Participant 4, Indian male).

Furthermore, social stigma and misconceptions about diabetes made it difficult for a few participants to adhere to medication, particularly in public places. One participant explained:

"…it is very difficult to take medicine in my work, so sometimes I don't want others to see me taking my medication [tablet]*, I don't want to show anyone I have diabetes. This makes it difficult for me to take my medicine in front of others"* (Participant 16, Indian female).

Also, another participant expressed:

"…people are talking, oh, you have diabetes, you are a diabetic patient. They're showing sympathy. I don't like sympathy" (Participant 19, Bangladeshi female).

3) Religious belief and practices

Religious beliefs and practices were discussed by nearly half of the participants to impact adherence to antidiabetic medication, both positively and negatively. Some participants reported that spiritual beliefs and practices, such as prayer, provided them with inner strength and motivation to manage their condition. One participant noted, *"Praying and asking for help in my prayers give me strength"* (Participant 1, Indian male). Another participant mentioned that belief in God was among the factors that facilitated adherence to medication:

"One of the things that has helped me is that I always pray to Allah, asking for healing, self-reliance, and strength" (Participant 2, Indian male).

Additionally, a few participants who followed Islam reported that reciting the Quran gives them inner peace and strength to manage their diabetes, as one stated:

"I've been reading the Quran every morning. I start with Surah Y-Seen and then read Surah Al-Rahman. This has become a daily habit for me because it gives me inner strength to manage my illness without causing me any stress" (Participant 7, Indian female).

However, some Muslim participants' reliance on the healing properties of Zamzam water (a holy water from the Masjid al-Haram in Mecca, Saudi Arabia, which holds religious significance in Islam and is believed by Muslims to have healing properties[520]) led to a reduction or complete discontinuation of the medication. One participant shared, *"When I drink Zamzam water, I don't need to take pills because Zamzam water is a cure for all diseases"* (Participant 11, Pakistani male). Another mentioned:

"In times when I am not taking my medication, I pray and ask Allah to improve my condition and prevent my sugar levels from rising. I also drink Zamzam water to help in reducing my sugar levels because it is believed to have healing properties" (Participant 15, Indian male).

Furthermore, some participants following Hinduism reported that they sometimes used meditation and yoga to manage their blood sugar instead of relying on medication. One participant noted:

"I practice meditation like what I learned from Hinduism, and this really helps me and lowers my sugar and blood pressure even without taking any medication" (Participant 3, Indian male)

Another shared:

"I practice yoga with my Hindu friends, and it really helps improve my blood sugar. On the days I go to yoga in the morning, I reduce the medication dose because my blood sugar decreases" (Participant 17, Indian male).

4) Alternative medicine preference

The preference for alternative medicine affected adherence to antidiabetic medication for about half of participants in this group, serving primarily as a barrier. Some participants reported they prefer using herbal medicines over prescribed medication due to perceived safety and effectiveness in managing diabetes. One participant, for instance, shared his belief in effectiveness:

"There is a vegetable called Karela that my wife used to cut and mix with water, and I drink it in the morning before breakfast, and it is one hundred per cent effective and lowers my blood sugar immediately" (Participant 10, Bangladeshi male).

Another participant expressed a similar belief:

"In India, I stopped using my prescribed medication and used herbal medicines instead. During the first few months after returning to Saudi Arabia from India, if I had a supply of these herbs, I would take them instead of the medications because they are better and safer, and I believe that English medications can cause problems for the kidneys" (Participant 3, Indian male).

Many participants reported that their preference for alternative medicine was influenced by family advice and cultural practices from their country of origin. For instance, one participant shared, *"At the beginning, I didn't take medication, because my father recommended myrrh…"*

(Participant 9, Pakistani male). Another participant added, *"In India, many people recommend using Ayurvedic medication because it is very effective and has no side effects…"* (Participant 3, Indian male). Although some participants initially used alternative medicine based on family recommendations, they stopped using it after experiencing its ineffectiveness and returned to prescribed medicine, as one participant stated:

"My mother-in-law, who is diabetic, recommended her herbal medicines to me, but I didn't find them effective" (Participant 6, Indian male).

Theme 5: Healthcare provider influences

1) Communication with healthcare providers

Some interviewees emphasised that communication with healthcare providers can impact adherence to antidiabetic medications, either facilitating or hindering adherence. Positively, few participants reported receiving advice and guidance from their healthcare providers about the importance of consistent medication taking in encouraging adherence, as one participant shared:

"I always see the doctor, and he treats me very well. He always tells me that I have to take the medication continuously and not stop it" (Participant 4, Indian male).

However, some participants reported communication barriers and a lack of engagement from their healthcare providers during conversations to discuss their concerns and preferences related to medication due to limited consultation time. One participant, for instance, expressed:

"The doctor says I must continuously take the prescribed medication. This is because he isn't aware of the benefits of herbal medicines, and there isn't enough time to discuss these alternatives during the appointment. The doctor doesn't talk much, he just checks the tests and prescribes medication" (Participant 3, Indian male).

2) Impact of cultural and language concordance

Cultural and language concordance between patients and healthcare providers influenced communication and, in turn, adherence to medication. One participant, for instance, shared:

"Once I went to the hospital and either the doctor or nurse was Indian, this helped me a lot. I was able to discuss my issues with the English medication. If there isn't an Indian doctor, it's just a matter of going through the regular check-up and prescribing medication without much discussion" (Participant 3, Indian male).

Similarly, this view was expressed by another participant:

"If there are Indian staff or a doctor at the hospital, I find it much easier to communicate because I'm Indian, and it's easier for me to explain my condition to them. But when there are doctors from Egypt or other nationalities, it's harder for me to explain that I'm suffering from diabetes and what I'm experiencing with medication. Sometimes, I feel unable to convey my situation properly" (Participant 16, Indian female).

Furthermore, one participant mentioned that he relied on healthcare providers in his country of origin to seek information about diabetes management. He stated: *"I contacted a doctor in India who told me that if the blood sugar level is low, I should not take the medication"* (Participant 2, Indian male), which may indicate his distrust of healthcare providers in his country of residence or poor communication due to lack of language and cultural concordance between patient and healthcare providers.

5.5.4 Development of the themes (Saudi Arabian group)

Five overarching themes were developed from the data to highlight the perceived barriers and facilitators affecting adherence to antidiabetic medication among people of Saudi Arabian ethnic background. These themes centred around (1) individual challenges and adaptation strategies; (2) beliefs and experiences with medications; (3) emotional and perceptual responses to diabetes; (4) social and cultural influences; (5) healthcare system influences (as demonstrated in Figure 8). Each theme and subtheme are discussed in turn, using pseudonymised verbatim interview quotes to reflect participants' perspectives. Non-identifiable pseudonyms, such as Participant 1, Participant 2, and so forth, are used throughout following each quote.

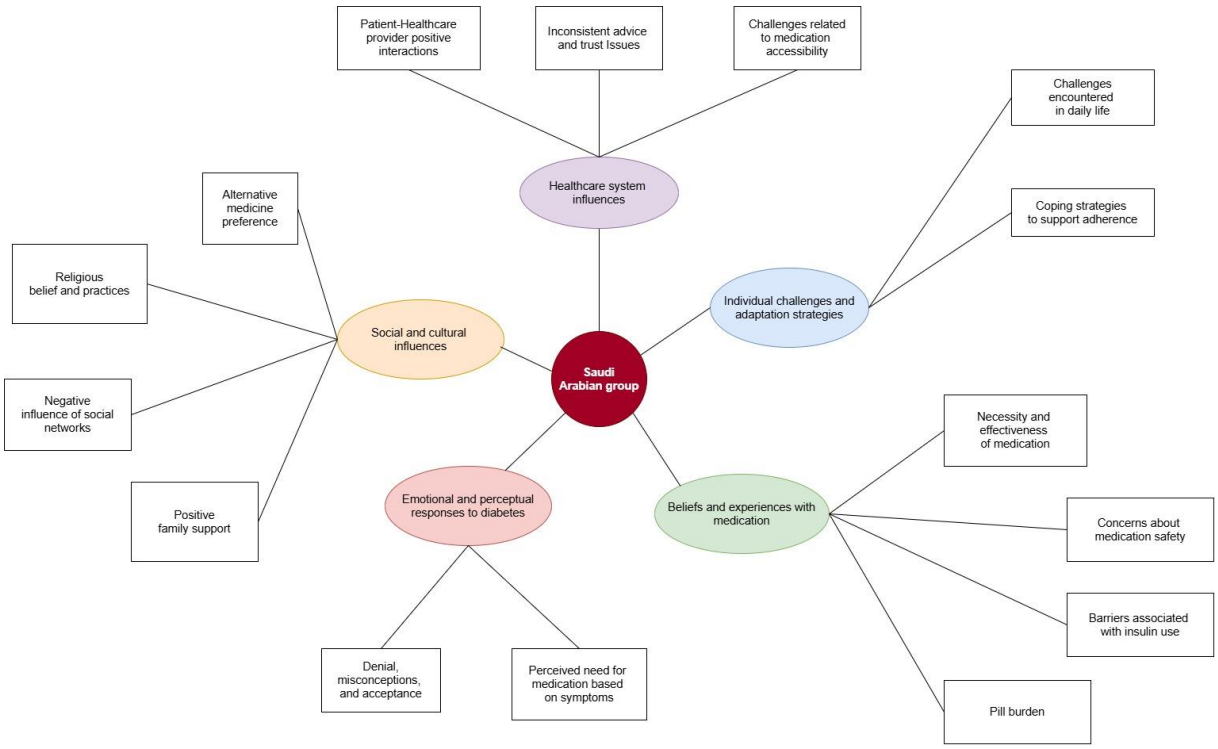

Figure 9: Developed themes and subthemes around the barriers and facilitators of adherence to antidiabetic medications among people of Saudi Arabian origin in socioeconomically deprived communities

Theme 1: Individual challenges and adaptation Strategies

1) Challenges encountered in daily life

Several daily challenges, including family responsibilities, unavailability of medications, routine disruptions, work, and mood status, were identified by participants as contributors to forgetfulness and, in turn, acted as barriers to adherence. A few participants described how responsibility toward their family contributed to forgetfulness:

> *"Sometimes I forget to take it due to being busy at home, as I am responsible for seven children, cleaning, and cooking for them"* (Participant 10, female).

Many participants identified that the medication not being immediately accessible, particularly during outings, led to forgetfulness, as one interviewee shared:

"Situations that make it difficult for me to take my medication occur when I go out and forget the medications at home. Sometimes I take them when I return home and remember, but sometimes I forget" (Participant 3, female).

Some participants mentioned the conflict between work hours and taking medication led to poor adherence, for example, one noted, *"...sometimes I have to go to work in the early morning before having breakfast and forget to take my medicine"* (Participant 4, female). One participant related mood state to their ability to remember taking their medication: *"if my mood is affected by certain events, I tend to forget and skip doses"* (Participant 2, female). Disruptions to routine were also described by some participants as barriers to adherence to antidiabetic medication. One participant, for instance, illustrated how disruption of his daily routine due to working evening shifts made it difficult to adhere to medication:

"The most difficult situation for me is the irregular sleep schedule because of my work. Sometimes I have an evening shift from 9 pm to the morning, and then I sleep all day. Also, my meal schedule is irregular, so when my schedule is disrupted, I can't take the medication on time, and I can't stick to it" (Participant 19, male).

2) Coping strategies to support adherence

Integrating medication into a daily routine and using reminders or prompts were found to be important facilitators to support adherence. Some participants acknowledged the importance of establishing a consistent routine, such as regular meal and sleep schedules, in promoting medication adherence:

"If I stick to regular meal times, it becomes very easy for me to take my medications regularly. Also, if my sleep schedule is consistent, if I go to bed early and wake up early, I can follow my daily routine, including taking my medications" (Participant 8, female).

Another participant echoed this viewpoint, stating:

"If my sleep schedule is organized and I wake up early in the morning and have regular meal times, it makes it much easier for me to stick to my medications" (Participant 16, male).

Additionally, some participants reported that integrating medication into daily activities, such as meals, enhances adherence:

"...daily routine helps me the most when I wake up, I take the pill before breakfast, then I have breakfast and take the pill after breakfast, and I remember to take them after lunch and dinner" (Participant 3, female).

Some participants reported that the use of reminders, particularly phone alarms, facilitated adherence to diabetic medication, as one participant shared:

"One thing that makes it easier for me is that I have set alarms on my phone for my medication times in the morning and evening. In the morning, I first take the diabetes medication and then the other, followed by another alarm at night to take my medication before dinner and so on" (Participant 1, male).

Another participant emphasised the importance of reminders to avoid forgetting medication time, as she expressed:

"One thing that makes it easier for me to take my medications on time is setting an alarm on my phone for the medication time. This really helps me not to forget" (Participant 5, female).

Theme 2: Beliefs and experiences with medication

1) Necessity and effectiveness of medication

Some participants reported that their perceived belief in the necessity and effectiveness of antidiabetic medication in managing their diabetes impacted adherence positively. The importance of taking antidiabetic medication regularly to control diabetes and maintain their health was expressed by several participants:

"I see the medication is prescribed to help me with my diabetes, and I know they are essential for my health" (Participant 1, male).

In addition, another participant showed a clear understanding of the long-term need for antidiabetic medication *"...I know chronic diseases like diabetes require lifelong medication"* (Participant 4, female). Moreover, the effectiveness of antidiabetic medication, which was observed by improvement in the symptoms and their condition reported by some participants, was a motivator of adherence: *"The medications are very beneficial, Alhamdulillah* [praise be to God]*, since I started taking them, my symptoms have improved significantly"* (Participant 5, female), and another added:

"…feeling tired and experiencing symptoms of lethargy in my body are the main things that motivate me to take my medication regularly, because it helps alleviate these symptoms" (Participant 6, female).

2) Concerns about medication safety

Some participants mentioned concerns about antidiabetic medication adverse effects as a barrier to adherence. Most participants reported that they had experienced adverse effects with antidiabetic medication, which resulted in reluctance to continue their medications. One participant, for instance, discussed how adverse effects associated with metformin influenced adherence:

"I have difficulty with metformin, it makes me reluctant to take it, and I've stopped taking it for long periods because it caused significant weight loss and made me abnormally thin. I also developed yellowing of the skin because of it" (Participant 5, female).

Moreover, a few participants reported that they discontinued their medication as the adverse effects outweighed the perceived benefits *"…I stopped taking it even though it lowers my blood sugar"* (Participant 8, female). Moreover, some participants reported their concerns about the long-term safety of antidiabetic medication on body organs as one participant shared *"I always fear the long-term effects of these medications on the liver, kidneys, and heart…"* (Participant 14, female), these concerns can influence adherence negatively.

3) Barriers associated with insulin use

The fear and inconvenience associated with insulin injections were cited as a barrier to adherence as one participant explained:

"One of the biggest challenges I've faced is taking the insulin injections because they really bother me and I've gotten very tired of them, so some days I take them and others I skip" (Participant 7, female).

Additionally, fear of injections led to resistance to initiating insulin therapy, as reported by one participant:

"The doctor wanted to start me on insulin injections, but I completely refused because I was very afraid of needles. He then agreed to let me continue with pills, warning me that any

consequences would be my responsibility. I insisted that was fine as long as I didn't have to take injections" (Participant 8, female).

On the other hand, the desire to avoid escalation of the medication regimen to insulin therapy motivated a few participants to adhere to their oral antidiabetic medications. One participant, for instance, explained:

"I started taking my medication regularly again because I don't want to be put on insulin injections. They are difficult to administer, and I am very scared of using needles" (Participant 4, female).

4) Pill burden

Participants with comorbidities expressed fatigue associated with the pill burden as a barrier to adherence to antidiabetic medications. One participant shared her feelings about being on multiple medications:

"Honestly, I'm fed up with taking so many different types of medication. It's very tiring, and I'm exhausted from this situation" (Participant 15, female).

Another participant described how the complexity and stress related to managing many medications for long-term conditions affected adherence, stating:

"I was frustrated by the number of medications I had to take, as I was on medication for heart and asthma alongside diabetes and hypertension. So, I stopped them for a while…" (Participant 12, female).

Furthermore, one participant expressed worries about taking other medications with antidiabetic medication, even for short-term illnesses, which result in discontinuation or reduction of antidiabetic medication dose:

"To be honest, I do get worried about taking so many medications. Like, if I get something for the flu, allergies, or any little thing, I try to discontinue or reduce the dose of diabetes medication and to stick with just other medications, you know, how they say, sometimes not taking medicine is the best medicine" (Participant 19, male).

Theme 3: Emotional and perceptual responses to diabetes

1) Denial, misconceptions, and acceptance

The initial emotional responses and perceived misconceptions related to a diabetes diagnosis were reported by some participants, which negatively influenced adherence to their medication. Three participants discussed how they struggled emotionally to accept the diagnosis of the long-term condition, which led them to moments of denial and non-adherence, one stating:

"Initially, I didn't want to accept that I had diabetes, especially in the beginning, I thought it was temporary and would go away, but I was shocked when they told me it would stay with me for life. I got really upset and struggled a lot emotionally, and during that time, I didn't take my medication" (Participant 6, female).

Moreover, some participants linked their diabetes diagnosis to external factors such as traumatic emotional events or spiritual beliefs. For instance, one participant explained:

"The main reason I developed diabetes was due to fear and shock when my mother passed away. The second reason was due to the evil eye and envy, and then I developed diabetes" (Participant 11, female).

Another participant shared a similar misconception, noting that his diabetes was also caused by the *"evil eye and envy"* (Participant 16, male). This misconception can potentially affect adherence as it may lead to seeking non-medical treatments based on the believed cause.

However, the acceptance of their condition facilitated adherence, as one participant described the shift from initial reactions to diagnosis: *"I was surprised and very depressed in a way that you can't imagine because I took it as if it was the end of my life"* to acceptance *"…I after I accepted it, I started taking medication"* (Participant 19, male).

2) Perceived need for medication based on symptoms

For some of the participants, adherence to antidiabetic medication depended only on the presence of symptoms of diabetes, which was considered as a barrier to consistent taking of their medication. Several participants described how the appearance of diabetes-related

symptoms encouraged people to restart the medication after stopping it. One participant, for instance, noted:

"One of the things that make me retake my medication is if I notice mild symptoms, I continue with the pills, and if the symptoms are stronger and my sugar reaches 400, I take the injections regularly" (Participant 7, female).

In contrast, at the time when symptoms temporarily improved, some participants mentioned that they skipped their medication: *"If I didn't experience symptoms, I would leave them"* (Participant 18, female). Moreover, the influence of witnessing the severe complications of diabetes in others presented as a strong motivator of adherence, as one participant shared:

"My friend, who got diabetes before I did, told me he got a wound from falling in a swimming pool. He didn't really take care of it and left it for a while, and it ended up so bad that his leg had to be amputated. When he told me that, it really scared me about how serious diabetes can be, and I started to worry I could end up like him, I have become very concerned about my medication to the point that I always have the medication with me wherever I go, in my pocket and in the car…" (Participant 19, male).

Theme 4: Social and cultural influence

1) Positive family support

Family support had a significant impact on facilitating adherence to medication. Many participants highlighted the positive role of their family in providing emotional support and encouragement to adhere to their medication. One participant, for instance, shared:

"My family support me and ask how I feel and whether I am taking care of myself and taking my medication or not. So, their presence around me helps and encourages me to continue and pay attention to myself and my health" (Participant 2, female).

In addition to providing emotional support, several participants emphasised the active roles of their family members in reminding them of their medication time and managing their medication routines. One participant explained how family support can facilitate medication adherence: *"My son often reminds me to take my medication, and if I go out, he makes sure that my medication is with me"* (Participant 1, male). Another participant added:

"My family are always there to support me, particularly when I have questions or if I make a mistake with my medication doses, they guide me on the correct usage" (Participant 3, female).

Furthermore, several participants mentioned that having family members with diabetes can contribute to a more encouraging environment, as one participant explained:

"My son has diabetes. He is currently on insulin and medication. My father also had diabetes, and even my daughter got tired, and then she got diabetes, she is also on insulin and medications. So, when I see their condition, and we all remind each other about the medications, they really motivate me" (Participant 11, female).

Another participant described how his father, who has managed diabetes for thirty years, shared his experience and influenced him positively:

"...after seeing me take a lower dose than what the doctor prescribed, he told me I should stick to the medications as is prescribed because he knows more about how to deal with it" (Participant 16, male).

2) Negative influence of social networks

Recommendations from family and social networks for diabetes management can have a negative impact on adherence to antidiabetic medication. Several participants reported receiving advice from people in their community against taking medication, which resulted in participants discontinuing their medication. One participant shared:

"In my community and among my relatives, some people advise against taking medication, claiming it's baseless and offers no benefit. They mention having diabetes themselves and getting better without these medications, I followed their advice, and I stop taking them for some time" (Participant 1, male).

Another participant also described the time when she stopped her medication based on a relative's advice:

"When I first diagnosed with diabetes, we had a family gathering where a relative saw me taking medication. She asked me why I was taking it, and when I told her it was for diabetes prescribed by my doctor, she advised me not to take it, she said it could cause significant

damage to the kidneys. Her words really affected me because I know medication can be a double-edged sword at the same time. So, I stopped taking it for a while" (Participant 4, female).

Some participants mentioned that some people in their community advised them to use herbal remedies instead of medication, as one mentioned:

"I have heard about some herbs, and some people say they stopped taking medications and only continued with herbs, and their blood sugar became normal and improved with them" (Participant 8, female).

Another participant shared similar experience:

"Some people I have met told me not to take the medications. They ask why I take them and what benefit I get from them. They suggest using herbs instead" (Participant 11, female).

3) Religious belief and practices

Participants discussed religious beliefs and practices that influence adherence to antidiabetic medication in either positive or negative ways. The faith and religious practices, such as praying and reading the Quran (the Islamic holy book), were reported by the majority of participants to facilitate the management of their conditions and adherence to medication. One participant shared, *"Prayer and reading the Quran always help me; they improve my mood and spirit, and this helps me manage my condition"* (Participant 2, female). Another participant expressed a similar view, stating:

"Alhamdulillah, it is easy for me to continue taking my medications through prayer, reading the Quran, and reciting supplications. Whenever I remember to praise Allah, it becomes easy for me to take the medications on time" (Participant 11, female).

The participants also found strength and hope through praying and seeking spiritual support, which had a positive impact on their adherence, as one participant shared *"Prayer is very important; it helps me stay strong and continue taking care of myself and taking my medication"* (Participant 3, female). Additionally, some participants were motivated to take their medication as taking care of themselves and seeking treatment is a part of their religious teachings. One participant explained:

"I do take my medication because Prophet Muhammad said, 'Seek treatment, for Allah has not made a disease without appointing a remedy for it.' This encourages me to take my medication as needed" (Participant 4, female).

Some participants mentioned that certain religious practices, such as fasting, made it difficult to take their medication at the prescribed time or believed that fasting could control their blood sugar, which resulted in skipping some doses or discontinuing medication during fasting, as one participant shared:

"The biggest challenge I face is during fasting, especially during the white days [specific days of each Islamic month] *and Ramadan. My medication schedule gets messed up, instead of taking them during the day, I take them at night, and sometimes I missed some doses, which really affects me"* (Participant 14, female).

Furthermore, participants who attributed their illness to evil eyes mentioned using traditional healing practices, one of them stated:

"I also recite the Ruqyah (Islamic healing prayer) over water, pray for healing, and then drink the water. Afterward, I feel relief in my body, and my blood sugar improves" (Participant 14, female).

In addition, two participants indicated belief in the spiritual and therapeutic advantages of Zamzam water in controlling their diabetes, as one participant mentioned:

"I believe that drinking Zamzam water improves my blood sugar because there is a saying of the Prophet Muhammad that Zamzam water is for whatever intention it is drunk for. So, if I drink it with the intention of reducing sugar levels, it improves my condition" (Participant 16, male).

4) Alternative medicine preference

Around half of the participants reported believing that alternative medicines were effective in controlling diabetes, which acted as a barrier to adherence to their antidiabetic medications. The following herbal remedies, including moringa, cinnamon, fenugreek, myrrh, okra, and aloe vera, were reported be used by some participants instead of medication to lower blood glucose levels. One participant shared:

"I have a plant called moringa that I've planted at home. Many people have told me that it helps lower blood sugar and fats. We take the leaves, grind them, and mix them with yogurt, or just add them to water or tea. It helped me a lot especially during a period when I stopped my medication" (Participant 3, female).

The preference to use alternative medicine was influenced mainly by advice from their social networks *"I once used an herb that my neighbour brought, and she said it lowers blood sugar"* (Participant 11, female), or based on the personal belief and experience:

"I take honey, myrrh, and aloe vera. I mix them together in a cup of water and drink it every morning. This is the best treatment for my diabetes, and it actually improves my blood sugar levels" (Participant 17, male).

Additionally, recommendations from some social media sources can also influence the decision to prioritise these remedies on their medication, as one participant shared:

"From time to time, I receive WhatsApp messages about using certain herbs or okra that can cure diabetes, and I go to the herbalist and try them, and I feel a slight benefit from them" (Participant 19, male).

Theme 5: Healthcare system influences

1) Patient-healthcare provider positive interactions

Many participants highlighted the impact of their interactions with healthcare providers on adherence to antidiabetic medication, which acted as both a barrier and a facilitator. Positive and effective communication with healthcare providers who provided explicit, consistent instruction and support was expressed by many participants to influence them positively and motivate adherence to antidiabetic medication. One participant, for instance, described the support provided by the pharmacist:

"The pharmacist always helps me, calls me first without waiting or delaying when dispensing the medication, and gives me information that makes it easier to take my medication. He tells me this is your medication, you must take it every day at this time and explains that the quantity is enough for a month and emphasises that I must come back to dispense it before the stock runs out" (Participant 1, male).

Similarly, some participants reported the positive impact of the advice and guidance from their general practitioner about the importance of taking medication on adherence, as one participant shared, *"I make sure to take them because the doctor strongly advised me to keep taking them"* (Participant 13, female). Another participant added:

"Doctors always encourage me and advise me to adhere to taking the medication. when I go and my blood sugar is high, the doctor always advises and warns me that if I don't take the medication consistently, complications of diabetes may occur" (Participant 15, female).

2) Inconsistent advice and trust Issues

Several participants indicated that seeing different general practitioner could lead to being provided inconsistent and conflicting advice, which could create confusion and negatively influence adherence. One participant expressed frustration, stating:

"Every time I see a different doctor, I get different advice. Some say my sugar levels are under control, you don't need to take one of these medications, while others say they're not and you need to take it" (Participant 4, female).

Additionally, receiving conflicting instructions from healthcare providers (general practitioner and pharmacist) reported by one participant, which led to confusion as he shared:

"Sometimes the pharmacist contradicts the doctor's opinion and says, for example, to only take one pill instead of two, and I get confused about whether to take one or two" (Participant 16, male).

Furthermore, two participants shared distrust in some healthcare providers due to perceived inexperience, as one expressed *"…these doctors are new graduates just experimenting on us"* (Participant 4, female), reflecting a lack of confidence in their doctor's guidance and advice as a barrier to medication adherence. Additionally, another participant expressed similar concerns for the pharmacist, reporting a lack of trust in the pharmacist's counselling, stating:

"When I get medicine from the pharmacy, they tell me how to take it, but I'm not always sure I can trust what the pharmacist says. I feel like I need to check with my doctor again because sometimes the pharmacist might get it wrong. For instance, they might say to take one pill when the doctor actually said two" (Participant 10, female).

This lack of trust highlights the importance of strong relationships and mutual trust in developing effective patient-pharmacist interactions. The absence of trust may result in patients not fully engaging in counselling or believing the information shared, which may result in poor adherence.

3) Challenges related to medication accessibility

Some participants cited medication accessibility as a barrier to adhering to antidiabetic medications. The unavailability of medications at their local health centres, leading to medication discontinuation, was reported by two participants living in rural areas. One participant shared:

"Two days ago, I went to the doctor for one of the diabetes medications, and he said it was not available, I must go to the main city and buy it at my expense. If it becomes available at the primary care centre later, it will be dispensed to you. This makes it very difficult for me; I must look for this medication in any of the big commercial pharmacies before the stock runs out, and sometimes I can't afford it for financial reasons, and I go for a period without taking this medication until it becomes available at the primary care centre" (Participant 1, male).

Another participant described a similar problem:

"The medications are not available because I live in a village and the health centre here doesn't always provide them. If they are not available, I have to wait until they are and then start taking them. They are available at commercial pharmacies, but they are expensive, and I can't afford to buy them" (Participant 12, female).

Additionally, one participant living in a rural area reported transportation issues that hindered access to the nearest healthcare facility. As she explained:

"Sometimes it's difficult for me because I run out of medication, and I stop taking it for a while because I have transportation issues. I don't have a car, and I live far from the nearest health centre, so I can't go for hospital visits or get the medication" (Participant 15, female).

The lengthy waiting times at hospitals to renew prescriptions was also described by several participants as a barrier to obtaining medication, which, in turn, influenced adherence. One participant shared:

"…. it's difficult. I have to see the doctor first for a prescription renewal, and I don't have much time to wait at the doctor's office and then get the medication. Because of this, sometimes I run out of medication and don't have time to get it dispensed, so I end up not taking it for several days because it's not available" (Participant 5, female).

Additionally, one participant mentioned that he intentionally skipped clinic appointments due to the inconvenience and lengthy wait times for the antidiabetic medication to be dispensed at the hospital:

"What stops me from taking them or getting a prescription is the inconvenience of going to the hospital. I have to wait for about five or six hours in the waiting room, and then they give me a strip of pills" (Participant 17, male).

5.6 Discussion: contextualising the findings into current literature

This qualitative study explored the barriers and facilitators of adherence to antidiabetic medication among people of South Asian and Saudi Arabian ethnic origin from socioeconomically deprived communities in Saudi Arabia. By collecting the perspectives of individuals from both minority ethnic groups and the majority, five key themes were developed for each group regarding the factors perceived as barriers or facilitators to adherence to antidiabetic medication. It is crucial to note that the thematic analysis for each group was performed independently using an inductive approach. Therefore, the overlap in themes indicates real similarities in experience instead of reflecting a predetermined framework. These main themes and subthemes developed among both groups were summarised in Table 23. The emerging themes included subthemes considered barriers, facilitators, or both of adherence to antidiabetic medication. The key findings for both groups will be discussed and compared in relation to the existing literature below.

Table 23: Developed themes and subthemes around the barriers and facilitators of adherence to antidiabetic medications among people of South Asian and Saudi Arabian origin in socioeconomically deprived communities

Group	Developed themes	Subthemes
South Asian group	1. Individual challenges and adaptation strategies	Impact of daily obligations on medication routine
		Financial barriers
		Coping strategies to support adherence
	2. Beliefs and experiences with medication	Necessity and effectiveness of medication
		Concerns about medication safety and long-term use
	3. Perceptions related to diabetes management	Reliance on symptoms and blood glucose for adherence
		Fear of complications as a motivator
	4. Social and cultural influences	Influence of family support
		Negative influence of social networks
		Religious belief and practices
		Alternative medicine preference
	5. Healthcare provider influences	Communication with healthcare providers
		Impact of cultural and language concordance
Saudi Arabian group	1. Individual challenges and adaptation strategies	Challenges encountered in daily life
		Coping strategies to support adherence

	2. Beliefs and experiences with medication	Necessity and effectiveness of medication
		Concerns about medication safety
		Barriers associated with insulin use
		Pill burden
	3. Emotional and perceptual responses to diabetes	Denial, misconceptions, and acceptance
		Perceived need for medication based on symptoms
	4. Social and cultural influences	Positive family support
		Negative influence of social networks
		Religious belief and practices
		Alternative medicine preference
	5. Healthcare system influences	Patient-Healthcare provider positive interactions
		Inconsistent advice and trust Issues
		Challenges related to medication accessibility

5.6.1 Individual challenges and adaptation strategies

Forgetfulness due to various daily challenges was primarily viewed as a barrier to adherence to antidiabetic medications among participants of South Asian and Saudi Arabian ethnic backgrounds. This finding, particularly for the Saudi Arabian group, is consistent with previous cross sectional studies conducted in Saudi Arabia among people with different long-term conditions, including diabetes, hypertension, stroke, epilepsy, and asthma in which forgetfulness was revealed as a reason for non-adherence to medication.[521-526] Participants in both groups reported that interruptions to their regular daily routines and busy schedules were the primary causes of their forgetfulness. This result confirms the findings of some studies that linked routine interruption to forgetting to take medication. These studies indicated that changes in daily routine caused by work schedules or other life events might lead to forgetfulness and reduce adherence.[199, 408, 409] Further, the literature has reported the impact of a busy schedule on medication adherence,[185, 527] as highlighted by participants from both groups. A previous study by Klinedinst *et al.,* revealing an association between a busy schedule and unintentional medication nonadherence.[527]

A few participants from the South Asian groups reported difficulties in adhering to their medications due to work-related stress. This finding might be explained and supported by previous research exploring the relationship between work-related factors (job strains) and medication adherence among people with diabetes and cardiovascular disease. A positive correlation was found between lower adherence and high job strain, where individuals experience less stable work schedules and increased physical and psychological stress, leading to a reduced ability to perform positive health behaviours (medication adherence).[528] In addition, many participants in this group experienced financial constraints that prevented their access to medications, thus hindering their adherence. These financial barriers resulted in an inability to renew medical insurance and, consequently, an inability to afford medications without insurance coverage. This finding is supported by a recent systematic review exploring the associations between socioeconomic factors and antidiabetic medication adherence in people with type 2 diabetes globally. This review found that most studies revealed an association between antidiabetic medication adherence and individuals' insurance status, with people less likely to adhere when they had no insurance.[218]

Participants from both groups, but predominantly the Saudi Arabian group, reported that integration medication into their daily routine facilitated adherence. This finding was also reported in a scoping review that examined the factors influencing medication adherence in people with long term conditions.[185] This review found that the ability to integrate medication into daily life was shown to improve adherence to medication of long-term conditions.[185] Consistent with other studies in the literature,[419, 529] this research found that using reminder tools such as phone alarms facilitated adherence to antidiabetic medication among participants of both the Saudi Arabian and South Asian groups.

5.6.2 Beliefs and experiences with medication

Most of the participants in both groups reported experiencing adverse effects as barriers to adherence to antidiabetic medication, leading them to reduce the dose or discontinue their medication without consulting their healthcare providers. This result aligns with previous research, where people of South Asian and Saudi Arabian origin revealed that experiencing adverse effects as the main factor that influenced adherence negatively in various long term conditions.[369, 405, 497, 521, 530-533] Moreover, participants from both groups, particularly the South Asian group, expressed their concerns about the safety of antidiabetic medication on body organs, specifically the kidneys, which hindered medication adherence. This result is consistent with the findings of a qualitative systematic review that explored the beliefs and attitudes towards medication among people of South Asian ethnic origin with cardiovascular disease and diabetes. This review showed the belief that medication toxicity can have a negative impact on medication adherence.[369] Similarly, a qualitative study was conducted to explore the barriers to adherence to antidiabetic medication among people of Saudi Arabian origin with uncontrolled diabetes. The study revealed that concerns about the impact of the medication on the kidneys and liver were significant barriers to adherence.[530] Collectively, the experience of medication adverse effects and concerns about the toxicity of medication on the kidneys resulted in participants from both groups, but mostly the South Asian group, reducing the dose or discontinuing their medication without prior consultation with their health care providers. This behaviour could be explained through the medication necessity concerns framework, which described two components involved in medication adherence: the belief in the necessity of the medication and the concerns regarding the medication (*e.g.,* long-term toxicity, adverse effects, dependency). Consequently, when concerns about medication

exceed beliefs in its necessity, patients are less likely to adhere to their prescribed regimen.[534] Therefore, the findings of this study indicated that the concerns outweighing necessity beliefs lead to reduced medication adherence among participants.

Furthermore, some medication-related barriers to adherence were reported uniquely within each group. The fear of medication dependency was reported by some participants of South Asian ethnic background, leading to inconsistency in medication taking and negatively influencing adherence. A similar finding was found in a recent qualitative study conducted in Australia to investigate medication adherence and factors influencing it among Indian migrants, which revealed that fears of becoming addicted to antidiabetic medication had a negative impact on adherence.[363] Additionally, some participants from the Saudi group reported another barrier to adherence, which was the inconveniences related to insulin use mainly fear of needles. This inconvenience resulted in inconsistent insulin use for some participants on insulin and the refusal of others to initiate insulin therapy. This result is consistent with the findings of a cross-sectional study conducted in Saudi Arabia, which investigated people's perceptions of perceived barriers to insulin. The study identified several barriers to insulin therapy, including needle phobia and discomfort.[535] Consistent with the previous studies,[530, 531] pill burden was also reported as a barrier to adherence to antidiabetic medication in some participants from the Saudi group. This finding can be explained by considering that these participants manage their diabetes along with other long-term conditions. To further support this, a study by Almutairi *et al.,* investigated the prevalence of nonadherence to medication among people of Saudi origin who experiencing multimorbidity and polypharmacy. This study found that about half of the participants had low adherence, with adherence decreased as the number of comorbidities increased.[536]

On the other hand, several participants across both groups believed in the necessity and efficacy of antidiabetic medication, which positively influenced adherence. This finding aligns with existing literature for the South Asian group, which indicated that beliefs regarding the necessity and efficacy of their medication were facilitators of adherence to medication.[369, 537] However, this finding for the participants from the Saudi group did not support previous research by Alodhaib *et al.*, who found that the perception of the ineffectiveness of antidiabetic medication was a barrier to adherence.[530] However, one finding which was not previously described in the literature was that a few participants from the South Asian group

reported that their belief in the ineffectiveness of antidiabetic medication acted as a barrier to adherence. As a whole, these findings were interpreted in light of the necessity-concerns framework and the health belief model.[428, 534] According to these models, people who believe in the necessity of the medication and perceive that its benefits outweigh the concerns are more likely to adhere to the medication regimen.

5.6.3 Emotional and perceptual responses to diabetes and Perceptions related to diabetes management

This study highlighted that some participants from both groups reported several barriers related to their illness perceptions, which can influence adherence. The initial denial and emotional response to the diabetes diagnosis led some participants from the Saudi group to delay the initiation of their medication or stop taking their medication after the initial initiation. Alruwaili also reported similar findings in research that explored the lived experiences of people with type 2 diabetes in a rural northern of Saudi Arabia, where the initial emotional reactions to the diabetes diagnosis resulted in a state of denial mixed with shock. These negative emotional responses to diabetes diagnosis have been shown in the literature to interfere with treatment adherence.[441, 442] However, acceptance of the diabetes diagnosis was shown to be a facilitator of adherence among some people in this group. This result is in line with previous research that found accepting the diagnosis of type 2 diabetes was associated with increased medication adherence.[445-447, 538] Additionally, this study revealed for the first time that several participants from the Saudi group held beliefs linking diabetes diagnosis to ‘evil eyes’, the belief among Muslims that one has the power to harm others by looking at them.[539] This belief was also reported in this population with other health conditions such as type 1 diabetes and multiple sclerosis.[539, 540] Consequently, this belief might negatively impact adherence to antidiabetic medication, as these participants' belief in the nonmedical cause of diabetes made them less likely to perceive disease severity and have hope that this, the evil eye, can be reversed through spiritual healing.[540, 541]

Participants from both groups, but mainly the South Asian group, reported illness perceptions related to managing diabetes based on symptoms or blood glucose levels, which also seemed to impact adherence to medications negatively. In the absence of these symptoms and low blood glucose levels, they tend to discontinue medications and only restart them when symptoms reappear, or the blood glucose level is elevated. Misconceptions among Saudi group

participants may be related to their educational level, as most did not receive formal education. This finding is supported by a recent cross-sectional study in Saudi Arabia investigating the factors influencing medication adherence among people with long-term diseases.[542] This study found that educational level was significantly associated with medication adherence, and people with a higher educational level may have a better understanding of medication adherence and the potential consequences of nonadherence.[542] For the South Asian group, the misconceptions may stem from minority ethnic groups' belief that diabetes is a short-term condition, which arose from not understanding the long-term nature of the disease.[450-454, 543] A qualitative study, for instance, explored Indian women's cultural beliefs and practices regarding diabetes management. In the study, participants perceived diabetes as a short-term condition, and this was seen as a barrier to self-management. The belief leads to inconsistent adherence to antidiabetic medication, as participants typically only take their medication when experiencing symptoms and discontinue use once symptoms subside.[451]

In contrast, illness perceptions about the complications and seriousness of uncontrolled diabetes among participants in both groups were associated with strong perceptions of the importance of medicines. This factor facilitates adherence to antidiabetic medications, as seen in other studies on diabetes and long-term illnesses.[130, 361, 424, 426] This could be interpreted using the health belief model, which states that a higher perceived severity of a condition correlates with increased adherence to recommended health behaviours.[458] Uniquely, one participant from the South Asian group mentioned that his concerns about the negative influence of uncontrolled diabetes on fertility were a strong motivator of adherence to antidiabetic medication. This could be explained using the health belief model, which suggests that perceiving a higher susceptibility to the risk of acquiring an illness (infertility) is related to increased adherence to recommended health behaviours (medication adherence).[428]

5.6.4 Social and cultural influences

This study found that South Asian and Saudi Arabian participants identified various sociocultural factors that were considered barriers, facilitators, or both to adherence to antidiabetic medications. Despite their differing backgrounds, both groups highlighted four

main factors: family support influence, negative influence of social networks, religious beliefs and practices, and alternative medicines preference.

Participants from both groups mentioned how their family support contributed to their medication adherence. Various types of family support were discussed, including reminding about medication times, emphasising the importance of medication adherence, providing emotional support, and actively engaging in medication management. Many studies in the literature have demonstrated that family support positively influenced medication adherence in the studied groups and other groups.[372, 463-466, 497, 544, 545] The role of families in supporting diabetes self-care management practices, including medication adherence, was examined in a recent umbrella review of 19 systematic reviews. This review showed that when families engaged positively with diabetes self-management, people with type 2 diabetes were more likely to adhere to it.[466]

In addition, the presence of other family members who also had diabetes served as an additional source of encouragement and motivation for medication adherence. This finding further supports the result of previous studies examining how an individual's health behaviours are influenced by those of their family members, particularly in adherence to medications for long-term conditions. This study found that individuals were 38% more likely to be adherent if they and their families took medication for the same condition.[467] A possible explanation for this might be the reinforcement of positive behaviours from family members. This positive reinforcement can provide encouragement, share knowledge about managing a condition, or supply practical assistance with daily routines for disease management.[468]

Furthermore, some participants from the South Asian group were motivated to adhere to medication to stay healthy and take care of family responsibilities to support and provide for their families. This could be attributed to the fact that in collectivist societies such as Asian communities,[546] families play an important role in individual's decision-making. The recognition that managing health has a direct impact on one's ability to care for and support family members can encourage adherence, as people frequently view their health through the lens of their ability to participate in family life, making medication adherence not just a personal concern but a familial obligation. As a result, the desire to remain active and capable of fulfilling familial responsibilities may enhance medication adherence.

Lack of social support was reported by some participants from the South Asian group to be a barrier to adherence to antidiabetic medication. This finding is consistent with that of Zhai *et al*., who also reported that minority groups in the US are less likely than Whites to have a social support system.[547] A systematic review of 18 observational studies on people with type 2 diabetes showed that higher levels of social support were associated with better medication adherence. Additionally, some participants from both groups expressed how community and familial advice against taking medication can have an impact on their decisions regarding adherence, ultimately leading to the discontinuation of their diabetes medication. This might result from the limited health literacy of participants and their community regarding diabetes and its management,[283, 548, 549] leading to a reduced understanding of the importance of consistent medication adherence and a belief in the effectiveness of diabetes management recommendations shared within the community. Further, a few participants from the South also reported experiencing stigma associated with diabetes in their communities, which negatively affected their adherence to antidiabetic medications since they preferred to keep their diabetes private by not taking medication in public places, similar to other studies.[313, 363, 369]

Consistent with previous research,[322, 473-475] several participants from the Saudi Arabian group and some from the South Asian group reported that religious beliefs and practices, such as praying, provided them with inner strength and motivation, which can positively influence adherence to antidiabetic medication. Additionally, some participants from both groups who followed Islam reported that reciting the Quran gives them internal peace and strength to manage their diabetes. This finding supports a recent qualitative study by Ahmad *et al.*, which explored the influence of religious beliefs on diabetes self-management among 23 Indian migrants in Australia. The study revealed that reciting the Quran, among other religious practices, helped them in managing their diabetes.[550] Further, some participants from the Saudi group expressed that self-care and seeking treatment are part of their religious teachings, which motivated them to adhere to their medications. This finding is supported by the idea that Islam emphasises the significance of health preservation and seeking treatment when faced with illness.[551]

On the other hand, some religious-related beliefs and practices were identified by participants from both groups as a barrier to adherence to antidiabetic medication. Some participants in

both groups reported believing in the healing properties of Zamzam water to help them manage their diabetes without the need for medication. This belief was also reported by other qualitative studies that have examined the medicine-related problems experienced by people of South Asians and Middle Eastern origin and have identified potential culturally specific factors that could be contributing to such issues.[552] The belief in Zamzam water's healing properties stems from its significant value for Muslims. They believe it will heal illnesses, as shown in their religious teachings.[553] In addition, some participants from the Saudi group who believed that they developed diabetes because of evil eyes used Ruqyah (Islamic practice that involves reciting specific verses from the Qur'an and prophetic supplications to seek protection and healing. It is considered a remedy for various kinds of harm, including the evil eye, magic, and health issues.[554]) to cure the evil eye, and, as a result, diabetes disappeared. Several factors could explain this finding. Firstly, cultural beliefs influenced people's perception of diabetes itself, as participants who used Ruqyah believed that their diabetes aetiology was due to the evil eye. Secondly, all participants in this group were Muslim, and they seemed to follow all complementary and alternative medicine mentioned in Islamic literature as having therapeutic benefits.[555] A few interviewees in this group also mentioned that fasting during Ramadan, the white days (specific days of each Islamic month), caused them to miss taking their medication on time or that they believed fasting could control their blood sugar, which can adversely affect adherence to antidiabetic medications. This finding had not previously been reported in this group, except in one cross-sectional study, which found that approximately 59% of people from the eastern region of Saudi Arabia changed their medication during Ramadan, frequently leading to reduced adherence.[556] Furthermore, some participants who followed Hinduism reported that their Hindu beliefs influenced them sometimes to use meditation and yoga to manage blood glucose rather than their antidiabetic medication. Similarly, among Indian immigrants who practised Hinduism, meditation was thought to be effective in improving diabetes. They reported meditation can enhance their immune system and reduce blood glucose levels.[550]

This study highlighted that many participants from both groups reported the preference for alternative medicines over the prescribed antidiabetic medication due to their belief in its effectiveness and safety, which worked as a barrier to adherence to antidiabetic medication. This finding is consistent with previous research findings that showed Saudi and South Asians

using alternative medicine in addition to or instead of prescribed medication for diabetes.[356, 369, 494, 530, 545] The preference for alternative medicine among these groups was primarily influenced by recommendations from social networks or social media, as was previously reported.[369, 494, 530, 545] Furthermore, the prevalence of herbal medication use was 75% among Saudis and 73% among South Asians, and participants in both groups did not disclose their use of herbal medicines to their healthcare providers.[495, 557, 558] The consistent finding of these groups using alternative medicines throughout this study and previous studies suggested that it might be a cultural phenomenon rather than an individual case.

5.6.5 Healthcare providers / system influences

Most of the study participants in both groups reported some factors related to healthcare providers that they perceived as barriers or facilitators to adherence to antidiabetic medication. Consistent with previous studies,[497, 501, 531, 545] many participants from the Saudi group and a few from the South Asian group cited effective communication between them and their healthcare providers, which includes providing explicit instructions and guidance on the importance of consistent medication adherence as a motivator to adhere to their medication. This result supported the findings of a meta-analysis of 106 studies that examined the relationship between provider-patient communication and adherence in different health conditions, which found that patients with poor provider communication were 19% [r = 0.19, 95% CI = 0.16 - 0.21] less likely to adhere to their medication.[502] Furthermore, previous research has shown that providing clear and sufficient medical information about medication benefits, as well as answering patients' questions, contributed to medication adherence.[138, 531] However, these improvements may not be sustainable, highlighting the need for ongoing support and intervention.

Some South Asian participants, however, reported that ineffective communication and lack of engagement from healthcare providers during consultations hindered their ability to express concerns about medication, thus negatively impacting adherence. This might be attributed to the cultural and language barriers, which made the participants reluctant to express their concerns and seek information about their medication. Previous study examined influence of race/ethnicity and language concordance between people of African American ethnicity and their physicians on adherence to cardiovascular medications.[559] The study found that people of African American ethnicity whose physicians shared their ethnicity were more likely

to adhere to their medications, possibly due to improved communication and trust with their physicians.[559] Further, a systematic review of studies conducted in different settings concluded that language barriers can lead to miscommunications between healthcare professionals and patients, reduced access to routine healthcare services, poor understanding of their disease and medication, and decreased satisfaction with their healthcare.[374] Additionally, the perceived lack of engagement and ineffective communication from the healthcare provider made some participants feel less involved than active participants in their medical consultations. A lack of partnership in the patient-physician relationship affects patients' ability to establish rapport with their healthcare providers. As a result, patients may feel ignored and hesitant to interact with healthcare providers, and they believe that the time provided for their appointments is insufficient to satisfy their needs and expectations.[560] Moreover, a few participants in this group depend on healthcare providers in their country of origin to seek information about diabetes management. This might be related to the language barriers and cultural differences, which hinder access and consultations with the local healthcare providers.

Additionally, some participants from the Saudi group reported barriers to adherence related to healthcare providers. Seeing multiple healthcare providers at frequent appointments who provided inconsistent and conflicting advice was noticed by a few participants, which can create confusion and negatively influence adherence to antidiabetic medication. This finding was also previously reported in the literature as a barrier to adherence to antidiabetic medication among people with uncontrolled diabetes in Qatar.[184] Inconsistent advice from healthcare providers can reduce patients' trust in their providers. When trust between patients and healthcare providers is reduced, patients might be less likely to follow medical instructions, negatively influencing adherence.[185, 561, 562] Moreover, a few participants reported distrust of pharmacists and fresh graduate physicians. The lack of trust in pharmacists could be attributed to the fact that many people in Saudi Arabia are unaware of the expanded clinical roles that pharmacists can play and frequently see them as medication dispensers rather than healthcare providers with clinical expertise.[563, 564] This perception may limit their trust in pharmacists and the information they provide, leading to a decrease in medication adherence. Similarly, the lack of trust in physicians has been shown to have a direct effect on medication nonadherence.[562] Furthermore, only one participant reported

receiving conflicting instructions from physicians and pharmacists, which has been shown in the literature to have a negative impact on medication adherence.[565, 566]

Participants in Saudi group reported barriers to adherence related to medication accessibility, attributed to different factors in each group. The unavailability of medication in the local primary centre in rural areas was reported as a barrier to adherence for some participants. Medication shortages in rural pharmacies in Saudi Arabia have been reported in the literature, causing patients to be unable to fill their prescriptions and consequently hindering medication adherence.[567, 568] Additionally, the long waiting time at the hospitals to renew prescriptions was highlighted by a few participants from the Saudi group as a barrier to adherence, which led them sometimes to skip their appointments and inconsistently taking their medication. Longer wait times at hospitals have frequently been found to be negatively related to patient satisfaction.[569-571] For instance, a study of 850 people in Saudi Arabia showed that excessive wait times for various services in hospitals, such as medical appointments and dispensing medication, resulted in significant patient dissatisfaction.[570] Research has indicated that patients with lower satisfaction levels are less likely to form positive relationships with the healthcare system, which can result in lower levels of adherence and continuity of care.[572]

5.7 Conclusion

This qualitative study explored the barriers and facilitators of adherence to antidiabetic medication from the perspective of people of South Asian and Saudi Arabian ethnic origin from socioeconomically deprived communities in Saudi Arabia. The results identified various barriers and facilitators, some unique to the participants from each group and others shared by both groups. Based on this finding, adherence to antidiabetic medications should not be solely attributed to ethnicity but to a complex interplay between individual, cultural, socioeconomic, and healthcare system factors. Future interventions aimed at improving medication adherence for people with diabetes from these groups should consider an approach that addresses healthcare system-related barriers, individuals' specific barriers and their cultural background influence.

The following chapter (Chapter 6) focuses on the overarching discussion and conclusions for this programme of work and identifies the key recommendations and implications for policy

and practice that have emerged in this thesis. In addition, Chapter 6 will discuss the strengths and limitations of the qualitative research studies carried out as part of this project, as well as identify the relevant areas that future research should explore.

Chapter 6. Discussion and Conclusions

6.1 Introduction

Given that Chapters 4 and 5 of this thesis provide individual discussions of the qualitative study findings specific to each setting, this chapter aims to consolidate the key findings, reflect on the strengths and limitations, and discuss their implications for practice. Building upon the overarching research question of how ethnicity influences adherence to antidiabetic medications among people from minority and majority ethnic groups in socioeconomically deprived communities across two settings, this thesis explores several key areas. Chapter 4 explores the barriers and facilitators of medication adherence among South Asian and White British individuals in socioeconomically deprived areas in the North East of England. Furthermore, Chapter 5 delves into the barriers and facilitators of adherence to antidiabetic medication among people of South Asian and Saudi Arabian ethnic origin in socioeconomically deprived areas in Saudi Arabia. Additionally, recommendations are provided to improve the current situation and support the development of patient-centred medication adherence interventions for these minority ethnic groups. Finally, the chapter will outline potential areas that future research could address and how the results of this work could inform future interventions for the studied ethnic groups.

6.2 Comparing the findings from the four groups across the two study sites (UK and Saudi Arabia)

The researcher has synthesised the main thematic similarities and differences across the minority and majority ethnic groups at the two study sites (demonstrated in Figure 10). The main thematic similarities across the majority and minority groups at both study sites were centred around four areas: (1) daily life challenges and strategies affecting adherence, (2) beliefs about medication necessity and safety, (3) support systems from family, healthcare providers, and religion, and (4) awareness of the consequences of uncontrolled diabetes as a motivator. The main thematic differences across the majority and minority groups at both study sites were synthesised into six key areas: (1) the emotional impact of diabetes diagnosis and treatment, (2) misconceptions about diabetes management, (3) concerns and perceptions about antidiabetic medication, (4) social network influences, (5) cultural and religious beliefs and practices, and (6) healthcare system/provider influences. These six areas were either unique to the minority groups or shared in varying combinations between majority and

minority groups, such as one majority group and both minority groups, or one majority group and one minority group (summarised in Table 24).

The sections below will discuss the synthesised thematic similarities and differences separately. To facilitate comparing in these sections, the four groups are referred to as follows: UK minority, UK majority, Saudi minority, and Saudi majority. The UK minority group refers to participants of South Asian ethnic backgrounds in the UK, while the UK majority group refers to White British participants. Similarly, the Saudi minority group refers to participants of South Asian ethnic backgrounds in Saudi Arabia, while the Saudi majority group refers to Saudi Arabian participants. Where a finding is reported by all groups across the two study sites, it will be referred to as 'all ethnic groups'.

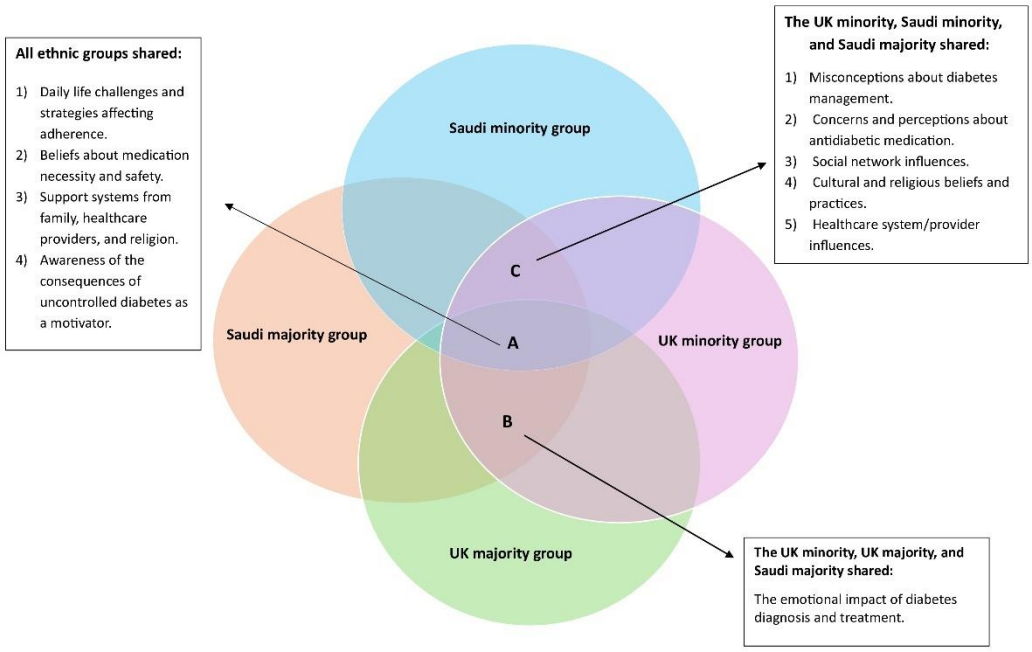

Figure 10: The overarching thematic similarities and differences across the minority and majority ethnic groups in the UK and Saudi Arabia

Table 24: The overarching thematic differences across the minority and majority ethnic groups in the UK and Saudi Arabia

Overarching thematic differences		UK majority group	Saudi majority group	UK minority group	Saudi minority group
The emotional impact of diabetes diagnosis and treatment	Emotional responses to diabetes diagnosis and medication	✓	✓	✓	
	Self-motivation and awareness as a motivator to adherence.	✓		✓	
	Fatigue associated with the pill burden		✓		
Misconceptions about diabetes management	Causal belief about diabetes diagnosis		✓		
	Adherence based on symptoms		✓	✓	✓
	Adherence based on the blood glucose level				✓
Concerns and perceptions about antidiabetic medication	Concerns about the long-term safety of medication		✓	✓	✓
	Fear of becoming dependent on medication			✓	✓
	Inconveniences associated with insulin administration		✓	✓	
	Inconvenience associated with insulin pump	✓			

	Negative perception about insulin			✓	
	Perception about ineffectiveness of medication.				✓
Social network influences	Negative advice from social networks		✓		✓
	Social stigma related to diabetes			✓	✓
Cultural and religious beliefs and practices	Fasting during Ramadan as barrier to adherence		✓	✓	
	Concerns about the halal status of medication			✓	
	Managing diabetes depends on animistic traditions and meditation			✓	✓
	Religious healing practice 'Ruqyah'		✓		
	Belief in Zamzam water for diabetes management			✓	✓
	Alternative medicine preference		✓	✓	✓
Healthcare system/provider influences	Language barriers and limited consultation time			✓	✓

	Lack of engagement during consultation time				✓
	Seeing multiple physicians		✓		
	receiving conflicting instructions from healthcare providers		✓		
	Lack of trust in healthcare providers		✓		
	Barriers related medication accessibility: medication cost			✓	
	Barriers related medication accessibility: financial barriers / health insurances status				✓
	Challenges related to medication accessibility: unavailability of medication at outpatient pharmacies in rural areas and lengthy waiting times to renew prescriptions.		✓		

6.2.1 Thematic similarities across majority and minority groups in the UK and Saudi Arabia

Daily life challenges and strategies affecting adherence

Participants across all ethnic groups reported forgetfulness, work and disruption to daily routines as hindrances to adherence to antidiabetic medication. In particular, among participants from the Saudi minority and Saudi majority groups, forgetfulness was attributed to the unavailability of medication within reach during daily outings. This finding aligns with a scoping review that explored factors influencing medication adherence among people with long-term conditions from the patient's perspective. The review reported that a lack of regular routines, busy schedules, and changes to routines during special occasions negatively impacted adherence, often leading to missed doses.[185] Additionally, participants from all ethnic groups consistently mentioned that balancing work hours with prescribed medication times was a challenge that negatively affected their adherence. This finding supports the work of other qualitative studies, which revealed the difficulty of taking medication during work hours as a barrier to adherence.[199, 573, 574] Moreover, participants from the UK minority and Saudi minority groups found it difficult to take medication in public, particularly at work, leading them to skip their medication during work hours. This issue may be linked to the perception of diabetes as a stigmatised condition and taking medication as a sign of weakness or ill health within the South Asian community.[496, 575] Despite these barriers, participants from all ethnic groups discussed adopting strategies, such as using alarms and integrating medication into daily routines, to facilitate adherence to antidiabetic medication. Prior literature has also highlighted the role of associating medication with daily routines in promoting adherence.[185, 576]

Beliefs about medication necessity and safety

Experiencing adverse effects were reported by participants from all ethnic groups as a difficulty in taking their medication as prescribed; however, there were differences described between participants from all ethnic groups in the way that people coped in response to adverse effects. Among participants from the UK majority and the UK minority groups, there was a shared experience that if they experienced side effects, they discussed and sought counselling from their healthcare providers on how to manage or minimise these effects. On the other hand, participants from the UK minority, Saudi minority and Saudi majority groups experiencing

adverse effects resulted in inconsistency in taking or discontinuing their antidiabetic medication without consulting their healthcare provider. A possible explanation for this might be a lack of knowledge about medication necessity or heightened concerns about medication safety due to adverse effects, particularly when such concerns were prevalent among these groups.[337, 369, 577] Furthermore, issues related to healthcare providers, including a lack of trust or communication barriers that prevent patients from expressing concerns, may also be contributing factors.[184, 578, 579] Despite these concerns, some participants from all four groups beliefs in the necessity and effectiveness of antidiabetic medication in managing their diabetes was expressed by participants from all ethnic groups, which positively impacted their adherence.

Support systems from family, healthcare providers, and religion

The positive effects of supportive family and social networks that provide emotional and practical support for medication adherence were expressed by participants from all ethnic groups. This finding is consistent with other studies, which also emphasise the positive role of family support in influencing medication adherence among people with various long-term conditions.[372, 459-465] The social support among the UK minority group was not limited to the immediate family, but also to the social networks in the workplace or religious communities. However, uniquely for the Saudi minority group, participants mentioned that not having access to family and social support made it difficult for them to adhere to their medication. This challenge, faced by the South Asian minority group in Saudi Arabia, but not the minority ethnic group in the UK, may be due to their migration status and the conditions of their residency in the country.[580] In contrast, the South Asian community in the United Kingdom, where many people had obtained nationality or permanent residency, which allowed them to establish community networks, including extended family and social support systems.

Participants from all ethnic groups shared that some religious beliefs and practices (such as prayer) provided them with emotional support, strength, sense of hope, and motivation, which facilitated their medication adherence. Religious practices, such as recitation of the Quran, were shared by participants who followed Islam, particularly those from the Saudi majority and Saudi minority groups. These practices contributed to their inner peace and strength, helping them manage their condition and adhere to medication. A possible interpretation of

this finding lies in the religious coping paradigm, which involves relying on faith to find strength, comfort, and understanding. Religious beliefs can provide emotional support to individuals in dealing with the psychological burden of illnesses. This support can improve people's psychological well-being by reducing stress and leading to better health outcomes.[581] Additionally, Some Muslim participants from the Saudi majority and the UK minority groups were motivated to take their medication as part of their religious obligation, believing it was essential to care for themselves and seek treatment. This finding further supports the idea that religious beliefs positively influence medication adherence, as religious teachings often promote caring for the body as a moral duty, encouraging individuals to adhere to treatments and providing them with a sense of purpose and responsibility toward their health.[581] Another source of support that expressed by participants from all ethnic group were healthcare providers. Participants described the positive support from healthcare providers can work as a motivator for adherence to antidiabetic medication. This finding highlights the critical role of healthcare providers in offering not only informational support but also emotional support.[582] A previous study found that support from healthcare providers can reduce diabetes-related distress.[583] Consequently, the reduction in distress was associated with higher adherence to their medication in people with diabetes.[412, 584]

Awareness of the consequences of uncontrolled diabetes as a motivator

The awareness of the consequences of uncontrolled diabetes based on personal experience of diabetes complications or influenced by others' experience among participants from all ethnic groups served as a facilitator of adherence to antidiabetic medication. This finding was consistent with the Common-Sense Model, in which people perceiving severe consequences associated with their illness are motivated to take action (medication adherence) to reduce the likelihood of these consequences.[585] People with hypertension and chronic non-malignant pain reported a positive relationship between perceived serious illness consequences and medication adherence.[586, 587] However, individuals with other long-term conditions, including asthma and heart failure, reported a negative correlation.[588, 589] The discrepancy in the findings may be due to the patient's level of control over their health condition and the years of illness experience, which may have an impact on the correlation between perceived illness consequences and medication adherence.[426] People who adhere

regularly to their medication are likely to feel better and, consequently, perceive the consequences of their illness as less severe.[426]

6.2.2 Thematic differences across majority and minority groups in the UK and Saudi Arabia

The emotional impact of diabetes diagnosis and treatment

In respect of a diabetes diagnosis, the initial negative emotions, including self-denial were discussed mainly as barriers to adherence to antidiabetic medication among participants from the UK majority, Saudi majority, and UK minority groups. These negative emotional reactions to diabetes diagnosis, such as anxiety, denial, and fear, were reported to significantly interfere with medication adherence, leading to reluctance or not initiating medication and negatively affecting clinical outcomes.[441, 442] Acceptance of a diabetes diagnosis, however, was reported as a facilitator of adherence among these groups. This aligns with earlier findings that acceptance of long-term conditions results from a gradual change in patient behaviour, which in turn increases awareness of and adaptation to the illness.[590] This acceptance enhances patients' responsibility for their health and encourages them to adhere to medication.

Negative feelings about the requirement to take medication daily and the inconvenience of carrying medication on their person were reported by participants from the UK majority and UK minority groups as barrier to adhering to antidiabetic medication. These negative feelings can reduce self-care motivation, leading to poor physical and emotional well-being, suboptimal diabetes management, and decreased medication adherence.[413-415] Particularly for the UK majority and UK minority groups, self-motivation and awareness of the importance of medication for their condition and overall health were key motivators of adherence to antidiabetic medication. This may be attributed to the availability and accessibility of structured diabetes education programs in the UK, such as DESMOND (Diabetes Education and Self-Management for Ongoing and Newly Diagnosed).[591] These programs can result in increasing patients' self-awareness and motivation to manage their condition effectively, leading to improved medication adherence. Especially among participants from the Saudi majority group with comorbidities, fatigue associated with the pill burden was expressed as a barrier to adherence. This served as a barrier due to the emotional distress of managing diabetes alongside other long-term conditions, with previous studies showing that psychological distress is significantly associated with comorbidities.[416, 417]

Misconceptions about diabetes management

The causal belief about diabetes diagnosis, which is believed to be the result of envy or evil eye or because of traumatic effects, was uniquely reported by participants from the Saudi majority group, which can act as a barrier to adherence. In accordance with this result, previous studies have demonstrated that people with hypertension and asthma with strong cause beliefs about the illness were less likely to adhere to their medications.[592, 593] Additionally, misconceptions about diabetes management that negatively influence adherence to antidiabetic medication were reported mainly among the UK minority , Saudi majority, and Saudi minority groups. Many participants from these groups mentioned that they only adhered to their medication when they experienced symptoms. If they felt relief, they would stop taking the medication or reduce the dose, which hindered consistent taking of their medication. These misconceptions were predominantly observed among the Saudi minority group, who hold the belief that they need to take their medication only based on their blood glucose levels. Varying levels of health literacy among these groups might explain the observed misconceptions. A recent review of 18 studies identified limited health literacy as one of the main causes of poor medication adherence among patients with type 2 diabetes.[594] Consequently, these groups may lack an understanding of the importance of consistent medication adherence, regardless of immediate symptoms, leading them to base their adherence on personal feelings or blood glucose readings.

Moreover, people of South Asian ethnic origin may hold misconceptions about diabetes due to cultural beliefs that view it as a short-term condition, reflecting a lack of understanding of its long-term nature.[450-454, 543] A qualitative study highlighted how Indian women perceive diabetes management, noting that they see diabetes as a short-term condition. [451] This belief results in inconsistent medication adherence, with participants tending to take antidiabetic medication only when symptoms appear and stopping once it is improved.

Concerns and perceptions about antidiabetic medication

The Saudi majority, the UK minority, and predominantly Saudi minority groups expressed concerns about the long-term safety of medications on the kidneys and liver as barriers to adherence, often leading participants to skip doses and avoid taking their medications regularly. These concerns are influenced by cultural beliefs that favour the perceived safety of

alternative medicine, leading individuals to prioritise natural remedies over prescribed medications, which they view as chemical and synthetic.[494, 595] Uniquely among the UK minority and the Saudi minority groups, participants reported a fear of becoming dependent on antidiabetic medication as a reason for inconsistently in taking their medication to avoid this perceived effect. This perception could be the result of cultural beliefs or a lack of knowledge about the medication.[337, 596]

Barriers related to insulin were reported by participants in the UK minority and the Saudi majority groups. These participants noted that inconveniences associated with insulin administration, such as fear of injections, led them to skip doses or refuse to initiate insulin therapy. Additionally, a unique barrier related to insulin pumps was reported by one participant in the UK majority group, which led to inconsistent use due to fear, physical discomfort from the injections, and negative emotional effects, such as the pump serving as a constant reminder of their illness. All of these concerns are related to psychological insulin resistance, a common barrier that prevents people with diabetes from starting or adhering to the insulin therapy.[597] Furthermore, some misconceptions related to insulin and oral antidiabetic medication were reported among the UK minority and Saudi minority groups. Participants from the UK minority group expressed misconceptions about insulin therapy, viewing it as a last resort and a sign of disease progression. These misconceptions are likely to be influenced by the common belief among South Asian people that insulin is only used as a last resort and that a rapid decline is inevitable if it is used at all.[598, 599]

Additionally, misconceptions about the ineffectiveness of antidiabetic medications were reported by participants from the Saudi minority group. These misconceptions may stem from cultural beliefs, educational gaps, and communication barriers. Cultural and traditional practices within South Asian communities often emphasise a preference for alternative medicines over prescribed ones, leading to doubt regarding the efficacy of prescribed antidiabetic medications.[494, 595]

Social network influences

Receiving advice against taking medication from people in their social networks, due to safety concerns or other reasons, has led participants from both the Saudi majority and Saudi minority groups to hinder adherence to antidiabetic medications. This finding emphasises the

importance of social networks in shaping health behaviours within these groups. Families and communities have a significant influence on individual decisions in collectivist cultures like Saudi Arabia and South Asian communities.[600, 601] Consequently, recommendations from trusted family members and friends can significantly impact patients' perceptions of antidiabetic medications, leading to situations where, if these trusted individuals express concerns about the safety or necessity of the medication, patients may question or disregard healthcare provider advice. This misinformation often originates from limited health literacy among participants and their communities regarding diabetes and its management. [283, 548, 549] Uniquely for the UK minority and Saudi minority groups, participants reported experiencing stigma related to diabetes within their communities; specifically, this stigma negatively impacted their adherence to antidiabetic medication, as they preferred not to take their medication in public to keep their condition private. The social stigma associated with type 2 diabetes among South Asian communities can result from the perception that having diabetes or taking medication is related to being 'unhealthy' or 'weak', [496] and also the belief that diabetes is a sign of physical inadequacy in traditional marriages in these communities. [313]

Cultural and religious beliefs and practices

Some religious practices were described as barriers to medication adherence; specifically, this was among participants from the UK minority, Saudi minority, and Saudi majority groups. Muslim participants from the UK minority and Saudi majority groups mentioned that fasting during Ramadan made it difficult to take their medication at the prescribed time. Specifically, among the Saudi majority group, participants believed that fasting could control their blood glucose levels, which resulted in them skipping doses or discontinuing medication during the fasting period. The inconsistent use or discontinuation of medication during fasting can often be attributed to a lack of education about the importance of adherence and the possibility of adjusting medication doses with healthcare providers before Ramadan, as well as people's reluctance to disclose their fasting intentions during consultations, leading to a lack of counselling regarding dosage adjustment.[480-482] Concerns about the halal status of medications were also seen to influence adherence, especially among the UK Minority group.[602] However, the Muslim participants in the Saudi minority group did not report this concern, as Saudi Arabia is a Muslim country and generally ensures that medications comply

with Islamic dietary laws. This assurance is regulated by the Saudi Food and Drug Authority, a governmental body responsible for supervising and regulating food products, medicines, and health products, as well as ensuring their halal compliance.[603] These laws alleviated concerns about the medication's permissibility, making it less of an issue among this group. One participant from the UK minority group, who identified as Christian, reported that he followed the advice of his Buddhist friend by adhering to animistic traditions, specifically by discontinuing medication and making sacrifices to spirits, in an attempt to cure his diabetes. Additionally, participants from the Saudi minority group reported controlling their diabetes through meditation and yoga instead of medications, influenced by their beliefs as Hindus. These findings highlight how various religious traditions significantly influence the ways in which people from minority ethnic groups perceive and manage diabetes. Uniquely, participants from the Saudi majority group who believed their diabetes was due to some spiritual belief such as 'envy and evil eyes' mentioned that they used traditional healing practices 'Ruqyah' to treat the believed cause of diabetes. This finding is consistent with a previous review examining the impact of complementary and alternative medicine, including spiritual healing, on adherence to antiepileptic therapy.[604] The study found that the belief that epilepsy has a spiritual cause was one of the most common reasons for poor adherence to antiepileptic medication and greater reliance on spiritual healing.[604] Further, some Muslim participants in the Saudi majority and Saudi minority groups were reported to believe in the healing properties of Zamzam water to help them manage their diabetes without the need for medication. Further, participants from the UK minority, Saudi minority, and Saudi majority groups reported barriers to adherence related to alternative medicine preference. The preference for alternative medicine over prescribed medications was mainly due to beliefs in its efficacy and safety, recommendations from others within their social networks, and, for some Muslim participants, the use of certain herbs such as black seed and other alternative medicine because it is part of their religious teachings.[605]

Healthcare system/provider influences

Effective communication between healthcare providers and participants from the UK minority and Saudi minority groups was hindered by language barriers and limited consultation time. This prevented them from seeking or expressing their concerns about diabetes management, particularly medication-related issues, or disclosing their use of alternative medicine, which

can negatively influence medication adherence. This finding with those of Al Shamsi *et al.*, who also found that language barriers can result in ineffective communication between healthcare providers and patients, reduced access to routine healthcare services, and poor understanding of disease and medication, negatively influencing adherence.[374] Furthermore, lack of engagement during consultation time were reported by participants from the Saudi minority group to prevent them from discussing medication concerns, which had a negative impact on adherence. This can result from cultural and language barriers between patients and healthcare providers. Consequently, patients may feel ignored and hesitant to interact with healthcare providers, believing that the time allocated for their appointments is insufficient to meet their needs and expectations.[560] Additionally, participants from the Saudi majority group reported unique barriers related to healthcare providers, including seeing multiple physicians, receiving conflicting instructions from healthcare providers, and lacking trust in their healthcare providers. A lack of consistency in the advice given by healthcare providers and lack of trust, can lead patients not to follow medical instructions and negatively impacting their adherence.[185, 561, 562]

Moreover, medication accessibility was discussed as barrier to adherence mainly among the UK minority and Saudi minority groups. For the UK minority group, some participants reported medication costs as a barrier to adherence to antidiabetic medication, despite the availability of free prescriptions for people with diabetes in the UK; specifically, this was attributed to a lack of knowledge about the free prescription scheme or how to obtain the necessary eligibility certification. This result might be related to the language barrier, which is widely recognised as a barrier to accessing healthcare services by ethnic minorities in the literature.[504-506] In the Saudi minority group, access to medication was directly linked to health insurance status. Many participants stated that, on occasion, their financial restrictions prevented them from renewing their medical insurance, which in turn hindered their ability to access free medication and negatively impacted their adherence. This result is consistent with a previous review which found that individual health insurance status significantly impacts antidiabetic medication adherence in people with type 2 diabetes globally, with those lacking insurance less likely to adhere to their medication.[218] In addition, participants from the Saudi majority group reported barriers to medication accessibility, though for different reasons than those reported by the Saudi minority group. These barriers included the unavailability of medication

at local primary healthcare centre outpatient pharmacies for those living in rural areas, transportation issues that hindered access to the nearest healthcare facility and medications, and lengthy waiting times to renew prescriptions.

6.3 Strengths and weaknesses of the two qualitative studies

6.3.1 Overarching strengths and weaknesses of both studies

As part of this PhD programme, two qualitative studies were conducted among minority and majority ethnic groups in two distinct countries to explore barriers and facilitators of adherence to antidiabetic medication, offering noteworthy strengths. One of the key strengths is that the research provided insights into the barriers and facilitators of adherence to antidiabetic medication from the perspective of the same minority ethnic groups in two different settings, as well as from the majority groups, enabling cross-cultural comparisons. Comparing different group perspectives on these phenomena using a qualitative approach allows for the identification of similarities and differences whilst also providing insight into areas where further support or intervention may be needed.[606] This approach offers a comprehensive understanding of how cultural contexts and healthcare systems influence adherence to antidiabetic medication and allows for the identification of unique factors perceived by minority ethnic groups as barriers and facilitators of adherence across the two settings. Furthermore, focusing on minority and majority ethnic groups in each country ensured that the study captured experiences from the perspectives of each group, which is critical because it highlights the unique barriers that different ethnic groups face when adhering to antidiabetic medication, providing valuable insights for developing tailored interventions specific to each ethnic group. However, there were some important limitations, which should be acknowledged. The studies in both settings only included participants who had an active prescription for antidiabetic medication for at least one year. This focus may have excluded individuals who face additional or different barriers to medication adherence, particularly those who have discontinued their prescriptions, never started them and choosing to control their condition through non-medication-based approaches. These people might encounter unique challenges that were not captured in this study.

6.3.2 Strengths and weaknesses specific to the UK study arm

This study was the first to explore the views of minority and majority ethnic groups from socioeconomically deprived communities in the North East of England regarding barriers and facilitators of adherence to antidiabetic medication, identifying unique challenges faced by minority groups and informing interventions to improve health equity. However, the researcher acknowledges some limitations in the work conducted within this study. Firstly, the research focused on South Asian people as the minority ethnic group in this study because they have disproportionately higher rates of diabetes and its complications.[23, 377] However, the other minority ethnic groups may have different experiences, and thus, future research should explore the barriers and facilitators of adherence from the perspectives of these other groups in the UK.

There are also some potential limitations related to the interview techniques used in this study, including the use of virtual call-based software and telephone calls, which were employed according to participant preferences. Although using web-based platforms for qualitative interviews offers several advantages, such as providing scheduling flexibility, convenience, and allowing participants to choose a comfortable and familiar environment,[607] there are also potential drawbacks, including internet connectivity problems that affect the clarity of the audio and video in a few interviews, but no differences were noted in the data collected across the different interview formats.[607]

Additionally, a few participants preferred telephone calls over video call software, which impacted researcher’s ability to observe a full range of body language and nonverbal communication that might have added additional context and depth to the participants' verbal responses. Although some interviews were conducted in person, it is important to consider the environment in which these participants were interviewed. The researcher observed that the interviews took place in the pharmacy consultation room within the community pharmacy, an environment associated with medical authority, which might have made participants feel less comfortable compared to their own home environments, where many other participants were interviewed. This discomfort could explain the less extensive quotes and shorter interview durations from those interviewed in the pharmacy compared to those interviewed at home.

6.3.3 Strengths and weaknesses specific to the Saudi study arm

This study was one of the first to examine the perspectives of majority and minority ethnic groups from socioeconomically deprived communities in Saudi Arabia about barriers and facilitators of adherence to antidiabetic medication, highlighting difficulties encountered by minority groups and informing interventions aimed at enhancing health equity. However, the researcher acknowledges that there were some limitations in the conduct of this study that should be considered. One limitation of this study is the lack of an established socioeconomic status or deprivation index in Saudi Arabia. Consequently, this study relied on an SES index derived from a single study to assess area- or governance-level SES in Saudi Arabia. However, this approach may not fully capture the complexity of deprivation at the individual level in different regions.[511] Therefore, socioeconomic deprivation was also assessed using individual-based data, such as household income and educational level, which are the primary socioeconomic indicators used in previous Saudi Arabian research.

It was also recognised that the population sample in this study, particularly for the Saudi group, included more female participants (n= 14, 74%) than male (n= 5, 26%). This demographic difference likely arose because some male participants refused to participate due to the female interviewer, a decision influenced by cultural norms in Saudi Arabia. These sex-specific factors complicate qualitative research in Saudi Arabia, where cultural expectations and social dynamics significantly impact participant engagement and accessibility.[608] Additionally, it was observed that the population sample in this study, particularly for the South Asian group, included more male participants (n=17, 89%) than female participants (n=2, 11%). This demographic difference is likely due to the fact that a significant portion of the South Asian population in Saudi Arabia is composed of male workers who have come on work visas, often without their families. The trend reflects the common practice of male migrants working primarily in various industries while their families remain in their countries of origin. Due to the sample's sex imbalance, the experiences of South Asian women in Saudi Arabia may not be fully represented.

Finally, conducting interviews in Arabic and then translating them into English before analysis may also present some limitations that could influence the findings. Translation across different languages carries the risk of misinterpretation or loss of nuance. Despite careful translation by bilingual researcher, some cultural and contextual meanings might not have

been completely conveyed, potentially impacting the accuracy of the data interpretation. In addition, not employing a back-and-forward translation process may have allowed minor translation biases to persist.[609]

6.4 Recommendations from this project: future interventions and areas of focus

This PhD has identified three main areas that future interventions should target to improve adherence to antidiabetic medication among people from minority ethnic groups (mainly South Asian) and those from socioeconomically deprived areas in the UK and Saudi Arabia. These include: (i) engaging faith-based organisations, (ii) enhancing community awareness, and (iii) improving cultural competency in healthcare systems. Each of these areas will now be discussed individually below.

6.4.1 Engaging faith-based organisations

Faith-based organisations play a critical role in communities, particularly among minority ethnic groups in which religion is deeply woven into daily life.[610] They are potentially efficient means for delivering health interventions and promoting behavioural change at the individual and community levels.[611-613] Furthermore, religious beliefs have the potential to influence health behaviours, including medication adherence.[474, 614-616] A number of barriers related to religious beliefs and practices have been identified in studies conducted as a part of this PhD, significantly influencing adherence. Therefore, there is a critical need to collaborate with religious leaders to develop faith-based interventions that are culturally sensitive and align with religious values within their communities. Literature have demonstrated several benefits of faith-based or placed interventions in promoting health behaviours.[617] Faith-based organisations can reach a large, consistent group, facilitate programming, offer social support, and engage influential leaders who encourage participation and sustain long-term programs.[618-620] These interventions may provide a welcoming environment for people who might feel isolated from healthcare systems because of differences in health beliefs, attitudes, or languages.[611, 621] Additionally, these settings' pre-existing social networks and organisational structures facilitate the adoption and maintenance of health behaviours.[611, 622, 623] Furthermore, involving religious leaders can bridge the gap between medical recommendations and religious beliefs and practices, offering a reliable resource for encouraging adherence to prescribed medication. For example, working

with imams, pastors, and other religious leaders can help the dissemination of accurate health information. These leaders are well-positioned to tackle misconceptions that hinder adherence by interpreting religious teachings in ways that support health-promoting behaviours while maintaining appreciation for their religious values.[624]

6.4.2 Enhancing community awareness

One of the most notable findings was the misconceptions and lack of knowledge about diabetes and its management at both the individual and community levels among people from South Asian ethnic backgrounds and those from socioeconomically deprived areas in the UK and Saudi Arabia. Health-related behaviours, including medication adherence, are greatly influenced by the community through shared attitudes, peer pressure, and social norms.[625] Therefore, increasing community awareness and knowledge is crucial to overcome barriers such as disseminating negative advice about medication, preference for alternative medicine over prescribed information, and stigmatisation of diabetes. This can be achieved through developing culturally sensitive education programs that can effectively promote awareness about diabetes management and the importance of medication adherence. Furthermore, accurate information about diabetes and its management can also be disseminated through trusted channels like local media, community events, and the leaders of local communities. The implementation of culturally sensitive educational program interventions has been shown to be effective in improving health behaviours and outcomes in ethnic minority groups.[626-629]

6.4.3 Improving cultural competency in healthcare systems

A number of barriers to adherence identified in this PhD have been related to ineffective communication with healthcare providers and medication accessibility. Improving cultural competency among healthcare providers could address these barriers, leading to enhanced provider knowledge of how cultural and religious beliefs influence medication adherence in minority ethnic communities.[317] Cultural competence is defined as the ability to provide healthcare services that respect and address the needs and beliefs of diverse patient populations.[317] Five approaches can enhance cultural competence in the healthcare system: (1) promoting and maintaining diversity among the healthcare workforce, (2) providing cultural competency education for healthcare workers, (3) providing interpreter services to

facilitate effective communication between different racial and ethnic groups, (4) developing health education resources tailored to the cultural nuances of different communities, and (5) establishing healthcare settings that are sensitive to the cultural specifics of the populations they serve.[630] Furthermore, addressing language barriers can increase the accessibility of healthcare services.[374, 631] Providing multilingual information and assistance with available resources ensures that minority ethnic groups are adequately informed and can access these critical services.[374] Clear and accessible communication in multiple languages is crucial to help these groups navigate the process of obtaining free medications and medication exemption certificates, thus improving overall access to vital healthcare services.

6.5 Recommendations from this project: areas of future research

This PhD has identified critical areas for future research specific for the UK and Saudi Arabia, and areas applicable to both settings.

- ***For both settings***, future research should explore the barriers and facilitators of adherence to antidiabetic medication among minority ethnic groups from the perspective of healthcare providers. Investigating these viewpoints is critical for identifying gaps between the perspectives of minority ethnic groups and the understanding of healthcare providers. Understanding these disparities is essential for developing more effective interventions centred around minority ethnic groups.
- ***Future research in the UK***

1) Future research should investigate diabetes distress and its influence on medication adherence, particularly among people with multiple long-term conditions, as this may help in developing targeted interventions for individuals experiencing diabetes-related stress.
2) The impact of religious disaffiliation or discord on social support and medication adherence in minority populations should be explored, as changes in religious beliefs can disrupt support system and affect adherence.
3) Further investigation is needed to explore insulin-related perceptions and the barriers to initiating and adhering to insulin therapy among people using insulin, including those using insulin pumps, particularly within minority ethnic groups. Identifying the cultural, psychological, and practical factors affecting these challenges will aid in developing targeted support strategies for these individuals.

4) Future work is required to explore the barriers to disclosing religious-related factors, such as fasting, that may affect adherence to healthcare providers, in order to help them adjust medication during religious obligations.
5) A key area for future research is identifying specific barriers that restrict access to healthcare services among ethnic minority groups.

- ***Future research in Saudi Arabia***

1) Further studies should explore knowledge and beliefs about diabetes causes, management, and complications and their association with medication adherence in both minority and majority groups in socioeconomically deprived areas. Through an understanding of these knowledge gaps, targeted educational interventions can be developed to improve adherence by improving patients' understanding and management of their conditions.
2) It would be valuable for future research to examine the role of the family in diabetes management, as family involvement can negatively affect adherence. Therefore, it is important to understand community and relative concerns about diabetes management since social attitudes and family beliefs can influence how individuals perceive and manage diabetes, and these studies can provide a deeper understanding on the social factors influencing adherence.
3) Qualitative research is particularly needed to explore the diverse religious beliefs and practices that influence adherence to antidiabetic medication. Despite the availability of medical guidelines allowing for medication timing readjustment during fasting, participants in this study still report fasting as a barrier to adherence. Future research should investigate why these people often avoid following these clear guidelines to adjust medication schedules safely during fasting.
4) Further work is needed to explore healthcare provider-related barriers to adherence to antidiabetic medication. Research should examine how trust and communication between patients and providers affect adherence. Understanding these barriers will help identify areas where provider-patient relationships can be improved, leading to better adherence to antidiabetic medications.
5) It is vital to explore the barrier to adherence to antidiabetic medication for people living in rural areas. This study includes a few participants from these regions who reported

facing additional challenges, such as limited access to healthcare services. These individuals may also encounter other barriers that must be acknowledged and addressed.

6.6 Conclusions

This thesis presents a PhD programme of work comprising two systematic literature reviews (Chapters 2 and 3) and two qualitative studies to explore the barriers and facilitators of adherence to antidiabetic medication among minority and majority ethnic groups from socioeconomically deprived communities across two different settings (Chapters 4 and 5). The first systematic review revealed a clear association between ethnicity and adherence to antidiabetic medication, highlighting notably lower adherence among minority ethnic groups in high-income countries. This pivotal finding emphasised the need for a deeper understanding of the underlying factors contributing to these disparities. Building on this, the meta-ethnographic review was conducted to explore specific barriers and facilitators affecting minority groups in high-income countries, revealing several factors that influence medication adherence. The two qualitative studies further expanded understanding by directly exploring the experiences of minority and majority ethnic groups. These studies confirmed that while ethnicity significantly influences adherence, it is also shaped by the interplay between individual and healthcare factors, demonstrating that adherence results from dynamic interactions between individual and systemic influences, not only solely determined by ethnicity. To develop interventions aimed at improving medication adherence, future research should continue to build on the findings of this thesis by employing theoretical frameworks such as theoretical domains framework and the Capability-Opportunity-Motivation-Behaviour Model (COM-B). These frameworks can assist in identifying key determinants of behaviour that need to be targeted and facilitate the development of tailored interventions that address specific barriers and facilitators identified in the studied ethnic groups.

Appendices

Appendix 1: Ethnic disparities in medication adherence? A systematic review examining the association between ethnicity and antidiabetic medication adherence

RESEARCH ARTICLE

Ethnic disparities in medication adherence? A systematic review examining the association between ethnicity and antidiabetic medication adherence

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Abstract

Objectives

Adherence to prescribed medication is an essential component of diabetes management to obtain optimal outcomes. Understanding the relationship between medication adherence and ethnicity is key to optimising treatment for all people with different chronic illnesses, including those with diabetes. The aim of this review is to examine whether the adherence to antidiabetic medications differed by ethnicity among people with diabetes.

Methods

A systematic review was conducted of studies reporting adherence to antidiabetic medication amongst people from different ethnic groups. MEDLINE, Embase, CINAHL, and PsycINFO were searched from their inception to June 2022 for quantitative studies with a specific focus on studies assessing adherence to antidiabetic medications (PROSPERO: CRD42021278392). The Joanna Briggs Institute critical appraisal checklist and a second checklist designed for studies using retrospective databases were used to assess study quality. A narrative synthesis approach was used to summarize the results based on the medication adherence measures.

Results

Of 17,410 citations screened, 41 studies that included observational retrospective database research and cross-sectional studies were selected, each of which involved diverse ethnic groups from different settings. This review identified a difference in the adherence to antidiabetic medications by ethnicity in 38 studies, despite adjustment for several confounding variables that may otherwise explain these differences

Appendix 2: PROSPERO registration

NIHR | National Institute for Health Research

PROSPERO
International prospective register of systematic reviews

Understanding the Influence of Ethnicity on Adherence to Antidiabetic Medication: Meta-ethnography and Systematic Review

Citation

Rayah Asiri, Andrew Husband, Adam Todd. Understanding the Influence of Ethnicity on Adherence to Antidiabetic Medication: Meta-ethnography and Systematic Review. PROSPERO 2022 CRD42022320681 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42022320681

Review question

What are the factors perceived as barriers or facilitators of adherence to antidiabetic medications in patients from ethnic minority groups?

This meta-ethnography and systematic review research question has been defined according to the SPIDER :

Sample: Patients with diabetes from ethnic minority groups.

Phenomenon and interest: Factors identified amongst ethnic minority groups as barriers or facilitators of adherence to antidiabetic medications.

Design: Structured or semi-structured interviews and focus groups.

Evaluation: Barriers and facilitators of adherence to antidiabetic medications in patients' views.

Research type: Qualitative research.

Searches

Studies will be identified through a systematic search of the following electronic databases: MEDLINE, Embase, PsycINFO and CINAHL. We will update the search prior to accepting this systematic review. Our search strategy will consist of medical subject headings (MeSH) and keywords related to medication adherence, diabetes, ethnicity, glycaemic control, and qualitative study. A combination of MeSH terms and keywords was used to run the database searches. In addition, Boolean operators 'OR' and 'AND' were used to narrow or expand searches. This search was performed in March 2022 and re-run in July 2022 to avoid missing new publications. A backward hand search of the included studies' reference lists and a forward search for the studies' citations, and a grey literature search will be performed to identify the relevant additional studies. There will be no search restriction on the language and date.

Appendix 3: Results of the risk of bias assessment of retrospective database studies

Checklist for assessing medication compliance and persistence study components and questions		Study citation																																				
		[288]	[271]	[302]	[287]	[289]	[272]	[265]	[290]	[229]	[296]	[293]	[276]	[233]	[263]	[269]	[270]	[277]	[284]	[291]	[281]	[216]	[282]	[274]	[285]	[230]	[278]	[279]	[283]	[273]	[264]	[267]	[280]	[268]
Title/Abstract	The title is descriptive and reflective of the purpose of the study.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	The abstract is a short, concise description, commensurate with the journal's standards.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Abstract follows a structured format.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	The abstract accurately reflects the contents of the study and there are no discrepancies.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Introduction	The author(s) clearly reviewed fundamental literature related to topic being addressed.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Objective of study clearly stated.	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Objectives and Definitions	The objective of the study has been clearly stated.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	There is an explicit definition of the compliance and persistence variable and the definition used is based on a published, accepted definition.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Compliance or persistence is the primary "outcome" of interest.	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y
	Compliance or persistence is being used as an explanatory or control variable to explain variance in another outcome.	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	Y	N	N	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	N	Y	N	Y	N

Design and Methods	Design	The design is clearly stated.	N	Y	Y	N	N	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N
		The design matches the objectives.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Data Sources	All of the data sources have been described adequately.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
		The time frame for data has been clearly stated.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
		The methods for sampling the population are well Described.	X	X	X	X	X	X	X	X	X	Y	Y	X	X	X	X	X	X	X	X	X	X	X	X	X	Y	X	X	X	X	X	X	X	X	X	X
		The data have been appropriately “cleaned”.	Y	N	N	Y	N	N	N	N	N	X	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	Y	N	Y	N	N	N	N	N	N
		There is evidence for the reliability/accuracy of the data.	Y	Y	Y	Y	Y	Y	Y	Y	Y	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Inclusion/Exclusion Criteria	The inclusion and exclusion criteria for the study are clearly stated.	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
		The rationale for these criteria is described.	N	Y	N	Y	N	Y	Y	Y	N	N	N	Y	Y	N	Y	N	Y	N	N	N	N	Y	Y	N	N	Y	Y	N	Y	Y	Y	Y	N	N
		Patients had sufficient data to make a valid estimate of compliance.	N	N	N	Y	N	N	Y	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	Y	N	N	N
		For studies of patients who are newly initiated on a drug regimen, there was an	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

		examination of data from a sufficient pre-enrolment period to ensure that the subject was truly naive to the drug.																																		
		The duration of the study period is appropriate to the objectives of the study.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
		There is evidence for protecting the confidentiality of subjects.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
		The matching process, if appropriate to the study design, is well described.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Measurement of Compliance	The methods for calculating the compliance or persistence variables are clearly described.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
		Do the objectives indicate that the study is to measure compliance but persistence is calculated?	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
		Standard methods are used for calculating compliance	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	Y
	Standard Methods for Calculating Persistence	If an atypical method is used for calculating compliance, the rationale/formula for the new method is provided.	X	X	Y	X	X	Y	X	X	X	Y	X	X	X	Y	X	Y	X	X	X	X	X	X	Y	X	X	X	X	Y	X	Y	Y	X	Y

		The researchers provided an appropriate explanation for how patients who switched drugs within, or between, therapeutic classes were handled.	X	Y	X	X	N	Y	Y	Y	Y	X	X	Y	N	N	Y	N	Y	N	N	N	N	N	N	N	Y	N	N	X	Y	N	Y	N	N
		If multiple medications were included within a single compliance or persistence estimate, the researchers provided a rationale and/or a formula for this variable.	X	Y	X	X	Y	Y	Y	Y	Y	X	X	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	X	Y	Y	Y	Y	Y
	Statistical Analyses	If continuous data are converted to categorical data, the rationale for the selection of cut-points should be provided and consistent with existing evidence for compliance in the selected population.	Y	X	X	Y	Y	N	Y	X	Y	Y	Y	X	Y	Y	Y	Y	Y	Y	Y	X	Y	Y	Y	Y	Y	Y	Y	X	Y	Y	X	X	Y
		The tests are appropriate given the objectives, design, and the nature of the data.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
		Appropriate adjustments for multiple comparisons were conducted.	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
		Power and/or sample size calculations are presented and appropriate.	X	X	X	X	X	X	X	X	X	Y	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Y	X	X	X	X	X	X	X	X	X

		If the researcher is evaluating an association between compliance or persistence and another variable, the researcher attempted to control for other variables that may confound the association being studied.	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Presentation and Discussion of Findings	Results	The distribution of the compliance or persistence variable is presented.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
		Test statistics and confidence intervals are appropriately presented in addition to P-values	N	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
		The number of subjects is clearly identified in tables and graphs.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
		Graphs were constructed with an appropriate scale.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Discussion/Conclusion	The limitations are appropriately noted and the implications of the limitations are discussed.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
		The findings of this study are placed in the context of our existing knowledge of the subject.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

		The findings and conclusions are related to the objectives of the study	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Disclosure of potential conflicts of interest		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Key	Y = yes, N = no, X = not applicable																																			

Appendix 4: Understanding the influence of ethnicity on adherence to antidiabetic medication: Meta-ethnography and systematic review

PLOS ONE

RESEARCH ARTICLE

Understanding the influence of ethnicity on adherence to antidiabetic medication: Meta-ethnography and systematic review

Rayah Asiri[1,2☯], **Anna Robinson-Barella**[1☯], **Anum Iqbal**[1☯], **Adam Todd**[1☯], **Andy Husband**[1☯*]

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☯ These authors contributed equally to this work.
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OPEN ACCESS

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Data Availability Statement: All relevant data are within the paper and its Supporting Information

Abstract

Introduction

A high prevalence of diabetes and diabetes-related complications in people from minority ethnic communities in high income countries is of significant concern. Several studies have indicated low adherence rates to antidiabetic medication in ethnic minority groups. Poor adherence to antidiabetic medication leads to a higher risk of complications and potential mortality. This review aims to qualitatively explore the barriers to and facilitators of adherence to antidiabetic medication among ethnic minority groups in high-income countries.

Methods

A comprehensive search of MEDLINE, Embase, CINAHL, PsycINFO, and Global Health databases for qualitative studies exploring the barriers to or facilitators of adherence to antidiabetic medication in minority ethnic groups was conducted from database inception to March 2023 (PROSPERO CRD42022320681). A quality assessment of the included studies was conducted using the Critical Appraisal Skills Programme (CASP) tool. Key concepts and themes from relevant studies were synthesised using a meta-ethnographic approach. The Grading of Recommendations Assessment, Development and Evaluation Confidence in the Evidence from Reviews of Qualitative research (GRADE-CERQual) approach was used to assess the Confidence in the review findings.

Result

Of 13,994 citations screened, 21 studies that included primary qualitative studies were selected, each of which involved people from minority ethnic communities from eight high income countries. This qualitative evidence synthesis has identified three overarching themes around the barriers to and facilitators of adherence to antidiabetic medication among ethnic minority groups.: 1) cultural underpinnings, 2) communication and building relationships, and 3) managing diabetes during visiting home countries. Based on the

Appendix 5: PROSPERO registration

NIHR | National Institute for Health Research

PROSPERO
International prospective register of systematic reviews

Understanding the Influence of Ethnicity on Adherence to Antidiabetic Medication: Meta-ethnography and Systematic Review

Citation

Rayah Asiri, Andrew Husband, Adam Todd. Understanding the Influence of Ethnicity on Adherence to Antidiabetic Medication: Meta-ethnography and Systematic Review. PROSPERO 2022 CRD42022320681 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42022320681

Review question

What are the factors perceived as barriers or facilitators of adherence to antidiabetic medications in patients from ethnic minority groups?

This meta-ethnography and systematic review research question has been defined according to the SPIDER :

Sample: Patients with diabetes from ethnic minority groups.

Phenomenon and interest: Factors identified amongst ethnic minority groups as barriers or facilitators of adherence to antidiabetic medications.

Design: Structured or semi-structured interviews and focus groups.

Evaluation: Barriers and facilitators of adherence to antidiabetic medications in patients' views.

Research type: Qualitative research.

Searches

Studies will be identified through a systematic search of the following electronic databases: MEDLINE, Embase, PsycINFO and CINAHL. We will update the search prior to accepting this systematic review. Our search strategy will consist of medical subject headings (MeSH) and keywords related to medication adherence, diabetes, ethnicity, glycaemic control, and qualitative study. A combination of MeSH terms and keywords was used to run the database searches. In addition, Boolean operators 'OR' and 'AND' were used to narrow or expand searches. This search was performed in March 2022 and re-run in July 2022 to avoid missing new publications. A backward hand search of the included studies' reference lists and a forward search for the studies' citations, and a grey literature search will be performed to identify the relevant additional studies. There will be no search restriction on the language and date.

Appendix 6: Interview schedule

Thank you for agreeing to take part in this study. I am fascinated to know more about your perspective regarding the barriers to and facilitators of adherence to antidiabetic medications. If you are not sure about any of the questions, please let me know, and I will rephrase accordingly. Also, do let me know if there were anything you would like to share that we have not discussed at the end of the interview. Do you have any questions?

If you are happy with everything. I will start the recording…

Introductory questions		
1)Diabetes	*Can you tell me about your diabetes?* ***Prompts:*** *How long have you had diabetes?*	
2) Antidiabetic medications	*What type of medication/s are you taking for your diabetes?* ***Prompts:*** *How long have you been taking them?* *How do you take your diabetes medication?*	
(barriers & facilitators)		
1)Barriers	*What situations make it difficult for you to take your diabetes medications as prescribed?* ***Probes:*** *Can you give me an example of a specific issue?* *How did you feel at the time?* *Please tell me more about that?* *Can you give me some more detail about that?* ***Prompts:*** *Could you tell me about an experience where you felt hesitant or reluctant to take your diabetes medication?*	
2)Facilitators	*What situations make it easy for you to take your diabetes medicines as prescribed?* ***Probes:*** *Can you give me an example?*	

	How did you feel at the time? *Please tell me more about that?* *Can you give me some more detail about that?* ***Prompts:*** *Could you tell me about a time or situation that really helped you stay motivated to keep taking your medication?*	
Closing		
	Do you have anything else to share about your diabetes or antidiabetic medication? *Is there anything we did not cover that you would like to discuss?* *Do you have any questions for me?*	
Thank you for taking part in this interview.		

Appendix 7: IRAS Ethical Approval

Health Research Authority

North East - Tyne & Wear South Research Ethics Committee
NHSBT Newcastle Blood Donor Centre
Holland Drive
Newcastle upon Tyne
NE2 4NQ

10 October 2022

Professor Andrew Husband
Newcastle University
School of Pharmacy
King George VI Building, Queen Victoria Road, Newcastle Upon Tyne
NE1 7RU

Dear Professor Husband

Study title:	**A qualitative study exploring the barriers and facilitators of adherence to antidiabetic medication among people of South Asian and White British origin from socioeconomically deprived communities.**
REC reference:	**22/NE/0206**
Protocol number:	**202223 11 Husband**
IRAS project ID:	**318913**

The Proportionate Review Sub-committee of the North East - Tyne & Wear South Research Ethics Committee reviewed the above application on 10 October 2022.

Ethical opinion: Favourable Opinion

On behalf of the Research Ethics Committee (REC), the sub-committee gave a favourable ethical opinion of the above research on the basis described in the application form, protocol and supporting documentation, subject to the conditions specified below.

Good practice principles and responsibilities

The UK Policy Framework for Health and Social Care Research sets out principles of good practice in the management and conduct of health and social care research. It also outlines the responsibilities of individuals and organisations, including those related to the four elements of research transparency:

Appendix 8: Antidiabetic medication list

No.	Antidiabetic medication
1	Insulin
2	Metformin
3	Glibenclamide
4	Gliclazide
5	Glimepiride
6	Glipizide
7	Tolbutamide
8	Acarbose
9	Pioglitazone
10	Alogliptin
11	Linagliptin
12	Sitagliptin
13	Saxagliptin
14	Vildagliptin
15	Canagliflozin
16	Dapagliflozin
17	Empagliflozin
18	Dulaglutide
19	Exenatide
20	Liraglutide
21	Lixisenatide

Appendix 9: UK study participant information sheet

Newcastle University

A qualitative study exploring the barriers and facilitators of adherence to antidiabetic medication among people of South Asian and White British origin from socioeconomically deprived communities

Participant Information Sheet

Names of Investigators: Miss Rayah Asiri, Professor Andrew Husband, Professor Adam Todd.

Ethical Approval Ref: 22/NE/0206

Invitation paragraph

You are being invited to take part in a research study. Before you decide it is important that you understand why the research is being carried out and what it will involve. One of our team will go through the information sheet with you and answer any questions you may have. You may wish to discuss it with friends and relatives.

Ask us if there is anything that is not clear or if you would like more information. Feel free to take time to decide whether you wish to take part. If you decide not to take part, it will not in any way affect your medical care.

What is the purpose of the study?

Several researchers have found considerable differences in how people with diabetes take antidiabetic medication as recommended by their prescriber amongst those from different ethnic groups. Understanding the causes of these differences will help develop medication adherence facilitators based on the difficulties facing each group. The problem is that no study has been carried out to identify the perspective of people from ethnic minorities or majority groups from communities of low socioeconomic status about the factors that hinder or support taking antidiabetic medication regularly. This research aims to explore barriers and factors that help patients to take diabetes medicines as prescribed in two ethnic groups, people of South Asian origin and those with White British ethnicity. The researchers anticipate that data obtained in this study could improve diabetic care for patients from different ethnic and socioeconomically deprived groups. Furthermore, this research could help shape the design of future guidelines and/or interventions.

Why have I been invited?

This project is offered to White British and South Asian people with type 2 diabetes from socioeconomically disadvantaged communities with an active prescription of antidiabetic medications as part of their treatment.

Do I have to take part?

It is up to you to decide whether to take part. If you decide to take part, you will be given this information sheet to keep and will be asked to sign and return the consent form. You are free to withdraw from this study at any time and without giving a reason. Your decision will not affect the quality of your care.

What will happen if I take part?

If you agree to participate, you will be asked to sign a consent form. Then you will take part in an interview. This will be arranged with a researcher. The interview will involve a researcher asking you some questions about how you take your type 2 diabetes medicines and any challenges you face in doing that. There are no right or wrong answers – we simply want to know about your experiences.

The interview will be arranged for a time convenient for you. It will be by telephone, video call (such as Zoom) or in person (at your home, in the community pharmacy, or at the University), depending on your preferences. If are not sure how to do video calls, we will talk you though that before the interview. The interview will take around 1 hour.

If there are questions you do not want to answer, you do not have to. We will record the interview (and will ask for your agreement to this). This is so that we can analyse it later to extract all the important information. This recording will be kept in a secure location and will only be accessible to members of the research team. After the interview we will transcribe (type out) the recording, your identity will not be available from the transcription and the recording will be deleted.

How will we use information about you?

We will need to use information from you for this research project. This information will include your name and contact details. People will use this information to do the research, check your records to make sure that the research is done properly, or to contact you if you wish to receive the results of the study. People who do not need to know who you are will not be able to see your name or contact details. Your data will have a code number instead. We will keep all information about you safe and secure. Once we have finished the study, we will keep some of the data so we can check the results. We will write our reports in a way that no-one can work out that you took part in the study.

What are your choices about how your information is used?

You can stop being part of the study at any time, without giving a reason, but we will keep information about you that we already have. We need to manage your records in specific ways for the research to be reliable. This means that we won't be able to let you see or change the data we hold about you.

Where can you find out more about how your information is used?

You can find out more about how we use your information

- at www.hra.nhs.uk/information-about-patients/
- by asking one of the research team
- by sending an email to andy.husband@newcastle.ac.uk or
- by ringing us on 0191 2082360.

Will the research benefit me?

It is unlikely that taking part will benefit you directly. However, it will allow you to talk about your experiences with an interested, non-judgmental listener who is not involved in your medical care. You will also be satisfied knowing that you are contributing to research, which could support the development of medication adherence facilitators in the future to help people from ethnic minority and socioeconomically deprived groups. As a thank you for your time, we will give you a £15 high street shopping voucher following the interview.

Are there any disadvantages of taking part?

Some people may find it upsetting to talk about their experiences. The interview may bring up difficult or distressing thoughts or memories. You will not be expected to talk about anything you are not comfortable with. You can take a break or stop entirely at any point during the interview.

What about my safety?

Newcastle University adheres to safeguarding procedures, and high ethical conduct in research. Appropriate measures will be in place to protect you participating in the research. Confidentiality can be broken without consent in very exceptional circumstances. These circumstances are when the researcher has seen or is told something that raises concerns about your safety or the safety of others.

What if something goes wrong?

In the event that something does go wrong and you are harmed during the research, and this is due to someone's negligence then you may have grounds for a legal action for compensation against Newcastle University, but you may have to pay your legal costs. Both organisations have liability insurance, which covers this research project. The normal National Health Service complaints mechanisms will still be available to you.

What if I decide I don't want to be involved anymore?

You are free to withdraw at any time, even in the middle of an interview. All data collected with consent up to the point of withdrawal will be retained. With that in mind if there is anything you feel uncomfortable sharing with the researchers, then please feel free not to answer. You will not be pushed to provide a response to any specific questions.

What will happen with the findings of the research?

Once all the data has been collected and analysed, a summary of the findings will be available for you. You will be asked after your interview if you: (i) would like this, and (ii) if so, how you would like to be contacted (email, text message, or post). The results will be used in research reports and in scientific journals, where anonymous quotes may be used. We will also communicate the results to patients more broadly and community support groups, particularly those based within the minority communities studied.

Who is organising the research?

This research is not funded it is being carried out as part of a PhD project. The sponsor is Newcastle University. The study has been reviewed and given favourable opinion by [to add once received] Research Ethics Committee.

Researcher Information

Thank you for taking the time to read this information sheet. Please feel free to ask any questions or share any concerns you may have about the project. If you would like to speak to someone about this project, please feel free to write, email or call:

PhD student: Miss Rayah Asiri

Address: Institute of Health and Society, King George VI Building, Newcastle University, Newcastle Upon Tyne, NE1 7RU.
Email: r.m.a.asiri1@ncl.ac.uk.
Contact number: 07983162694

Supervisor: Professor Andrew Husband
Address: School of Pharmacy, King George VI Building, Newcastle University, Newcastle Upon Tyne, NE1 7RU.
Email: andy.husband@newcastle.ac.uk.
Contact number: 0191 2082360

What if there is a problem?

If you have a concern about any aspect of this study you should speak to the researcher (Miss Rayah Asiri) initially, or the Chief Investigator (Professor Andrew Husband).

If you wish to complain formally, you can do this through the Patient Advice and Liaison Services (PALS). Details can be obtained from:
Free Phone 0800 0320202
Website: http://www.pals.nhs.uk/

If you decide that you do not want to take part, it will have no effect on any treatment or care that you will receive.

Thank you for taking time to read this information sheet

Appendix 10: Uk study consent form

Newcastle University

A qualitative study exploring the barriers and facilitators of adherence to antidiabetic medication among people of South Asian and White British origin from socioeconomically deprived communities

Participant Consent Form – Semi-structured patient interview

Ethical Approval Ref: 22/NE/0206
Name of Researcher: _____
Name of Participant: _____

Please initial next to each question to confirm that you understand each of the items below, and agree to take part in this study

Question	Initials
I confirm I have read and understood the information sheet for the study above, and have had the opportunity to ask questions.	
I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason. The decision to withdraw will not affect my medical care or legal rights.	
I understand that the interview will be audio-recorded and typed out and that any personal details (e.g., name) will be removed so I cannot be identified.	
I understand that direct quotations may be taken from what I say during the interview and used in reports and publications. The quotations used will be attributed to a participant code so I will not be identified.	
I understand that if I withdraw during the interview, the partial recording will be discarded, though if I withdraw after the interview has completed, my personal data will be destroyed, but my anonymised interview transcript will be retained.	
I understand that all information supplied will be kept confidential, unless there is a concern for my own, or others, safety. Any information reported or published will not enable me to be recognised. I understand that by taking part in this research, a consent form and key code with my name will be securely stored at Newcastle University under the supervisor of the senior researcher on this project.	
I understand I can consent to my details being kept so I can be contacted to receive the findings but can withdraw at any time by notifying the researcher.	
I agree with the above statements and agree to take part in the study.	
I understand that relevant sections of the data collected during the study may be looked at by individuals from: the study team, the Sponsor (Newcastle University), and from regulatory authorities, where it is relevant to taking part in this research.	

Participant's name:			
Participant signature		Date:	
Researcher's name:			
Researcher's signature		Date:	

Participant details for sharing a summary of the study findings

Would you like to receive a summary of the findings of this research once the study is finished?

Yes ☐ **No** ☐

If you answer yes to questions, we will keep your preferred contact details so we can use them to send you the summary. We can send you an email, a text with a link to the study website, or send a summary via the post – just let us know which you prefer by completing the table below. We will not keep your details once this information has been shared and will not use them for any other reason.

Name	
Email	
Or Mobile no.	
Or Address	

This page will be stored separately from your interview transcript.

Appendix 11: Poster for participant recruitment *via* social media

Appendix 12: Saudi study ethical approval

KINGDOM OF SAUDI ARABIA
Ministry of Education
King Khalid University
Deanship of Scientific Research
Research Ethics Committee

المملكة العربية السعودية
وزارة التعليم
جامعة الملك خالد
عمادة البحث العلمي
اللجنة الدائمة لأخلاقيات البحث العلمي

Ethical Clearance Certificate

The Research Ethics Committee at King Khalid University (HAPO-06-B-001)

has reviewed and agreed on the project shown below:

Approval No.	**ECM#2023-2107**
Name of PI	Rayah Mohammed Abdullah Assri
Research title	A qualitative study exploring the barriers and facilitators of adherence to antidiabetic medication among people of South Asian and Saudi origin
Approval date	From 30-05-2023To29-05-2024
Decision	Approved

Conditions of approval

- The conduction of research should be strictly in accordance with the approved proposal.
- The principal investigator must obtain the approval from related parties in order to conduct the research on the target group.
- The principal investigator must officially inform the Research ethics committee if any changes arise to the protocol and/or the target group of the research.
- Any amendments to the approved proposal require the submission and the approval from the Research Ethics Committee before implementation.
- The principal investigator must immediately notify the Research Ethics Committee in writing if the project is discontinued.

Ref: 33984/2023

Thank you for submitting the ethical approval form for the project 'Understanding the influence of ethnicity on adherence to antidiabetic medication' (Lead Investigator: Rayah Asiri). Expected to run from 25/07/2023 to 25/11/2023.

Your project already has ethical approval in place and your faculty representative has agreed to accept this approval in lieu of a new application. Based on your answers, the University Ethics Committee grants its approval for you to start working on your project. Please be aware that if you make any significant changes to your proposal then you should complete this form again, as further review may be required. This confirmation may be used within a research portfolio as evidence of ethical approval. Please note: this confirmation will be the only correspondence you should expect to receive as evidence of ethical approval. There will be no other confirmation provided. You may now proceed with research. If you have any queries, please review the internal and external ethics FAQ pages before contacting res.policy@ncl.ac.uk.

Best wishes

Research Policy Intelligence and Ethics Team,

Research Strategy & Development
res.policy@ncl.ac.uk

Appendix 13: Saudi study participant information sheet

Newcastle University

دراسة نوعية تستكشف العوائق والمحفزات للالتزام بالأدوية المضادة لداء السكري بين الأشخاص من أصل جنوب آسيوي وسعودي من المجتمعات محدودة الدخل

معلومات المشاركة في الدراسة

اسم الباحثة: ريعة عسيري

رقم الموافقة الاخلاقية: ***ECM#2023-210***

فقرة الدعوة للمشاركة

تم دعوتك للمشاركة في دراسة بحثية. قبل أن تقرر، من المهم أن تفهم لماذا يتم إجراء البحث وما سيتضمنه. سأقوم بمراجعة ورقة المعلومات معك والإجابة على أية أسئلة قد تكون لديك. قد ترغب في مناقشتها مع الأصدقاء والأقارب. اسألنا إذا كان هناك أي شيء غير واضح أو إذا كنت تريد مزيدًا من المعلومات. لا تتردد في أخذ الوقت الكافي لتقرر ما إذا كنت ترغب في المشاركة. إذا قررت عدم المشاركة، فلن يؤثر ذلك بأي شكل من الأشكال على الرعاية الطبية التي تتلقاها.

ما هو الهدف من إجراء هذه الدراسة؟

لقد وجد العديد من الباحثين اختلافات ملحوظة في كيفية تناول الأشخاص المصابين بمرض السكري للأدوية المضادة للسكري كما يوصي بها مقدمو الرعاية الصحية، وذلك بين الأفراد من مجموعات عرقية مختلفة. فهم أسباب هذه الاختلافات سيساعد في تطوير وسائل تسهل الالتزام بالأدوية بناءً على الصعوبات التي يواجهها كل مجموعة. المشكلة هي أنه لم يتم إجراء أي دراسة لتحديد وجهات نظر الأشخاص من الأقليات العرقية أو الأغلبيات من المجتمعات ذات الوضع الاقتصادي المنخفض حول العوامل التي تعيق أو تدعم تناول الأدوية المضادة للسكري بانتظام. تهدف هذه البحوث إلى استكشاف العوائق والعوامل التي تساعد الأشخاص على تناول أدوية السكري كما هو موصوف في مجموعتين عرقيتين، الأشخاص ذوي الأصول الجنوب آسيوية وأولئك من العرقية السعودية. يتوقع الباحثون أن البيانات التي سيتم الحصول عليها في هذه الدراسة يمكن أن تحسن الرعاية الصحية لمرضى السكري من مجموعات عرقية واقتصادية مختلفة. علاوة على ذلك، قد تساعد هذه الأبحاث في تشكيل تصميم الإرشادات أو التدخلات المستقبلي.

لماذا تمت دعوتي للمشاركة؟

يقدم هذا المشروع للأشخاص السعوديين والجنوب آسيويين المصابين بالنوع الثاني من السكري من المجتمعات ذات الوضع الاقتصادي المتدني، الذين لديهم وصفة طبية نشطة للأدوية المضادة للسكري كجزء من علاجهم.

هل يجب علي المشاركة؟

أنت من يقرر ما إذا كان سيشارك أم لا. إذا قررت المشاركة، سيعطى لك هذه الورقة المعلوماتية للاحتفاظ بها وسيطلب منك التوقيع على نموذج الموافقة وإعادته. أنت حر في الانسحاب من هذه الدراسة في أي وقت ودون إعطاء سبب. قرارك لن يؤثر على جودة الرعاية الصحية التي تتلقاها.

ماذا سيحدث إذا شاركت؟

إذا وافقت على المشاركة، سيُطلب منك التوقيع على نموذج الموافقة. بعد ذلك، ستشارك في مقابلة. سيتم ترتيب ذلك مع باحث. ستتضمن المقابلة طرح الباحث بعض الأسئلة عليك حول كيفية تناولك لأدوية السكري من النوع الثاني وأي تحديات تواجهها في ذلك. لا توجد إجابات صحيحة أو خاطئة - نحن نريد فقط معرفة تجاربك. سيتم ترتيب المقابلة في وقت يناسبك. ستكون عبر الهاتف، أو مكالمة فيديو (مثل زووم)، أو شخصيًا (في منزلك أو في عيادة المستشفى)، حسب تفضيلاتك. إذا لم تكن متأكدًا من كيفية إجراء مكالمات الفيديو، سنشرح لك ذلك قبل المقابلة. ستستغرق المقابلة حوالي ساعة واحدة. إذا كان هناك أسئلة لا ترغب في الإجابة عليها، فلست ملزمًا بذلك. سنقوم بتسجيل المقابلة (وسنطلب موافقتك على ذلك). الهدف من ذلك هو تحليل المقابلة لاحقًا لاستخراج كل المعلومات المهمة. سيتم الاحتفاظ بالتسجيل في مكان آمن ولن يتمكن من الوصول إليه سوى أعضاء فريق البحث. بعد المقابلة، سنقوم بنسخ (طباعة) التسجيل، ولن تكون هويتك متاحة من النسخة المكتوبة وسيتم حذف التسجيل.

كيف سنستخدم المعلومات الخاصة بك؟

سنحتاج إلى استخدام معلومات منك لهذا المشروع البحثي. ستشمل هذه المعلومات اسمك وتفاصيل الاتصال الخاصة بك. سيستخدم الأشخاص هذه المعلومات لإجراء البحث، وفحص سجلاتك للتأكد من أن البحث يتم بشكل صحيح، أو للاتصال بك إذا كنت ترغب في تلقي نتائج الدراسة. لن يتمكن الأشخاص الذين لا يحتاجون إلى معرفة من أنت من رؤية اسمك أو تفاصيل الاتصال الخاصة بك. بدلاً من ذلك، ستحمل بياناتك رقمًا خاصًا بك. سنحافظ على جميع المعلومات عنك بأمان وسرية. بمجرد انتهائنا من الدراسة، سنحتفظ ببعض البيانات حتى نتمكن من فحص النتائج. سنكتب تقاريرنا بطريقة لا يمكن لأحد أن يعرف أنك شاركت في الدراسة.

ما هي خياراتك حول كيفية استخدام معلوماتك؟

يمكنك التوقف عن المشاركة في الدراسة في أي وقت، دون الحاجة إلى تقديم سبب، لكننا سنحتفظ بالمعلومات التي لدينا عنك. نحتاج إلى إدارة سجلاتك بطرق معينة لضمان موثوقية البحث. هذا يعني أننا لن نتمكن من السماح لك برؤية أو تغيير البيانات التي نحتفظ بها عنك.

أين يمكنك معرفة المزيد عن كيفية استخدام معلوماتك؟

يمكنك معرفة المزيد عن كيفية استخدامنا لمعلوماتك :

بسؤال أحد أعضاء فريق البحث أو بإرسال بريد إلكتروني إلى:

r.m.a.asiri1@newcastle.ac.uk

هل ستفيدني المشاركة في هذه الدراسة؟

من غير المحتمل أن يعود عليك المشاركة في البحث بفائدة مباشرة. ومع ذلك، ستتاح لك الفرصة للحديث عن تجاربك مع مستمع مهتم وغير متحيز ليس مشاركًا في الرعاية الطبية الخاصة بك. ستشعر أيضًا بالرضا لمعرفتك أنك تساهم في بحث قد يدعم في المستقبل تطوير وسائل تسهيل الالتزام بالدواء لمساعدة الأشخاص من الأقليات العرقية والمجموعات المحدودة اقتصاديًا. كشكر لك على وقتك، سنقدم لك قسيمة تسوق بقيمة 50 ريال سعودي بعد المقابلة.

هل هناك أي أضرار من المشاركة في هذه الدراسة؟

قد يجد بعض الأشخاص أن الحديث عن تجاربهم مزعج. قد تثير المقابلة أفكارًا أو ذكريات صعبة أو مؤلمة. لن يتوقع منك الحديث عن أي شيء لا تشعر بالراحة تجاهه. يمكنك أخذ استراحة أو التوقف تمامًا في أي وقت خلال المقابلة.

ماذا عن سلامتي؟

تلتزم جامعة نيوكاسل بإجراءات الحماية والسلوك الأخلاقي العالي في البحث. ستكون هناك تدابير مناسبة لحمايتك أثناء مشاركتك في البحث. يمكن كسر السرية بدون موافقة في ظروف استثنائية جدًا. هذه الظروف هي عندما يرى الباحث أو يُخبر بشيء يثير مخاوف بشأن سلامتك أو سلامة الآخرين.

ماذا لو حدث خطأ ما؟

ي حال حدوث خطأ ما وتعرضت للأذى خلال البحث بسبب إهمال شخص ما، فقد يكون لديك أساس لاتخاذ إجراء قانوني للتعويض ضد جامعة نيوكاسل، ولكن قد تضطر إلى دفع تكاليفك القانونية. لدى كلا المنظمتين تأمين مسؤولية يغطي هذا المشروع البحثي. ستظل آليات الشكاوى العادية للخدمة الصحية الوطنية متاحة لك.

ماذا لو قررت الا أرغب في المشاركة بعد الآن؟

أنت حر في الانسحاب في أي وقت، حتى في منتصف المقابلة. سيتم الاحتفاظ بجميع البيانات المجمعة بموافقتك حتى نقطة الانسحاب. وعلى هذا الأساس، إذا كان هناك أي شيء تشعر بعدم الراحة في مشاركته مع الباحثين، فالرجاء عدم الإجابة. لن يتم الضغط عليك لتقديم رد على أي أسئلة محددة.

ماذا سيحدث لنتائج البحث؟

بمجرد جمع جميع البيانات وتحليلها، ستتوفر لك ملخص للنتائج. سيُطلب منك بعد المقابلة إذا كنت: (أ) ترغب في ذلك، و(ب) إذا كان الأمر كذلك، كيف ترغب في التواصل (عبر البريد الإلكتروني، رسالة نصية، أو البريد). سيتم استخدام النتائج في تقارير البحوث والمجلات العلمية، حيث يمكن استخدام الاقتباسات المجهولة. سنقوم أيضًا بنقل النتائج إلى المرضى على نطاق أوسع ومجموعات الدعم المجتمعية، خاصة تلك الموجودة ضمن المجتمعات الأقلية التي تم دراستها.

من ينظم البحث؟

هذا البحث غير ممول ويُجرى كجزء من مشروع دكتوراه. الجهة الراعية هي جامعة نيوكاسل. تمت مراجعة الدراسة وأعطت لجنة أخلاقيات البحوث في جامعة نيوكاسل وجامعة الملك خالد موافقة لأجراء هذه الدراسة.

معلومات الباحث:

شكرًا لك على تخصيص الوقت لقراءة هذه الورقة المعلوماتية. لا تتردد في طرح أي أسئلة أو مشاركة أي مخاوف قد تكون لديك حول المشروع. إذا كنت ترغب في التحدث إلى شخص ما حول هذا المشروع، فلا تتردد في الكتابة أو إرسال بريد إلكتروني أو الاتصال:

اسم الباحثة	ريعه عسيري
الايميل	**r.m.a.asiri1@newcastle.ac.uk**
رقم التواصل	**0502996895**
اسم المشرف الدراسي	Professor Andrew Husband
الايميل	Andy.husband@newcastle.ac.uk
رقم التواصل	0191 2082360

Appendix 14: Saudi study consent form

Newcastle University

دراسة نوعية تستكشف العوائق والمحفزات للالتزام بالأدوية المضادة لداء السكري بين الأشخاص من أصل جنوب آسيوي وسعودي من المجتمعات محدودة الدخل

نموذج موافقة المشارك – مقابلة شبه منظمة مع المرضى
رقم الموافقة الأخلاقية: ECM#2023-210

اسم الباحثة	
اسم المشارك	

يرجى كتابة الأحرف الأولى من اسمك بجانب كل سؤال لتأكيد أنك تفهم كل من العناصر أدناه، وتوافق على المشاركة في هذه الدراسة

الأسئلة	الأحرف الأولى من اسمك
أؤكد أنني قد قرأت وفهمت ورقة المعلومات الخاصة بالدراسة المذكورة أعلاه، وأتيحت لي الفرصة لطرح الأسئلة	
أفهم أن مشاركتي طوعية وأنه يمكنني الانسحاب في أي وقت دون إبداء أي سبب. لن يؤثر قرار الانسحاب على الرعاية الطبية التي أتلقاها أو حقوقي القانونية	
أفهم أن المقابلة سيتم تسجيلها صوتيًا ونسخها كتابةً، وأنه سيتم إزالة أي تفاصيل شخصية (مثل الاسم) بحيث لا يمكن التعرف علي	
أفهم أنه قد يتم أخذ اقتباسات مباشرة مما أقوله أثناء المقابلة واستخدامها في التقارير والمنشورات، سيتم نسب الاقتباسات إلى رمز مشارك، بحيث لا يمكن التعرف علي	
أفهم أنه إذا انسحبت أثناء المقابلة، سيتم التخلص من التسجيل الجزئي. ومع ذلك، إذا انسحبت بعد انتهاء المقابلة، سيتم حذف بياناتي الشخصية، ولكن سيتم الاحتفاظ بنسخة المقابلة المجهولة الهوية	
أفهم أن جميع المعلومات المقدمة ستظل سرية، إلا إذا كان هناك قلق بشأن سلامتي أو سلامة الآخرين. أي معلومات يتم الإبلاغ عنها أو نشرها لن تمكن أي شخص من التعرف علي. أفهم أنه من خلال المشاركة في هذا البحث، سيتم تخزين نموذج الموافقة ورمز المفتاح الذي يحتوي على اسمي بشكل آمن في جامعة نيوكاسل تحت إشراف الباحث الرئيسي في هذا المشروع	
أفهم أنني يمكنني الموافقة على الاحتفاظ بتفاصيلي ليتم التواصل معي لتلقي النتائج، ولكن يمكنني الانسحاب في أي وقت من خلال إخطار الباحث	
أوافق على البيانات المذكورة أعلاه وأوافق على المشاركة في الدراسة	
أفهم أنه قد يتم الاطلاع على الأقسام ذات الصلة من البيانات التي تم جمعها أثناء الدراسة من قبل أفراد من: فريق الدراسة، الجهة الراعية (جامعة نيوكاسل)، والهيئات التنظيمية، عندما يكون ذلك متعلقًا بالمشاركة في هذا البحث	

اسم المشارك	
توقيع المشارك	
اسم الباحث	
توقيع الباحث	

Interview consent form -version 01

تفاصيل وسائل الاتصال الخاصة بالمشارك إذا رغب في الحصول على ملخص لنتائج الدراسة

هل ترغب في الحصول على ملخص لنتائج هذا البحث بمجرد انتهاء الدراسة؟

☐ نعم ☐ لا

إذا أجبت بـ "نعم" على الأسئلة، سنحتفظ بتفاصيل الاتصال المفضلة لديك حتى نتمكن من استخدامها لإرسال الملخص إليك. يمكننا إرسال بريد إلكتروني، رسالة نصية تحتوي على رابط لموقع الدراسة، أو إرسال ملخص عبر البريد – فقط أخبرنا بالطريقة التي تفضلها من خلال إكمال الجدول أدناه. لن نحتفظ بتفاصيلك بعد مشاركة هذه المعلومات، ولن نستخدمها لأي سبب آخر

الاسم	
الايميل	
رقم الجوال	
العنوان	

سيتم تخزين هذه الصفحة بشكل منفصل عن نص مقابلتك

Interview consent form -version 01

References

1. Guariguata L, Whiting DR, Hambleton I, Beagley J, Linnenkamp U, Shaw JE. Global estimates of diabetes prevalence for 2013 and projections for 2035. Diabetes research and clinical practice. 2014;103(2):137-49.
2. Lin X, Xu Y, Pan X, Xu J, Ding Y, Sun X, et al. Global, regional, and national burden and trend of diabetes in 195 countries and territories: an analysis from 1990 to 2025. Scientific reports. 2020;10(1):14790.
3. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas. Diabetes research and clinical practice. 2019;157:107843.
4. Zheng Y, Ley SH, Hu FB. Global aetiology and epidemiology of type 2 diabetes mellitus and its complications. Nature reviews endocrinology. 2018;14(2):88-98.
5. Zimmet PZ, Magliano DJ, Herman WH, Shaw JE. Diabetes: a 21st century challenge. The lancet Diabetes & endocrinology. 2014;2(1):56-64.
6. Iglay K, Hannachi H, Joseph Howie P, Xu J, Li X, Engel SS, et al. Prevalence and co-prevalence of comorbidities among patients with type 2 diabetes mellitus. Current medical research and opinion. 2016;32(7):1243-52.
7. Akın S, Bölük C. Prevalence of comorbidities in patients with type–2 diabetes mellitus. Primary care diabetes. 2020;14(5):431-4.
8. Gilmer TP, O'Connor PJ, Rush WA, Crain AL, Whitebird RR, Hanson AM, et al. Predictors of health care costs in adults with diabetes. Diabetes care. 2005;28(1):59-64.
9. Organization WH. HEARTS D: diagnosis and management of type 2 diabetes. World Health Organization; 2020.
10. Organization WH. Classification of diabetes mellitus. 2019.
11. Rodriguez-Saldana J. The diabetes textbook: Clinical principles, patient management and public health issues: Springer Nature; 2023.
12. Willi C, Bodenmann P, Ghali WA, Faris PD, Cornuz J. Active smoking and the risk of type 2 diabetes: a systematic review and meta-analysis. Jama. 2007;298(22):2654-64.
13. DeFronzo RA, Eldor R, Abdul-Ghani M. Pathophysiologic approach to therapy in patients with newly diagnosed type 2 diabetes. Diabetes care. 2013;36(Suppl 2):S127.
14. Ahlqvist E, Ahluwalia TS, Groop L. Genetics of type 2 diabetes. Clinical chemistry. 2011;57(2):241-54.
15. Groop LC, Bonadonna RC, DelPrato S, Ratheiser K, Zyck K, Ferrannini E, et al. Glucose and free fatty acid metabolism in non-insulin-dependent diabetes mellitus. Evidence for multiple sites of insulin resistance. The Journal of clinical investigation. 1989;84(1):205-13.
16. Pendergrass M, Bertoldo A, Bonadonna R, Nucci G, Mandarino L, Cobelli C, et al. Muscle glucose transport and phosphorylation in type 2 diabetic, obese nondiabetic, and genetically predisposed individuals. American Journal of Physiology-Endocrinology and Metabolism. 2007;292(1):E92-E100.
17. Weyer C, Tataranni PA, Bogardus C, Pratley RE. Insulin resistance and insulin secretory dysfunction are independent predictors of worsening of glucose tolerance during each stage of type 2 diabetes development. Clinical Diabetology. 2001;2(2):167-72.
18. Ogurtsova K, Guariguata L, Barengo NC, Ruiz PL-D, Sacre JW, Karuranga S, et al. IDF diabetes Atlas: Global estimates of undiagnosed diabetes in adults for 2021. Diabetes research and clinical practice. 2022;183:109118.

19. Magliano DJ, Boyko EJ, Atlas ID. Global picture. IDF DIABETES ATLAS [Internet] 10th edition: International Diabetes Federation; 2021.
20. Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, et al. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. Diabetes research and clinical practice. 2022;183:109119.
21. Magliano DJ, Boyko EJ. IDF diabetes atlas. 2022.
22. Goff LM. Ethnicity and type 2 diabetes in the UK. Diabetic Medicine. 2019;36(8):927-38.
23. Whicher C, O'neill S, Holt RG. Diabetes in the UK: 2019. Diabetic Medicine. 2020;37(2):242-7.
24. Nagar SD, Nápoles AM, Jordan IK, Mariño-Ramírez L. Socioeconomic deprivation and genetic ancestry interact to modify type 2 diabetes ethnic disparities in the United Kingdom. EClinicalMedicine. 2021;37.
25. Riste L, Khan F, Cruickshank K. High prevalence of type 2 diabetes in all ethnic groups, including Europeans, in a British inner city: relative poverty, history, inactivity, or 21st century Europe? Diabetes care. 2001;24(8):1377-83.
26. DIABETES C. National Diabetes Statistics Report ONLINE: CDC; 2024 [Available from: https://www.cdc.gov/diabetes/php/data-research/index.html.
27. Misra A, Khurana L, Isharwal S, Bhardwaj S. South Asian diets and insulin resistance. British journal of nutrition. 2008;101(4):465-73.
28. Shah BR. Diabetes in visible minority populations in Ontario. Healthcare Quarterly (Toronto, Ont). 2013;16(4):14-7.
29. Sifunda S, Mbewu AD, Mabaso M, Manyaapelo T, Sewpaul R, Morgan JW, et al. Prevalence and psychosocial correlates of diabetes mellitus in South Africa: results from the South African National Health and Nutrition Examination Survey (SANHANES-1). International Journal of Environmental Research and Public Health. 2023;20(10):5798.
30. Chiang PP, Lamoureux EL, Cheung CY, Sabanayagam C, Wong W, Tai ES, et al. Racial differences in the prevalence of diabetes but not diabetic retinopathy in a multi-ethnic Asian population. Investigative ophthalmology & visual science. 2011;52(10):7586-92.
31. AUSTRALIA DI. 2023 SNAPSHOT: DIABETES IN AUSTRALIA 2023 [Available from: https://www.diabetesaustralia.com.au/wp-content/uploads/2023-Snapshot-Diabetes-in-Australia.pdf.
32. Hill-Briggs F, Adler NE, Berkowitz SA, Chin MH, Gary-Webb TL, Navas-Acien A, et al. Social determinants of health and diabetes: a scientific review. Diabetes care. 2021;44(1):258.
33. Hwang J, Shon C. Relationship between socioeconomic status and type 2 diabetes: results from Korea National Health and Nutrition Examination Survey (KNHANES) 2010–2012. BMJ open. 2014;4(8):e005710.
34. Sidahmed S, Geyer S, Beller J. Socioeconomic inequalities in diabetes prevalence: the case of Egypt between 2008 and 2015. BMC Public Health. 2023;23(1):1669.
35. Connolly V, Unwin N, Sherriff P, Bilous R, Kelly W. Diabetes prevalence and socioeconomic status: a population based study showing increased prevalence of type 2 diabetes mellitus in deprived areas. Journal of Epidemiology & Community Health. 2000;54(3):173-7.
36. Liu C, He L, Li Y, Yang A, Zhang K, Luo B. Diabetes risk among US adults with different socioeconomic status and behavioral lifestyles: evidence from the National Health and Nutrition Examination Survey. Frontiers in Public Health. 2023;11:1197947.

37. Bush KJ, Papacosta AO, Lennon LT, Rankin J, Whincup PH, Wannamethee SG, et al. Influence of neighborhood-level socioeconomic deprivation and individual socioeconomic position on risk of developing type 2 diabetes in older men: a longitudinal analysis in the British Regional Heart Study cohort. BMJ Open Diabetes Research and Care. 2023;11(5):e003559.
38. Thomas C, Nightingale CM, Donin AS, Rudnicka AR, Owen CG, Sattar N, et al. Socio-economic position and type 2 diabetes risk factors: patterns in UK children of South Asian, black African-Caribbean and white European origin. PLoS One. 2012;7(3):e32619.
39. Nishino Y, Gilmour S, Shibuya K. Inequality in diabetes-related hospital admissions in England by socioeconomic deprivation and ethnicity: facility-based cross-sectional analysis. PloS one. 2015;10(2):e0116689.
40. Al-Hanawi MK, Chirwa GC, Pulok MH. Socio-economic inequalities in diabetes prevalence in the Kingdom of Saudi Arabia. The International journal of health planning and management. 2020;35(1):233-46.
41. Shah A, Kanaya AM. Diabetes and associated complications in the South Asian population. Current cardiology reports. 2014;16:1-16.
42. Narayan KV, Kanaya AM. Why are South Asians prone to type 2 diabetes? A hypothesis based on underexplored pathways. Diabetologia. 2020;63(6):1103-9.
43. Gujral UP, Pradeepa R, Weber MB, Narayan KV, Mohan V. Type 2 diabetes in South Asians: similarities and differences with white Caucasian and other populations. Annals of the New York Academy of Sciences. 2013;1281(1):51-63.
44. Ramachandran A, Ma RCW, Snehalatha C. Diabetes in asia. The Lancet. 2010;375(9712):408-18.
45. Rabi DM, Edwards AL, Southern DA, Svenson LW, Sargious PM, Norton P, et al. Association of socio-economic status with diabetes prevalence and utilization of diabetes care services. BMC health services research. 2006;6:1-7.
46. Demakakos P, Marmot M, Steptoe A. Socioeconomic position and the incidence of type 2 diabetes: the ELSA study. European journal of epidemiology. 2012;27:367-78.
47. Tatulashvili S, Fagherazzi G, Dow C, Cohen R, Fosse S, Bihan H. Socioeconomic inequalities and type 2 diabetes complications: a systematic review. Diabetes & metabolism. 2020;46(2):89-99.
48. Hackl CM, Lee W-C, Sallam HS, Jneid H, Campbell KM, Serag H, editors. Racial Disparities in Selected Complications and Comorbidities among People with Type 2 Diabetes. Healthcare; 2024: MDPI.
49. Karter AJ, Ferrara A, Liu JY, Moffet HH, Ackerson LM, Selby JV. Ethnic disparities in diabetic complications in an insured population. Jama. 2002;287(19):2519-27.
50. Dall TM, Zhang Y, Chen YJ, Quick WW, Yang WG, Fogli J. The economic burden of diabetes. Health affairs. 2010;29(2):297-303.
51. Umpierrez G, Korytkowski M. Diabetic emergencies—ketoacidosis, hyperglycaemic hyperosmolar state and hypoglycaemia. Nature Reviews Endocrinology. 2016;12(4):222-32.
52. Kitabchi AE, Umpierrez GE, Miles JM, Fisher JN. Hyperglycemic crises in adult patients with diabetes. Diabetes care. 2009;32(7):1335.
53. Pasquel FJ, Umpierrez GE. Hyperosmolar hyperglycemic state: a historic review of the clinical presentation, diagnosis, and treatment. Diabetes care. 2014;37(11):3124-31.
54. McCoy RG, Van Houten HK, Ziegenfuss JY, Shah ND, Wermers RA, Smith SA. Increased mortality of patients with diabetes reporting severe hypoglycemia. Diabetes care. 2012;35(9):1897-901.

55. Smith WD, Winterstein AG, Johns T, Rosenberg E, Sauer BC. Causes of hyperglycemia and hypoglycemia in adult inpatients. American Journal of Health-System Pharmacy. 2005;62(7):714-9.
56. Stratton IM, Adler AI, Neil HAW, Matthews DR, Manley SE, Cull CA, et al. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. Bmj. 2000;321(7258):405-12.
57. Tabák AG, Jokela M, Akbaraly TN, Brunner EJ, Kivimäki M, Witte DR. Trajectories of glycaemia, insulin sensitivity, and insulin secretion before diagnosis of type 2 diabetes: an analysis from the Whitehall II study. The Lancet. 2009;373(9682):2215-21.
58. Fowler MJ. Microvascular and macrovascular complications of diabetes. Clinical diabetes. 2008;26(2):77-82.
59. Yan L-J. Pathogenesis of chronic hyperglycemia: from reductive stress to oxidative stress. Journal of diabetes research. 2014;2014.
60. Adler AI, Stevens RJ, Neil A, Stratton IM, Boulton AJ, Holman RR, et al. UKPDS 59: hyperglycemia and other potentially modifiable risk factors for peripheral vascular disease in type 2 diabetes. Diabetes care. 2002;25(5):894-9.
61. Adler AI, Stratton IM, Neil HAW, Yudkin JS, Matthews DR, Cull CA, et al. Association of systolic blood pressure with macrovascular and microvascular complications of type 2 diabetes (UKPDS 36): prospective observational study. Bmj. 2000;321(7258):412-9.
62. Hanif W, Ali SN, Bellary S, Patel V, Farooqi A, Karamat MA, et al. Pharmacological management of South Asians with type 2 diabetes: consensus recommendations from the South Asian Health Foundation. Diabetic medicine. 2021;38(4):e14497.
63. Bellary S, Paul O'Hare J, Raymond NT, Mughal S, Hanif WM, Jones A, et al. Premature cardiovascular events and mortality in south Asians with type 2 diabetes in the United Kingdom Asian Diabetes Study–effect of ethnicity on risk. Current medical research and opinion. 2010;26(8):1873-9.
64. Malik MO, Govan L, Petrie JR, Ghouri N, Leese G, Fischbacher C, et al. Ethnicity and risk of cardiovascular disease (CVD): 4.8 year follow-up of patients with type 2 diabetes living in Scotland. Diabetologia. 2015;58:716-25.
65. Pardhan S, Gilchrist J, Mahomed I. Impact of age and duration on sight–threatening retinopathy in South Asians and Caucasians attending a diabetic clinic. Eye. 2004;18(3):233-40.
66. Cicek M, Buckley J, Pearson-Stuttard J, Gregg EW. Characterizing multimorbidity from type 2 diabetes: insights from clustering approaches. Endocrinology and Metabolism Clinics. 2021;50(3):531-58.
67. Nowakowska M, Zghebi SS, Ashcroft DM, Buchan I, Chew-Graham C, Holt T, et al. The comorbidity burden of type 2 diabetes mellitus: patterns, clusters and predictions from a large English primary care cohort. BMC medicine. 2019;17:1-10.
68. Cusick M, Meleth AD, Agrón E, Fisher MR, Reed GF, Knatterud GL, et al. Associations of mortality and diabetes complications in patients with type 1 and type 2 diabetes: early treatment diabetic retinopathy study report no. 27. Diabetes Care. 2005;28(3):617-25.
69. Li S, Wang J, Zhang B, Li X, Liu Y. Diabetes mellitus and cause-specific mortality: a population-based study. Diabetes & metabolism journal. 2019;43(3):319-41.
70. Janssen L, Hiligsmann M, Elissen A, Joore M, Schaper N, Bosma J, et al. Burden of disease of type 2 diabetes mellitus: cost of illness and quality of life estimated using the Maastricht Study. Diabetic medicine. 2020;37(10):1759-65.

71. Tomic D, Shaw JE, Magliano DJ. The burden and risks of emerging complications of diabetes mellitus. Nature Reviews Endocrinology. 2022;18(9):525-39.
72. Wagner EH, Sandhu N, Newton KM, McCulloch DK, Ramsey SD, Grothaus LC. Effect of improved glycemic control on health care costs and utilization. Jama. 2001;285(2):182-9.
73. Capoccia K, Odegard PS, Letassy N. Medication adherence with diabetes medication: a systematic review of the literature. The Diabetes Educator. 2016;42(1):34-71.
74. Khunti K, Seidu S, Kunutsor S, Davies M. Association between adherence to pharmacotherapy and outcomes in type 2 diabetes: a meta-analysis. Diabetes Care. 2017;40(11):1588-96.
75. diabetes treatments: Diabetes UK; 2023 [Available from: https://www.diabetes.org.uk/diabetes-the-basics/diabetes-treatments.
76. Garcia-Molina L, Lewis-Mikhael A-M, Riquelme-Gallego B, Cano-Ibanez N, Oliveras-Lopez M-J, Bueno-Cavanillas A. Improving type 2 diabetes mellitus glycaemic control through lifestyle modification implementing diet intervention: a systematic review and meta-analysis. European journal of nutrition. 2020;59(4):1313-28.
77. Colberg SR, Sigal RJ, Yardley JE, Riddell MC, Dunstan DW, Dempsey PC, et al. Physical activity/exercise and diabetes: a position statement of the American Diabetes Association. Diabetes care. 2016;39(11):2065.
78. Hamasaki H. Daily physical activity and type 2 diabetes: A review. World journal of diabetes. 2016;7(12):243.
79. Viswanathan V, Krishnan D, Kalra S, Chawla R, Tiwaskar M, Saboo B, et al. Insights on medical nutrition therapy for type 2 diabetes mellitus: an Indian perspective. Advances in therapy. 2019;36(3):520-47.
80. Franz MJ, MacLeod J, Evert A, Brown C, Gradwell E, Handu D, et al. Academy of Nutrition and Dietetics nutrition practice guideline for type 1 and type 2 diabetes in adults: systematic review of evidence for medical nutrition therapy effectiveness and recommendations for integration into the nutrition care process. Journal of the Academy of Nutrition and Dietetics. 2017;117(10):1659-79.
81. Evert AB, Dennison M, Gardner CD, Garvey WT, Lau KHK, MacLeod J, et al. Nutrition therapy for adults with diabetes or prediabetes: a consensus report. Diabetes care. 2019;42(5):731.
82. Feingold KR. Oral and injectable (non-insulin) pharmacological agents for the treatment of type 2 diabetes. Endotext [Internet]. 2022.
83. Pharmacological management of glycaemic control

in people with type 2 diabetes: the Scottish Intercollegiate Guidelines Network (SIGN). 2017 [Available from: https://www.sign.ac.uk/media/1090/sign154.
84. Kirkman MS, Rowan-Martin MT, Levin R, Fonseca VA, Schmittdiel JA, Herman WH, et al. Determinants of adherence to diabetes medications: findings from a large pharmacy claims database. Diabetes care. 2015;38(4):604-9.
85. Boonpattharatthiti K, Songkla PN, Chantara J, Koomsri C, Krass I, Chaiyakunapruk N, et al. Prevalence of adherence to oral antidiabetic drugs in patients with type 2 diabetes: A systematic review and meta-analysis. Journal of Diabetes Investigation. 2024.
86. Viollet B, Guigas B, Garcia NS, Leclerc J, Foretz M, Andreelli F. Cellular and molecular mechanisms of metformin: an overview. Clinical science. 2012;122(6):253-70.
87. Rena G, Hardie DG, Pearson ER. The mechanisms of action of metformin. Diabetologia. 2017;60(9):1577-85.

88. Saenz A, Fernandez-Esteban I, Mataix A, Segura MA, i Figuls MR, Moher D. Metformin monotherapy for type 2 diabetes mellitus. Cochrane database of systematic reviews. 2005(3).
89. Hauner H. The mode of action of thiazolidinediones. Diabetes/metabolism research and reviews. 2002;18(S2):S10-S5.
90. Czoski-Murray C, Warren E, Chilcott J, Beverley C, Psyllaki M, Cowan J. Clinical effectiveness and cost-effectiveness of pioglitazone and rosiglitazone in the treatment of type 2 diabetes: a systematic review and economic evaluation. Health technology assessment (Winchester, England). 2004;8(13):iii, ix-x, 1.
91. Sola D, Rossi L, Schianca GPC, Maffioli P, Bigliocca M, Mella R, et al. State of the art paper Sulfonylureas and their use in clinical practice. Archives of medical science. 2015;11(4):840-8.
92. Hirst J, Farmer A, Dyar A, Lung T, Stevens R. Estimating the effect of sulfonylurea on HbA 1c in diabetes: a systematic review and meta-analysis. Diabetologia. 2013;56:973-84.
93. Hinnen D. Glucagon-like peptide 1 receptor agonists for type 2 diabetes. Diabetes spectrum. 2017;30(3):202-10.
94. Htike ZZ, Zaccardi F, Papamargaritis D, Webb DR, Khunti K, Davies MJ. Efficacy and safety of glucagon-like peptide-1 receptor agonists in type 2 diabetes: a systematic review and mixed-treatment comparison analysis. Diabetes, Obesity and Metabolism. 2017;19(4):524-36.
95. Thornberry NA, Gallwitz B. Mechanism of action of inhibitors of dipeptidyl-peptidase-4 (DPP-4). Best practice & research Clinical endocrinology & metabolism. 2009;23(4):479-86.
96. Kania DS, Gonzalvo JD, Weber ZA. Saxagliptin: a clinical review in the treatment of type 2 diabetes mellitus. Clinical therapeutics. 2011;33(8):1005-22.
97. Brown E, Rajeev SP, Cuthbertson DJ, Wilding JP. A review of the mechanism of action, metabolic profile and haemodynamic effects of sodium-glucose co-transporter-2 inhibitors. Diabetes, Obesity and Metabolism. 2019;21:9-18.
98. Zelniker TA, Wiviott SD, Raz I, Im K, Goodrich EL, Bonaca MP, et al. SGLT2 inhibitors for primary and secondary prevention of cardiovascular and renal outcomes in type 2 diabetes: a systematic review and meta-analysis of cardiovascular outcome trials. The Lancet. 2019;393(10166):31-9.
99. Chaudhury A, Duvoor C, Reddy Dendi VS, Kraleti S, Chada A, Ravilla R, et al. Clinical review of antidiabetic drugs: implications for type 2 diabetes mellitus management. Frontiers in endocrinology. 2017;8:6.
100. Black C, Donnelly P, McIntyre L, Royle P, Shepherd JJ, Thomas S. Meglitinide analogues for type 2 diabetes mellitus. Cochrane Database of Systematic Reviews. 2007(2).
101. Akmal M, Wadhwa R. Alpha glucosidase inhibitors. 2020.
102. Van De Laar FA, Lucassen PL, Akkermans RP, van de Lisdonk EH, Rutten GE, van Weel C. α-Glucosidase inhibitors for patients with type 2 diabetes: results from a Cochrane systematic review and meta-analysis. Diabetes care. 2005;28(1):154-63.
103. Horne R, Weinman J, Barber N, Elliott R, Morgan M, Cribb A, et al. Concordance, adherence and compliance in medicine taking. London: NCCSDO. 2005;2005(40):6.
104. Cramer JA, Roy A, Burrell A, Fairchild CJ, Fuldeore MJ, Ollendorf DA, et al. Medication compliance and persistence: terminology and definitions. Value in health. 2008;11(1):44-7.
105. Haynes R. Compliance in health care. Johns Hopkins University Press; 1979.
106. Banning M. Older people and adherence with medication: a review of the literature. International journal of nursing studies. 2008;45(10):1550-61.
107. Jimmy B, Jose J. Patient medication adherence: measures in daily practice. Oman medical journal. 2011;26(3):155.

108. Sabaté E. Adherence to long-term therapies: evidence for action: World Health Organization; 2003.
109. Julius RJ, Novitsky Jr MA, Dubin WR. Medication adherence: a review of the literature and implications for clinical practice. Journal of Psychiatric Practice®. 2009;15(1):34-44.
110. Chakrabarti S. What's in a name? Compliance, adherence and concordance in chronic psychiatric disorders. World J Psychiatry. 2014; 4 (2): 30–6.
111. Vrijens B, De Geest S, Hughes DA, Przemyslaw K, Demonceau J, Ruppar T, et al. A new taxonomy for describing and defining adherence to medications. British journal of clinical pharmacology. 2012;73(5):691-705.
112. Nieuwlaat R, Wilczynski N, Navarro T, Hobson N, Jeffery R, Keepanasseril A, et al. Interventions for enhancing medication adherence. Cochrane database of systematic reviews. 2014(11).
113. Lam WY, Fresco P. Medication adherence measures: an overview. BioMed research international. 2015;2015(1):217047.
114. Hutchins DS, Zeber JE, Roberts CS, Williams AF, Manias E, Peterson AM. Initial medication adherence—review and recommendations for good practices in outcomes research: an ISPOR medication adherence and persistence special interest group report. Value in Health. 2015;18(5):690-9.
115. Blaschke TF, Osterberg L, Vrijens B, Urquhart J. Adherence to medications: insights arising from studies on the unreliable link between prescribed and actual drug dosing histories. Annual review of pharmacology and toxicology. 2012;52:275-301.
116. Fischer MA, Stedman MR, Lii J, Vogeli C, Shrank WH, Brookhart MA, et al. Primary medication non-adherence: analysis of 195,930 electronic prescriptions. Journal of general internal medicine. 2010;25:284-90.
117. Andrade SE, Kahler KH, Frech F, Chan KA. Methods for evaluation of medication adherence and persistence using automated databases. Pharmacoepidemiology and drug safety. 2006;15(8):565-74.
118. Cambridgeshire N. Repeat medication for 28 Days. Cambridge: Cambridgeshire Primary Care Trust. 2009.
119. West K. NORTH EAST ESSEX CLINICAL COMMISSIONING GROUP.
120. Giardini A, Martin MT, Cahir C, Lehane E, Menditto E, Strano M, et al. Toward appropriate criteria in medication adherence assessment in older persons: Position Paper. Aging clinical and experimental research. 2016;28:371-81.
121. Hugtenburg JG, Timmers L, Elders PJ, Vervloet M, van Dijk L. Definitions, variants, and causes of nonadherence with medication: a challenge for tailored interventions. Patient preference and adherence. 2013:675-82.
122. Raebel MA, Schmittdiel J, Karter AJ, Konieczny JL, Steiner JF. Standardizing terminology and definitions of medication adherence and persistence in research employing electronic databases. Medical care. 2013;51(8 0 3):S11.
123. Fischer MA, Choudhry NK, Brill G, Avorn J, Schneeweiss S, Hutchins D, et al. Trouble getting started: predictors of primary medication nonadherence. The American journal of medicine. 2011;124(11):1081. e9-. e22.
124. Tamblyn R, Eguale T, Huang A, Winslade N, Doran P. The incidence and determinants of primary nonadherence with prescribed medication in primary care: a cohort study. Annals of internal medicine. 2014;160(7):441-50.

125. Lehane E, McCarthy G. Intentional and unintentional medication non-adherence: a comprehensive framework for clinical research and practice? A discussion paper. International journal of nursing studies. 2007;44(8):1468-77.
126. Branin JJ. The role of memory strategies in medication adherence among the elderly. Home Health Care Services Quarterly. 2001;20(2):1-16.
127. Clifford S, Barber N, Horne R. Understanding different beliefs held by adherers, unintentional nonadherers, and intentional nonadherers: application of the necessity–concerns framework. Journal of psychosomatic research. 2008;64(1):41-6.
128. Pantuzza LL, Ceccato MdGB, Silveira MR, Junqueira LMR, Reis AMM. Association between medication regimen complexity and pharmacotherapy adherence: a systematic review. European journal of clinical pharmacology. 2017;73:1475-89.
129. de Vries ST, Keers JC, Visser R, de Zeeuw D, Haaijer-Ruskamp FM, Voorham J, et al. Medication beliefs, treatment complexity, and non-adherence to different drug classes in patients with type 2 diabetes. Journal of psychosomatic research. 2014;76(2):134-8.
130. Horne R, Chapman SC, Parham R, Freemantle N, Forbes A, Cooper V. Understanding patients' adherence-related beliefs about medicines prescribed for long-term conditions: a meta-analytic review of the Necessity-Concerns Framework. PloS one. 2013;8(12):e80633.
131. Williams AB, Amico KR, Bova C, Womack JA. A proposal for quality standards for measuring medication adherence in research. AIDS and Behavior. 2013;17:284-97.
132. Nguyen TMU, Caze AL, Cottrell N. What are validated self-report adherence scales really measuring?: a systematic review. British journal of clinical pharmacology. 2014;77(3):427-45.
133. Broekmans S, Dobbels F, Milisen K, Morlion B, Vanderschueren S. Pharmacologic pain treatment in a multidisciplinary pain center: do patients adhere to the prescription of the physician? The Clinical journal of pain. 2010;26(2):81-6.
134. Mårdby A-C, Åkerlind I, Jörgensen T. Beliefs about medicines and self-reported adherence among pharmacy clients. Patient education and counseling. 2007;69(1-3):158-64.
135. Unni EJ, Farris KB. Unintentional non-adherence and belief in medicines in older adults. Patient education and counseling. 2011;83(2):265-8.
136. Lam WY, Fresco P. Medication adherence measures: an overview. BioMed research international. 2015;2015.
137. Pednekar PP, Agh T, Malmenäs M, Raval AD, Bennett BM, Borah BJ, et al. Methods for measuring multiple medication adherence: a systematic review–report of the ISPOR medication adherence and persistence special interest group. Value in Health. 2019;22(2):139-56.
138. Osterberg L, Blaschke T. Adherence to medication. New England journal of medicine. 2005;353(5):487-97.
139. Nau DP. Proportion of days covered (PDC) as a preferred method of measuring medication adherence. Springfield, VA: Pharmacy Quality Alliance. 2012;6:25.
140. Wawruch M, Wimmer Jr G, Murin J, Paduchova M, Petrova M, Tesar T, et al. Non-adherence to statin treatment in older patients with peripheral arterial disease depending on persistence status. Biomedicines. 2020;8(10):378.
141. Martin BC, Wiley-Exley EK, Richards S, Domino ME, Carey TS, Sleath BL. Contrasting measures of adherence with simple drug use, medication switching, and therapeutic duplication. Annals of Pharmacotherapy. 2009;43(1):36-44.

142. Zhu VJ, Tu W, Rosenman MB, Overhage JM, editors. A comparison of data driven-based measures of adherence to oral hypoglycemic agents in Medicaid patients. AMIA Annual Symposium Proceedings; 2014: American Medical Informatics Association.
143. Prieto-Merino D, Mulick A, Armstrong C, Hoult H, Fawcett S, Eliasson L, et al. Estimating proportion of days covered (PDC) using real-world online medicine suppliers' datasets. Journal of pharmaceutical policy and practice. 2021;14(1):113.
144. Gellad WF, Thorpe CT, Steiner JF, Voils CI. The myths of medication adherence. Pharmacoepidemiology and drug safety. 2017;26(12):1437-41.
145. Karve S, Cleves MA, Helm M, Hudson TJ, West DS, Martin BC. Good and poor adherence: optimal cut-point for adherence measures using administrative claims data. Current medical research and opinion. 2009;25(9):2303-10.
146. Dima AL, Dediu D. Computation of adherence to medication and visualization of medication histories in R with AdhereR: Towards transparent and reproducible use of electronic healthcare data. PloS one. 2017;12(4):e0174426.
147. Franklin JM, Shrank WH, Pakes J, Sanfélix-Gimeno G, Matlin OS, Brennan TA, et al. Group-based trajectory models: a new approach to classifying and predicting long-term medication adherence. Medical care. 2013:789-96.
148. Franklin JM, Krumme AA, Tong AY, Shrank WH, Matlin OS, Brennan TA, et al. Association between trajectories of statin adherence and subsequent cardiovascular events. Pharmacoepidemiology and drug safety. 2015;24(10):1105-13.
149. Franklin JM, Krumme AA, Shrank WH, Matlin OS, Brennan TA, Choudhry NK. Predicting adherence trajectory using initial patterns of medication filling. Am J Manag Care. 2015;21(9):e537-e44.
150. Librero J, Sanfélix-Gimeno G, Peiró S. Medication adherence patterns after hospitalization for coronary heart disease. A population-based study using electronic records and group-based trajectory models. PloS one. 2016;11(8):e0161381.
151. Nagin DS, Odgers CL. Group-based trajectory modeling in clinical research. Annual review of clinical psychology. 2010;6:109-38.
152. Jones BL, Nagin DS. Advances in group-based trajectory modeling and an SAS procedure for estimating them. Sociological methods & research. 2007;35(4):542-71.
153. Lehmann A, Aslani P, Ahmed R, Celio J, Gauchet A, Bedouch P, et al. Assessing medication adherence: options to consider. International journal of clinical pharmacy. 2014;36:55-69.
154. Prescription duration guidance Online: NHS; December 23 [Available from: https://www.hweclinicalguidance.nhs.uk/prescribing-guidance/prescription-duration-guidance-hwe-icb/.
155. Digital N. Practice level prescribing data: more information 2024 [Available from: https://digital.nhs.uk/data-and-information/areas-of-interest/prescribing/practice-level-prescribing-in-england-a-summary/practice-level-prescribing-data-more-information.
156. NHS. NHS prescription charges [Available from: https://www.nhs.uk/nhs-services/prescriptions/nhs-prescription-charges/.
157. Mantzourani E, Nazar H, Phibben C, Pang J, John G, Evans A, et al. Exploring the association of the discharge medicines review with patient hospital readmissions through national routine data linkage in Wales: a retrospective cohort study. BMJ open. 2020;10(2):e033551.
158. Goundrey-Smith S. The connected community pharmacy: benefits for healthcare and implications for health policy. Frontiers in pharmacology. 2018;9:1352.

159. Checchi KD, Huybrechts KF, Avorn J, Kesselheim AS. Electronic medication packaging devices and medication adherence: a systematic review. Jama. 2014;312(12):1237-47.
160. El Alili M, Vrijens B, Demonceau J, Evers SM, Hiligsmann M. A scoping review of studies comparing the medication event monitoring system (MEMS) with alternative methods for measuring medication adherence. British journal of clinical pharmacology. 2016;82(1):268-79.
161. Vrijens B, Urquhart J. Methods for measuring, enhancing, and accounting for medication adherence in clinical trials. Clinical Pharmacology & Therapeutics. 2014;95(6):617-26.
162. Balkrishnan R, Carroll CL, Camacho FT, Feldman SR. Electronic monitoring of medication adherence in skin disease: results of a pilot study. Journal of the american academy of dermatology. 2003;49(4):651-4.
163. Choo PW, Rand CS, Inui TS, Lee M-LT, Canning C, Platt R. Derivation of adherence metrics from electronic dosing records. Journal of clinical epidemiology. 2001;54(6):619-26.
164. Farmer KC. Methods for measuring and monitoring medication regimen adherence in clinical trials and clinical practice. Clinical therapeutics. 1999;21(6):1074-90.
165. Bangsberg DR, Hecht FM, Charlebois ED, Zolopa AR, Holodniy M, Sheiner L, et al. Adherence to protease inhibitors, HIV-1 viral load, and development of drug resistance in an indigent population. Aids. 2000;14(4):357-66.
166. Campbell JI, Eyal N, Musiimenta A, Haberer JE. Ethical questions in medical electronic adherence monitoring. Journal of general internal medicine. 2016;31:338-42.
167. Horne R, Hankins M, Jenkins R. The Satisfaction with Information about Medicines Scale (SIMS): a new measurement tool for audit and research. Quality in health care: QHC. 2001;10(3):135.
168. Levy HB. Self-administered medication-risk questionnaire in an elderly population. Annals of Pharmacotherapy. 2003;37(7-8):982-7.
169. Morisky DE, Ang A, Krousel-Wood M, Ward HJ. Retracted: predictive validity of a medication adherence measure in an outpatient setting. The journal of clinical hypertension. 2008;10(5):348-54.
170. Stirratt MJ, Dunbar-Jacob J, Crane HM, Simoni JM, Czajkowski S, Hilliard ME, et al. Self-report measures of medication adherence behavior: recommendations on optimal use. Translational behavioral medicine. 2015;5(4):470-82.
171. Horne R, Hankins M, Jenkins R. The Satisfaction with Information about Medicines Scale (SIMS): a new measurement tool for audit and research. BMJ Quality & Safety. 2001;10(3):135-40.
172. Garber MC, Nau DP, Erickson SR, Aikens JE, Lawrence JB. The concordance of self-report with other measures of medication adherence: a summary of the literature. Medical care. 2004:649-52.
173. Garfield S, Clifford S, Eliasson L, Barber N, Willson A. Suitability of measures of self-reported medication adherence for routine clinical use: a systematic review. BMC medical research methodology. 2011;11(1):1-9.
174. Asch DA, Jedrziewski MK, Christakis NA. Response rates to mail surveys published in medical journals. Journal of clinical epidemiology. 1997;50(10):1129-36.
175. Edwards P, Roberts I, Clarke M, DiGuiseppi C, Pratap S, Wentz R, et al. R. C: Methods to increase response rates to postal questionnaires. Cochrane Database of Systematic Reviews. 2007;2.

176. Podsadecki TJ, Vrijens BC, Tousset EP, Rode RA, Hanna GJ. “White coat compliance” limits the reliability of therapeutic drug monitoring in HIV-1—infected patients. HIV clinical trials. 2008;9(4):238-46.
177. Van Onzenoort HA, Verberk WJ, Kessels AG, Kroon AA, Neef C, van der Kuy P-HM, et al. Assessing medication adherence simultaneously by electronic monitoring and pill count in patients with mild-to-moderate hypertension. American journal of hypertension. 2010;23(2):149-54.
178. Lee JY, Kusek JW, Greene PG, Bernhard S, Norris K, Smith D, et al. Assessing medication adherence by pill count and electronic monitoring in the African American Study of Kidney Disease and Hypertension (AASK) Pilot Study. American journal of hypertension. 1996;9(8):719-25.
179. Demonceau J, Ruppar T, Kristanto P, Hughes DA, Fargher E, Kardas P, et al. Identification and assessment of adherence-enhancing interventions in studies assessing medication adherence through electronically compiled drug dosing histories: a systematic literature review and meta-analysis. Drugs. 2013;73:545-62.
180. DiMatteo MR, Haskard-Zolnierek KB, Martin LR. Improving patient adherence: a three-factor model to guide practice. Health Psychology Review. 2012;6(1):74-91.
181. Brown MT, Bussell JK, editors. Medication adherence: WHO cares? Mayo clinic proceedings; 2011: Elsevier.
182. Miller TA. Health literacy and adherence to medical treatment in chronic and acute illness: a meta-analysis. Patient education and counseling. 2016;99(7):1079-86.
183. Shi S, Shen Z, Duan Y, Ding S, Zhong Z. Association between medication literacy and medication adherence among patients with hypertension. Frontiers in Pharmacology. 2019;10:822.
184. Jin J, Sklar GE, Min Sen Oh V, Chuen Li S. Factors affecting therapeutic compliance: A review from the patient’s perspective. Therapeutics and clinical risk management. 2008;4(1):269-86.
185. Kvarnström K, Westerholm A, Airaksinen M, Liira H. Factors contributing to medication adherence in patients with a chronic condition: a scoping review of qualitative research. Pharmaceutics. 2021;13(7):1100.
186. Zairina E, Nugraheni G, Sulistyarini A, Mufarrihah, Setiawan CD, Kripalani S, et al. Factors related to barriers and medication adherence in patients with type 2 diabetes mellitus: a cross-sectional study. Journal of Diabetes & Metabolic Disorders. 2022;21(1):219-28.
187. Elnaem MH, Irwan NA, Abubakar U, Syed Sulaiman SA, Elrggal ME, Cheema E. Impact of medication regimen simplification on medication adherence and clinical outcomes in patients with long-term medical conditions. Patient preference and adherence. 2020:2135-45.
188. Ayele AA, Tegegn HG, Ayele TA, Ayalew MB. Medication regimen complexity and its impact on medication adherence and glycemic control among patients with type 2 diabetes mellitus in an Ethiopian general hospital. BMJ Open Diabetes Research and Care. 2019;7(1):e000685.
189. Mann DM, Ponieman D, Leventhal H, Halm EA. Predictors of adherence to diabetes medications: the role of disease and medication beliefs. Journal of behavioral medicine. 2009;32:278-84.
190. DiMatteo MR, Haskard KB, Williams SL. Health beliefs, disease severity, and patient adherence: a meta-analysis. Medical care. 2007:521-8.
191. Gao X, Nau D, Rosenbluth S, Scott V, Woodward C. The relationship of disease severity, health beliefs and medication adherence among HIV patients. AIDS care. 2000;12(4):387-98.

192. Kardas P, Lewek P, Matyjaszczyk M. Determinants of patient adherence: a review of systematic reviews. Frontiers in pharmacology. 2013;4:91.
193. Horne R, Weinman J. Patients' beliefs about prescribed medicines and their role in adherence to treatment in chronic physical illness. Journal of psychosomatic research. 1999;47(6):555-67.
194. Naderi SH, Bestwick JP, Wald DS. Adherence to drugs that prevent cardiovascular disease: meta-analysis on 376,162 patients. The American journal of medicine. 2012;125(9):882-7. e1.
195. Zolnierek KBH, DiMatteo MR. Physician communication and patient adherence to treatment: a meta-analysis. Medical care. 2009;47(8):826.
196. Świątoniowska-Lonc N, Polański J, Tański W, Jankowska-Polańska B. Impact of satisfaction with physician–patient communication on self-care and adherence in patients with hypertension: cross-sectional study. BMC health services research. 2020;20(1):1-9.
197. Vermeire E, Hearnshaw H, Van Royen P, Denekens J. Patient adherence to treatment: three decades of research. A comprehensive review. Journal of clinical pharmacy and therapeutics. 2001;26(5):331-42.
198. Vik SA, Maxwell CJ, Hogan DB. Measurement, correlates, and health outcomes of medication adherence among seniors. Annals of pharmacotherapy. 2004;38(2):303-12.
199. Jaam M, Hadi MA, Kheir N, Mohamed Ibrahim MI, Diab MI, Al-Abdulla SA, et al. A qualitative exploration of barriers to medication adherence among patients with uncontrolled diabetes in Qatar: integrating perspectives of patients and health care providers. Patient preference and adherence. 2018:2205-16.
200. Ledford CJ, Villagran MM, Kreps GL, Zhao X, McHorney C, Weathers M, et al. “Practicing medicine”: patient perceptions of physician communication and the process of prescription. Patient education and counseling. 2010;80(3):384-92.
201. Penn C, Watermeyer J, Evans M. Why don’t patients take their drugs? The role of communication, context and culture in patient adherence and the work of the pharmacist in HIV/AIDS. Patient education and counseling. 2011;83(3):310-8.
202. Al-Qazaz HK, Sulaiman SA, Hassali MA, Shafie AA, Sundram S, Al-Nuri R, et al. Diabetes knowledge, medication adherence and glycemic control among patients with type 2 diabetes. International journal of clinical pharmacy. 2011;33:1028-35.
203. Fernandez-Lazaro CI, García-González JM, Adams DP, Fernandez-Lazaro D, Mielgo-Ayuso J, Caballero-Garcia A, et al. Adherence to treatment and related factors among patients with chronic conditions in primary care: a cross-sectional study. BMC family practice. 2019;20(1):1-12.
204. Okuyan B, Sancar M, Izzettin FV. Assessment of medication knowledge and adherence among patients under oral chronic medication treatment in community pharmacy settings. Pharmacoepidemiology and drug safety. 2013;22(2):209-14.
205. Kalichman SC, Benotsch E, Suarez T, Catz S, Miller J, Rompa D. Health literacy and health-related knowledge among persons living with HIV/AIDS. American journal of preventive medicine. 2000;18(4):325-31.
206. Schoenthaler AM, Schwartz BS, Wood C, Stewart WF. Patient and physician factors associated with adherence to diabetes medications. The Diabetes Educator. 2012;38(3):397-408.
207. Kardas P, Morrison V, Fargher E, Parveen S, Plumpton C, Clyne W, et al. report on the determinants of patient non-adherence with short-term therapies and treatments for chronic

diseases in Europe. Ascertaining barriers for compliance: policies for safe, effective and cost-effective use of medicines in Europe Final Report of the ABC Project (Deliverable 71).2012:40.
208. Marx G, Witte N, Himmel W, Kühnel S, Simmenroth-Nayda A, Koschack J. Accepting the unacceptable: medication adherence and different types of action patterns among patients with high blood pressure. Patient education and counseling. 2011;85(3):468-74.
209. Schneider J, Kaplan SH, Greenfield S, Li W, Wilson IB. Better physician-patient relationships are associated with higher reported adherence to antiretroviral therapy in patients with HIV infection. Journal of general internal medicine. 2004;19:1096-103.
210. Pound P, Britten N, Morgan M, Yardley L, Pope C, Daker-White G, et al. Resisting medicines: a synthesis of qualitative studies of medicine taking. Social science & medicine. 2005;61(1):133-55.
211. Lamarche L, Tejpal A, Mangin D. Self-efficacy for medication management: a systematic review of instruments. Patient preference and adherence. 2018:1279-87.
212. Schunk DH. Social cognitive theory. 2012.
213. Náfrádi L, Nakamoto K, Schulz PJ. Is patient empowerment the key to promote adherence? A systematic review of the relationship between self-efficacy, health locus of control and medication adherence. PloS one. 2017;12(10):e0186458.
214. DiMatteo MR. Social support and patient adherence to medical treatment: a meta-analysis. Health psychology. 2004;23(2):207.
215. Loke YK, Hinz I, Wang X, Salter C. Systematic review of consistency between adherence to cardiovascular or diabetes medication and health literacy in older adults. Annals of Pharmacotherapy. 2012;46(6):863-72.
216. Langley CA, Bush J. The Aston Medication Adherence Study: mapping the adherence patterns of an inner-city population. International journal of clinical pharmacy. 2014;36:202-11.
217. Kurdi AI, Chen L-C, Elliott RA. Exploring factors associated with patients' adherence to antihypertensive drugs among people with primary hypertension in the United Kingdom. Journal of hypertension. 2017;35(9):1881-90.
218. Studer CM, Linder M, Pazzagli L. A global systematic overview of socioeconomic factors associated with antidiabetic medication adherence in individuals with type 2 diabetes. Journal of Health, Population and Nutrition. 2023;42(1):122.
219. Woodward A, Walters K, Davies N, Nimmons D, Protheroe J, Chew-Graham CA, et al. Barriers and facilitators of self-management of diabetes amongst people experiencing socioeconomic deprivation: a systematic review and qualitative synthesis. Health Expectations. 2024;27(3):e14070.
220. Buck D, Jacoby A, Baker GA, Chadwick DW. Factors influencing compliance with antiepileptic drug regimes. Seizure. 1997;6(2):87-93.
221. Balbay O, Annakkaya AN, Arbak P, Bilgin C, Erbas M. Which patients are able to adhere to tuberculosis treatment? A study in a rural area in the northwest part of Turkey. Japanese journal of infectious diseases. 2005;58(3):152-8.
222. Zhang Y, Baik SH. Race/ethnicity, disability, and medication adherence among Medicare beneficiaries with heart failure. Journal of general internal medicine. 2014;29:602-7.
223. Ling RZQ, Jiao N, Hassan NB, He H, Wang W. Adherence to diet and medication and the associated factors among patient with chronic heart failure in a multi-ethnic society. Heart & Lung. 2020;49(2):144-50.
224. Gast A, Mathes T. Medication adherence influencing factors—an (updated) overview of systematic reviews. Systematic reviews. 2019;8:1-17.

225. Lank RJ, Lisabeth LD, Levine DA, Zahuranec DB, Kerber KA, Shafie-Khorassani F, et al. Ethnic Differences in 90-Day Poststroke Medication Adherence. Stroke.50(6):1519-24.
226. Sigglekow F, Horsburgh S, Parkin L. Statin adherence is lower in primary than secondary prevention: a national follow-up study of new users. PLoS One. 2020;15(11):e0242424.
227. Marcum ZA, Zheng Y, Perera S, Strotmeyer E, Newman AB, Simonsick EM, et al. Prevalence and correlates of self-reported medication non-adherence among older adults with coronary heart disease, diabetes mellitus, and/or hypertension. Research in Social and Administrative Pharmacy. 2013;9(6):817-27.
228. Adams AS, Banerjee S, Ku CJ. Medication adherence and racial differences in diabetes in the USA: an update. Diabetes Management. 2015;5(2):79.
229. Taira DA, Seto BK, Davis JW, Seto TB, Landsittel D, Sumida WK. Examining factors associated with nonadherence and identifying providers caring for nonadherent subgroups. Journal of Pharmaceutical Health Services Research. 2017;8(4):247-53.
230. Egede LE, Gebregziabher M, Hunt KJ, Axon RN, Echols C, Gilbert GE, et al. Regional, geographic, and ethnic differences in medication adherence among adults with type 2 diabetes. Annals of Pharmacotherapy. 2011;45(2):169-78.
231. Opolka JL, Rascati KL, Brown CM, Gibson PJ. Role of ethnicity in predicting antipsychotic medication adherence. Annals of Pharmacotherapy. 2003;37(5):625-30.
232. Cramer JA. A systematic review of adherence with medications for diabetes. Diabetes care. 2004;27(5):1218-24.
233. Lin L-K, Sun Y, Heng BH, Chew DEK, Chong P-N. Medication adherence and glycemic control among newly diagnosed diabetes patients. BMJ Open Diabetes Research and Care. 2017;5(1):e000429.
234. Mosen DM, Glauber H, Stoneburner AB, Feldstein AC. Assessing the association between medication adherence and glycemic control. Am J Pharm Benefits. 2017;9(3):82-8.
235. Tominaga Y, Aomori T, Hayakawa T, Morisky DE, Takahashi K, Mochizuki M. Relationship between medication adherence and glycemic control in Japanese patients with type 2 diabetes. Pharmazie.73(10):609-12.
236. Sokol MC, McGuigan KA, Verbrugge RR, Epstein RS. Impact of medication adherence on hospitalization risk and healthcare cost. Medical care. 2005:521-30.
237. Curtis SE, Boye KS, Lage MJ, Garcia-Perez L-E. Medication adherence and improved outcomes among patients with type 2 diabetes. Am J Manag Care. 2017;23(7):e208-e14.
238. Khunti N, Khunti N, Khunti K. Adherence to type 2 diabetes management. British Journal of Diabetes. 2019;19(2):99-104.
239. Bhopal R. Glossary of terms relating to ethnicity and race: for reflection and debate. Journal of Epidemiology & Community Health. 2004;58(6):441-5.
240. Senior PA, Bhopal R. Ethnicity as a variable in epidemiological research. Bmj. 1994;309(6950):327-30.
241. Cornell S, Hartmann D. Ethnicity and race: Making identities in a changing world: Sage Publications; 2006.
242. Bhopal RS. Ethnicity, race, and health in multicultural societies: foundations for better epidemiology, public health, and health care: Oxford University Press; 2007.
243. Karter AJ. Race and ethnicity: vital constructs for diabetes research. Diabetes Care. 2003;26(7):2189-93.
244. Flanagin A, Frey T, Christiansen SL, Bauchner H. The reporting of race and ethnicity in medical and science journals: comments invited. Jama. 2021;325(11):1049-52.

245. Ethnic group, England and Wales: Census 2021: Office for National Statistics; 2021 [Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/culturalidentity/ethnicity/bulletins/ethnicgroupenglandandwales/census2021.
246. Ethnic group (detailed) variable: Census 2021; 2023 [Available from: https://www.ons.gov.uk/census/census2021dictionary/variablesbytopic/ethnicgroupnationalidentitylanguageandreligionvariablescensus2021/ethnicgroupdetailed.
247. Matthews K, Phelan J, Jones M, Konya S, Marks R, Pratt B, et al. 2015 National Content Test: Race and Ethnicity Analysis Report. US Department of Commerce; 2017.
248. Asiri R, Todd A, Robinson-Barella A, Husband A. Ethnic disparities in medication adherence? A systematic review examining the association between ethnicity and antidiabetic medication adherence. PLoS One. 2023;18(2):e0271650.
249. Polonsky WH, Henry RR. Poor medication adherence in type 2 diabetes: recognizing the scope of the problem and its key contributors. Patient preference and adherence. 2016:1299-307.
250. Egede LE, Gebregziabher M, Echols C, Lynch CP. Longitudinal effects of medication nonadherence on glycemic control. Annals of Pharmacotherapy. 2014;48(5):562-70.
251. DiBonaventura M, Wintfeld N, Huang J, Goren A. The association between nonadherence and glycated hemoglobin among type 2 diabetes patients using basal insulin analogs. Patient preference and adherence. 2014:873-82.
252. Currie CJ, Peyrot M, Morgan CL, Poole CD, Jenkins-Jones S, Rubin RR, et al. The impact of treatment noncompliance on mortality in people with type 2 diabetes. Diabetes care. 2012;35(6):1279-84.
253. Patton SR. Adherence to glycemic monitoring in diabetes. Journal of diabetes science and technology. 2015;9(3):668-75.
254. Monteiro LEdRC, Garcia SP, Bottino LG, Custodio JL, Telo GH, Schaan BD. Precipitating factors of diabetic ketoacidosis in type 1 diabetes patients at a tertiary hospital: a cross-sectional study with a two-time-period comparison. Archives of Endocrinology and Metabolism. 2022;66:355-61.
255. Morris AD, Boyle DI, McMahon AD, Greene SA, MacDonald TM, Newton RW. Adherence to insulin treatment, glycaemic control, and ketoacidosis in insulin-dependent diabetes mellitus. The Lancet. 1997;350(9090):1505-10.
256. Grant RW, Devita NG, Singer DE, Meigs JB. Polypharmacy and medication adherence in patients with type 2 diabetes. Diabetes care. 2003;26(5):1408-12.
257. Peeters B, Van Tongelen I, Boussery K, Mehuys E, Remon JP, Willems S. Factors associated with medication adherence to oral hypoglycaemic agents in different ethnic groups suffering from type 2 diabetes: a systematic literature review and suggestions for further research. Diabetic Medicine. 2011;28(3):262-75.
258. Spanakis EK, Golden SH. Race/ethnic difference in diabetes and diabetic complications. Current diabetes reports. 2013;13:814-23.
259. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. Bmj. 2021;372.
260. Peterson AM, Nau DP, Cramer JA, Benner J, Gwadry-Sridhar F, Nichol M. A checklist for medication compliance and persistence studies using retrospective databases. Value in health. 2007;10(1):3-12.

261. J B. The Joanna Briggs Institute Critical Appraisal tools: Checklists: The Joanna Briggs Institute; 2020 [Available from: https://jbi.global/critical-appraisal-tools.
262. Popay J, Roberts H, Sowden A, Petticrew M, Arai L, Rodgers M, et al. Guidance on the conduct of narrative synthesis in systematic reviews. A product from the ESRC methods programme Version. 2006;1(1):b92.
263. Fernández A, Quan J, Moffet H, Parker MM, Schillinger D, Karter AJ. Adherence to newly prescribed diabetes medications among insured Latino and White patients with diabetes. JAMA internal medicine. 2017;177(3):371-9.
264. Trinacty CM, Adams AS, Soumerai SB, Zhang F, Meigs JB, Piette JD, et al. Racial differences in long-term adherence to oral antidiabetic drug therapy: a longitudinal cohort study. BMC health services research. 2009;9:1-10.
265. Gatwood JD, Chisholm-Burns M, Davis R, Thomas F, Potukuchi P, Hung A, et al. Disparities in initial oral antidiabetic medication adherence among veterans with incident diabetes. Journal of managed care & specialty pharmacy. 2018;24(4):379-89.
266. Lopez JM, Bailey RA, Rupnow MF, Annunziata K. Characterization of type 2 diabetes mellitus burden by age and ethnic groups based on a nationwide survey. Clinical therapeutics. 2014;36(4):494-506.
267. Adams AS, Trinacty CM, Zhang F, Kleinman K, Grant RW, Meigs JB, et al. Medication adherence and racial differences in A1C control. Diabetes care. 2008;31(5):916-21.
268. Lee R, Taira DA. PEER REVIEWED: Adherence to Oral Hypoglycemic Agents in Hawaii. Preventing chronic disease. 2005;2(2).
269. Reynolds K, An J, Wu J, Harrison TN, Wei R, Stuart B, et al. Treatment discontinuation of oral hypoglycemic agents and healthcare utilization among patients with diabetes. Journal of Diabetes and its Complications. 2016;30(8):1443-51.
270. Patel I, Erickson SR, Caldwell CH, Woolford SJ, Bagozzi RP, Chang J, et al. Predictors of medication adherence and persistence in Medicaid enrollees with developmental disabilities and type 2 diabetes. Research in Social and Administrative Pharmacy. 2016;12(4):592-603.
271. Marshall CJ, Rodriguez HP, Dyer W, Schmittdiel JA. Racial and ethnic disparities in diabetes care quality among women of reproductive age in an integrated delivery system. Women's Health Issues. 2020;30(3):191-9.
272. Xie Z, St. Clair P, Goldman DP, Joyce G. Racial and ethnic disparities in medication adherence among privately insured patients in the United States. PloS one. 2019;14(2):e0212117.
273. Yang Y, Thumula V, Pace PF, Banahan III BF, Wilkin NE, Lobb WB. Predictors of medication nonadherence among patients with diabetes in Medicare Part D programs: a retrospective cohort study. Clinical therapeutics. 2009;31(10):2178-88.
274. Raebel MA, Ellis JL, Carroll NM, Bayliss EA, McGinnis B, Schroeder EB, et al. Characteristics of patients with primary non-adherence to medications for hypertension, diabetes, and lipid disorders. Journal of general internal medicine. 2012;27:57-64.
275. Walker EA, Gonzalez JS, Tripputi MT, Dagogo-Jack S, Matulik MJ, Montez MG, et al. Long-term metformin adherence in the diabetes prevention program outcomes study. BMJ Open Diabetes Research and Care. 2020;8(1):e001537.
276. Sutton CX, Carpenter D-A, Sumida W, Taira D. 2016 Writing Contest Undergraduate Winner: The Relationship Between Medication Adherence and Total Healthcare Expenditures by Race/Ethnicity in Patients with Diabetes in Hawai ‘i. Hawai'i Journal of Medicine & Public Health. 2017;76(7):183.

277. Lo-Ciganic W-H, Donohue JM, Jones BL, Perera S, Thorpe JM, Thorpe CT, et al. Trajectories of diabetes medication adherence and hospitalization risk: a retrospective cohort study in a large state Medicaid program. Journal of general internal medicine. 2016;31:1052-60.
278. Zhu VJ, Tu W, Marrero DG, Rosenman MB, Overhage JM, editors. Race and medication adherence and glycemic control: findings from an operational health information exchange. AMIA Annual Symposium Proceedings; 2011: American Medical Informatics Association.
279. Gebregziabher M, Lynch CP, Mueller M, Gilbert GE, Echols C, Zhao Y, et al. Using quantile regression to investigate racial disparities in medication non-adherence. BMC medical research methodology. 2011;11:1-11.
280. Shenolikar RA, Balkrishnan R, Camacho FT, Whitmire JT, Anderson RT. Race and medication adherence in Medicaid enrollees with type-2 diabetes. Journal of the National Medical Association. 2006;98(7):1071.
281. Juarez DT, Tan C, Davis JW, Mau MM. Using quantile regression to assess disparities in medication adherence. American journal of health behavior. 2014;38(1):53-62.
282. Rolnick SJ, Pawloski PA, Hedblom BD, Asche SE, Bruzek RJ. Patient characteristics associated with medication adherence. Clinical medicine & research. 2013;11(2):54-65.
283. Osborn CY, Cavanaugh K, Wallston KA, Kripalani S, Elasy TA, Rothman RL, et al. Health literacy explains racial disparities in diabetes medication adherence. Journal of health communication. 2011;16(sup3):268-78.
284. Calip GS, Hubbard RA, Stergachis A, Malone KE, Gralow JR, Boudreau DM. Adherence to oral diabetes medications and glycemic control during and following breast cancer treatment. Pharmacoepidemiology and drug safety. 2015;24(1):75-85.
285. Adeyemi AO, Rascati KL, Lawson KA, Strassels SA. Adherence to oral antidiabetic medications in the pediatric population with type 2 diabetes: a retrospective database analysis. Clinical Therapeutics. 2012;34(3):712-9.
286. Trief PM, Kalichman SC, Wang D, Drews KL, Anderson BJ, Bulger JD, et al. Medication adherence in young adults with youth-onset type 2 diabetes: iCount, an observational study. Diabetes research and clinical practice. 2022;184:109216.
287. Horsburgh S, Barson D, Zeng J, Sharples K, Parkin L. Adherence to metformin monotherapy in people with type 2 diabetes mellitus in New Zealand. Diabetes Research and Clinical Practice. 2019;158:107902.
288. Chepulis L, Mayo C, Morison B, Keenan R, Lao C, Paul R, et al. Metformin adherence in patients with type 2 diabetes and its association with glycated haemoglobin levels. Journal of Primary Health Care. 2020;12(4):318-26.
289. Kharjul MD, Cameron C, Braund R. Using the Pharmaceutical Collection Database to identify patient adherence to oral hypoglycaemic medicines. Journal of primary health care. 2019;11(3):265-74.
290. McGovern A, Hinton W, Calderara S, Munro N, Whyte M, de Lusignan S. A class comparison of medication persistence in people with type 2 diabetes: a retrospective observational study. Diabetes Therapy. 2018;9:229-42.
291. Chong E, Wang H, King-Shier K, Quan H, Rabi D, Khan N. Prescribing patterns and adherence to medication among South-Asian, Chinese and white people with Type 2 diabetes mellitus: a population-based cohort study. Diabetic medicine. 2014;31(12):1586-93.
292. Abdullah NF, Khuan L, Theng CA, Sowtali SN, Juni MH. Effect of patient characteristics on medication adherence among patients with type 2 diabetes mellitus: a cross-sectional survey. Contemporary nurse. 2019;55(1):27-37.

293. Ying C, Shah N. Adherence to insulin treatment in children with type I diabetes mellitus at a hospital in Malaysia. Asian J Pharm Clin Res. 2017;10(11):356-61.
294. Jannoo Z, Khan NM. Medication adherence and diabetes self-care activities among patients with type 2 diabetes mellitus. Value in health regional issues. 2019;18:30-5.
295. Nasruddin A, Bachok NA, Hassan NB, Naing NN. Insulin adherence and associated factors in patients with type 2 diabetes mellitus treated in Klang primary health care centres. The Malaysian journal of medical sciences: MJMS. 2021;28(6):76.
296. Lee CS, Tan JHM, Sankari U, Koh YLE, Tan NC. Assessing oral medication adherence among patients with type 2 diabetes mellitus treated with polytherapy in a developed Asian community: a cross-sectional study. BMJ open. 2017;7(9):e016317.
297. Gomes M, Negrato C. Adherence to insulin therapeutic regimens in patients with type 1 diabetes. A nationwide survey in Brazil. Diabetes research and clinical practice. 2016;120:47-55.
298. Jaam M, Ibrahim MIM, Kheir N, Hadi MA, Diab MI, Awaisu A. Assessing prevalence of and barriers to medication adherence in patients with uncontrolled diabetes attending primary healthcare clinics in Qatar. Primary care diabetes. 2018;12(2):116-25.
299. Al-Haj Mohd MM, Phung H, Sun J, Morisky DE. The predictors to medication adherence among adults with diabetes in the United Arab Emirates. Journal of Diabetes & Metabolic Disorders. 2015;15:1-9.
300. Ying C, Shah NM. Adherence to insulin treatment in children with type I diabetes mellitus at a hospital in Malaysia. Asian J Pharm Clin Res. 2017;10(11):356-61.
301. Institute JB. The Joanna Briggs Institute critical appraisal tools for use in JBI systematic reviews. Critical Appraisal Checklist for Cohort Studies. 2017.
302. Walker EA, Gonzalez JS, Tripputi MT, Dagogo-Jack S, Matulik MJ, Montez MG, et al. Long-term metformin adherence in the Diabetes Prevention Program Outcomes Study. BMJ Open Diabetes Res Care. 2020;8(1):e001537.
303. Unies N. Minority rights: International standards and guidance for implementation: UN; 2010.
304. Haw JS, Shah M, Turbow S, Egeolu M, Umpierrez G. Diabetes complications in racial and ethnic minority populations in the USA. Current diabetes reports. 2021;21:1-8.
305. Andersen JA, Scoggins D, Michaud T, Wan N, Wen M, Su D. Racial disparities in diabetes management outcomes: evidence from a remote patient monitoring program for type 2 diabetic patients. Telemedicine and e-Health. 2021;27(1):55-61.
306. Gaster B, Hirsch IB. The effects of improved glycemic control on complications in type 2 diabetes. Archives of Internal Medicine. 1998;158(2):134-40.
307. Cho NH, Shaw J, Karuranga S, Huang Y, da Rocha Fernandes J, Ohlrogge A, et al. IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. Diabetes research and clinical practice. 2018;138:271-81.
308. Williams JLS, Walker RJ, Smalls BL, Campbell JA, Egede LE. Effective interventions to improve medication adherence in Type 2 diabetes: a systematic review. Diabetes Management (London, England). 2014;4(1):29.
309. Parmar J, Masri AE, MacMillan F, McCaffery K, Arora A. Health literacy and medication adherence in adults from ethnic minority backgrounds with Type 2 Diabetes Mellitus: a systematic review. BMC Public Health. 2025;25(1):222.
310. Kripalani S, Henderson LE, Chiu EY, Robertson R, Kolm P, Jacobson TA. Predictors of medication self-management skill in a low-literacy population. Journal of general internal medicine. 2006;21:852-6.

311. Davis TC, Wolf MS, Bass III PF, Thompson JA, Tilson HH, Neuberger M, et al. Literacy and misunderstanding prescription drug labels. Annals of internal medicine. 2006;145(12):887-94.
312. Shahin W, Kennedy GA, Stupans I. The impact of personal and cultural beliefs on medication adherence of patients with chronic illnesses: a systematic review. Patient preference and adherence. 2019:1019-35.
313. Singh H, Cinnirella M, Bradley C. Support systems for and barriers to diabetes management in South Asians and Whites in the UK: qualitative study of patients' perspectives. BMJ open. 2012;2(6):e001459.
314. Parkin L, Maclennan K, Te Morenga L, Inder M, Moata'ane L. What helps and hinders metformin adherence and persistence: a qualitative study exploring the views of people with type 2 diabetes. 2021.
315. Shiyanbola OO, Brown CM, Ward EC. "I did not want to take that medicine": African-Americans' reasons for diabetes medication nonadherence and perceived solutions for enhancing adherence. Patient preference and adherence. 2018:409-21.
316. Anghel LA, Farcas AM, Oprean RN. An overview of the common methods used to measure treatment adherence. Medicine and pharmacy reports. 2019;92(2):117.
317. McQuaid EL, Landier W. Cultural issues in medication adherence: disparities and directions. Journal of general internal medicine. 2018;33:200-6.
318. Noblit GW, Hare RD. Meta-ethnography: Synthesizing qualitative studies: sage; 1988.
319. Britten N, Campbell R, Pope C, Donovan J, Morgan M, Pill R. Using meta ethnography to synthesise qualitative research: a worked example. Journal of health services research & policy. 2002;7(4):209-15.
320. Campbell R, Pound P, Morgan M, Daker-White G, Britten N, Pill R, et al. Evaluating meta ethnography: systematic analysis and synthesis of qualitative research. 2012.
321. Campbell R, Pound P, Pope C, Britten N, Pill R, Morgan M, et al. Evaluating meta-ethnography: a synthesis of qualitative research on lay experiences of diabetes and diabetes care. Social science & medicine. 2003;56(4):671-84.
322. Asiri R, Robinson-Barella A, Iqbal A, Todd A, Husband A. Understanding the influence of ethnicity on adherence to antidiabetic medication: Meta-ethnography and systematic review. Plos one. 2023;18(10):e0292581.
323. Taylor YJ, Davis ME, Mahabaleshwarkar R, Spencer MD. Racial/ethnic disparities in diabetes care and outcomes: a mixed methods study. Journal of Health Disparities Research and Practice. 2018;11(2):9.
324. Haw JS, Shah M, Turbow S, Egeolu M, Umpierrez G. Diabetes complications in racial and ethnic minority populations in the USA. Current diabetes reports. 2021;21(1):1-8.
325. Spanakis EK, Golden SH. Race/ethnic difference in diabetes and diabetic complications. Current diabetes reports. 2013;13(6):814-23.
326. Malik MO, Govan L, Petrie JR, Ghouri N, Leese G, Fischbacher C, et al. Ethnicity and risk of cardiovascular disease (CVD): 4.8 year follow-up of patients with type 2 diabetes living in Scotland. Diabetologia. 2015;58(4):716-25.
327. Sabaté E, Sabaté E. Adherence to long-term therapies: evidence for action: World Health Organization; 2003.
328. Ho PM, Rumsfeld JS, Masoudi FA, McClure DL, Plomondon ME, Steiner JF, et al. Effect of medication nonadherence on hospitalization and mortality among patients with diabetes mellitus. Archives of internal medicine. 2006;166(17):1836-41.

329. Langley CA, Bush J. The Aston Medication Adherence Study: mapping the adherence patterns of an inner-city population. Int J Clin Pharm. 2014;36(1):202-11.
330. Pardhan S, Nakafero G, Raman R, Sapkota R. Barriers to diabetes awareness and self-help are influenced by people's demographics: perspectives of South Asians with type 2 diabetes. Ethnicity & health. 2020;25(6):843-61.
331. Jaam M, Hadi MA, Kheir N, Ibrahim MIM, Diab MI, Al-Abdulla SA, et al. A qualitative exploration of barriers to medication adherence among patients with uncontrolled diabetes in Qatar: integrating perspectives of patients and health care providers. Patient preference and adherence. 2018;12:2205.
332. Shiyanbola OO, Brown CM, Ward EC. "I did not want to take that medicine": African-Americans' reasons for diabetes medication nonadherence and perceived solutions for enhancing adherence. Patient preference and adherence. 2018;12:409.
333. Flemming K, Noyes J. Qualitative evidence synthesis: where are we at? International Journal of Qualitative Methods. 2021;20:1609406921993276.
334. Sridharan SG, Chittem M, Maya S. Patients' experiences of barriers and facilitators for adherence to type 2 diabetes mellitus: A meta-ethnography. Journal of Social Health and Diabetes. 2019;7(02):61-72.
335. Byrne J, Willis A, Dunkley A, Fitzpatrick C, Campbell S, Sidhu MS, et al. Individual, healthcare professional and system-level barriers and facilitators to initiation and adherence to injectable therapies for type 2 diabetes: A systematic review and meta-ethnography. Diabetic Medicine. 2022;39(1):e14678.
336. McSharry J, McGowan L, Farmer A, French D. Perceptions and experiences of taking oral medications for the treatment of Type 2 diabetes mellitus: a systematic review and meta-synthesis of qualitative studies. Diabetic Medicine. 2016;33(10):1330-8.
337. Sohal T, Sohal P, King-Shier KM, Khan NA. Barriers and facilitators for type-2 diabetes management in South Asians: a systematic review. PloS one. 2015;10(9):e0136202.
338. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. Systematic reviews. 2021;10(1):1-11.
339. worldbank. New country classifications 2022 [Available from: https://blogs.worldbank.org/opendata/new-world-bank-country-classifications-income-level-2022-2023.
340. Gotschall T. EndNote 20 desktop version. Journal of the Medical Library Association: JMLA. 2021;109(3):520.
341. CASP C. CASP qualitative checklist. Critical Appraisal Skills Programme. 2018.
342. Noblit GW, Hare RD, Hare RD. Meta-ethnography: Synthesizing qualitative studies: sage; 1988.
343. France EF, Cunningham M, Ring N, Uny I, Duncan EA, Jepson RG, et al. Improving reporting of meta-ethnography: the eMERGe reporting guidance. BMC medical research methodology. 2019;19(1):1-13.
344. Lewin S, Booth A, Glenton C, Munthe-Kaas H, Rashidian A, Wainwright M, et al. Applying GRADE-CERQual to qualitative evidence synthesis findings: introduction to the series. BioMed Central; 2018. p. 1-10.
345. Omodara D, Gibson L, Bowpitt G. Exploring the impact of cultural beliefs in the self-management of type 2 diabetes among Black sub-Saharan Africans in the UK–a qualitative study informed by the PEN-3 cultural model. Ethnicity & health. 2021:1-19.

346. Patel NR, Kennedy A, Blickem C, Reeves D, Chew-Graham C. “I’m Managing My Diabetes between Two Worlds”: Beliefs and Experiences of Diabetes Management in British South Asians on Holiday in the East—A Qualitative Study. Journal of Diabetes Research. 2016;2016.
347. Singh H, Cinnirella M, Bradley C. Support systems for and barriers to diabetes management in South Asians and Whites in the UK: qualitative study of patients' perspectives. BMJ Open. 2012;2(6):e001459.
348. Noakes H. Perceptions of black African and African-Caribbean people regarding insulin. J Diabetes Nurs. 2010;14(4):148-56.
349. Lawton J, Ahmad N, Hallowell N, Hanna L, Douglas M. Perceptions and experiences of taking oral hypoglycaemic agents among people of Pakistani and Indian origin: qualitative study. Bmj. 2005;330(7502):1247.
350. Bockwoldt D, Staffileno BA, Coke L, Hamilton R, Fogg L, Calvin D, et al. Understanding experiences of diabetes medications among African Americans living with type 2 diabetes. Journal of Transcultural Nursing. 2017;28(4):363-71.
351. Joo J, Lee H. Barriers to and facilitators of diabetes self-management with elderly Korean-American immigrants. International nursing review. 2016;63(2):277-84.
352. Mohan AV, Riley MB, Boyington DR, Kripalani S. Illustrated medication instructions as a strategy to improve medication management among Latinos: a qualitative analysis. Journal of health psychology. 2013;18(2):187-97.
353. Lynch E, Fernandez A, Lighthouse N, Mendenhall E, Jacobs E. Concepts of diabetes self-management in Mexican American and African American low-income patients with diabetes. Health education research. 2012;27(5):814-24.
354. Barko R, Corbett CF, Allen CB, Shultz JA. Perceptions of diabetes symptoms and self-management strategies: a cross-cultural comparison. Journal of transcultural nursing. 2011;22(3):274-81.
355. Timsina MK, Peltzer JN, Pokharel Y, Peterson JM, Schwartz LJ, LeMaster JW. Understanding Medication Adherence in Bhutanese Refugees With Diabetes in a Midwestern City. Journal of Transcultural Nursing. 2022;33(3):324-33.
356. Jamil A, Jonkman LJ, Miller M, Jennings L, Connor SE. Medication adherence and health beliefs among South Asian immigrants with diabetes in the United States: A qualitative study. Journal of the American College of Clinical Pharmacy. 2022;5(8):829-36.
357. Ahmad A, Khan MU, Aslani P. A Qualitative Study on Medication Taking Behaviour Among People With Diabetes in Australia. Frontiers in pharmacology. 2021;12.
358. Sapkota S, Brien J-aE, Aslani P. Nepalese patients’ anti-diabetic medication taking behaviour: an exploratory study. Ethnicity & health. 2018;23(7):718-36.
359. Parkin L, Maclennan K, Te Morenga L, Inder M, Moata'ane L. What helps and hinders metformin adherence and persistence? A qualitative study exploring the views of people with type 2 diabetes. The New Zealand Medical Journal (Online). 2021;134(1536):25-40.
360. Ho EY, James J. Cultural barriers to initiating insulin therapy in Chinese people with type 2 diabetes living in Canada. Canadian Journal of Diabetes. 2006;30(4):390-6.
361. Peeters B, Van Tongelen I, Duran Z, Yüksel G, Mehuys E, Willems S, et al. Understanding medication adherence among patients of Turkish descent with type 2 diabetes: a qualitative study. Ethnicity & Health. 2015;20(1):87-105.
362. de-Graft Aikins A, Dodoo F, Awuah RB, Owusu-Dabo E, Addo J, Nicolaou M, et al. Knowledge and perceptions of type 2 diabetes among Ghanaian migrants in three European

countries and Ghanaians in rural and urban Ghana: The RODAM qualitative study. PloS one. 2019;14(4):e0214501.
363. Ahmad A, Khan MU, Aslani P. A qualitative study on medication taking behaviour among people with diabetes in Australia. Frontiers in pharmacology. 2021;12:693748.
364. Omodara D, Gibson L, Bowpitt G. Exploring the impact of cultural beliefs in the self-management of type 2 diabetes among Black sub-Saharan Africans in the UK–a qualitative study informed by the PEN-3 cultural model. Ethnicity & health. 2022;27(6):1358-76.
365. Pardhan S, Nakafero G, Raman R, Sapkota R. Barriers to diabetes awareness and self-help are influenced by people's demographics: perspectives of South Asians with type 2 diabetes. Ethnicity & Health.25(6):843-61.
366. Peeters B, Van Tongelen I, Duran Z, Yuksel G, Mehuys E, Willems S, et al. Understanding medication adherence among patients of Turkish descent with type 2 diabetes: a qualitative study. Ethnicity & Health.20(1):87-105.
367. Amarasekara A, Fongkaew W, Turale S, Wimalasekara S, Chanprasit C. An ethnographic study of diabetes health beliefs and practices in S ri L ankan adults. International Nursing Review. 2014;61(4):507-14.
368. Olorunfemi O, Ojewole F. Medication belief as correlate of medication adherence among patients with diabetes in Edo State, Nigeria. Nursing open. 2019;6(1):197-202.
369. Kumar K, Greenfield S, Raza K, Gill P, Stack R. Understanding adherence-related beliefs about medicine amongst patients of South Asian origin with diabetes and cardiovascular disease patients: a qualitative synthesis. BMC endocrine disorders. 2016;16:1-11.
370. Browne JL, Ventura A, Mosely K, Speight J. 'I call it the blame and shame disease': a qualitative study about perceptions of social stigma surrounding type 2 diabetes. BMJ open. 2013;3(11):e003384.
371. Brown K, Avis M, Hubbard M. Health beliefs of African–Caribbean people with type 2 diabetes: a qualitative study. British Journal of General Practice. 2007;57(539):461-9.
372. Shahin W, Kennedy GA, Stupans I. The association between social support and medication adherence in patients with hypertension: A systematic review. Pharmacy Practice (Granada). 2021;19(2).
373. Nixon AL, Leonardi-Bee J, Wang H, Chattopadhyay K. Barriers and facilitators to type 2 diabetes management in the Caribbean region: a qualitative systematic review. JBI Evidence Synthesis. 2021;19(5):911-65.
374. Al Shamsi H, Almutairi AG, Al Mashrafi S, Al Kalbani T. Implications of language barriers for healthcare: a systematic review. Oman medical journal. 2020;35(2):e122.
375. Traylor AH, Schmittdiel JA, Uratsu CS, Mangione CM, Subramanian U. Adherence to cardiovascular disease medications: does patient-provider race/ethnicity and language concordance matter? Journal of general internal medicine. 2010;25(11):1172-7.
376. Jin J, Sklar GE, Oh VMS, Li SC. Factors affecting therapeutic compliance: A review from the patient's perspective. Therapeutics and clinical risk management. 2008;4(1):269.
377. Pham TM, Carpenter JR, Morris TP, Sharma M, Petersen I. Ethnic differences in the prevalence of type 2 diabetes diagnoses in the UK: cross-sectional analysis of the health improvement network primary care database. Clinical epidemiology. 2019:1081-8.
378. Barbour RS. Introducing qualitative research: a student's guide. 2013.
379. Verhoef MJ, Casebeer AL. Broadening horizons: integrating quantitative and qualitative research. The Canadian journal of infectious diseases. 1997;8(2):65.
380. Goldkuhl G. Pragmatism vs interpretivism in qualitative information systems research. European journal of information systems. 2012;21:135-46.

381. Williams M. Interpretivism and generalisation. Sociology. 2000;34(2):209-24.
382. O'Reilly K. Inductive and deductive. Key concepts in ethnography. 2009:104-9.
383. Sutton J, Austin Z. Qualitative research: Data collection, analysis, and management. The Canadian journal of hospital pharmacy. 2015;68(3):226.
384. Weiner BJ, Amick HR, Lund JL, Lee S-YD, Hoff TJ. Use of qualitative methods in published health services and management research: a 10-year review. Medical Care Research and Review. 2011;68(1):3-33.
385. Thomas E, Magilvy JK. Qualitative rigor or research validity in qualitative research. Journal for specialists in pediatric nursing. 2011;16(2).
386. Wenz A, Al Baghal T, Gaia A. Language proficiency among respondents: Implications for data quality in a longitudinal face-to-face survey. Journal of survey statistics and methodology. 2021;9(1):73-93.
387. Hollway W, Jefferson T. Doing qualitative research differently: A psychosocial approach: Sage; 2012.
388. Kitzinger J. Qualitative research: introducing focus groups. Bmj. 1995;311(7000):299-302.
389. Creswell JW. Educational research: Planning, conducting, and evaluating quantitative and qualitative research: pearson; 2015.
390. Pope C, Van Royen P, Baker R. Qualitative methods in research on healthcare quality. BMJ Quality & Safety. 2002;11(2):148-52.
391. Cohen D, Crabtree B. Qualitative research guidelines project. 2006.
392. Karatsareas P. Semi-structured interviews. Research methods in language attitudes. 2022:99-113.
393. Carlson RV, Boyd KM, Webb DJ. The revision of the Declaration of Helsinki: past, present and future. British journal of clinical pharmacology. 2004;57(6):695-713.
394. NIHR. Good Clinical Practice (GCP) Online: NIHR; [Available from: https://www.nihr.ac.uk/health-and-care-professionals/training/good-clinical-practice.htm.
395. HRA. UK Policy Framework for Health and Social Care Research NHS HRA Online HRA; [Available from: https://www.hra.nhs.uk/planning-and-improving-research/policies-standards-legislation/uk-policy-framework-health-social-care-research/.
396. National statistics

English indices of deprivation 2019 Online: GOV.UK; 2019 [Available from: https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019.
397. The English Indices of Deprivation 2019 online: Department for Communities and Local Government.; 2019 [Available from: https://assets.publishing.service.gov.uk/media/5d8e26f6ed915d5570c6cc55/IoD2019_Statistical_Release.pdf.
398. Bhurji N, Javer J, Gasevic D, Khan N. Improving management of type 2 diabetes in South Asian patients: a systematic review of intervention studies. BMJ open. 2016;6(4):e008986.
399. South Asians in the United Kingdom - Minority Rights Group Online: Minority Rights Group; [Available from: https://minorityrights.org/communities/south-asians/.
400. Palinkas LA, Horwitz SM, Green CA, Wisdom JP, Duan N, Hoagwood K. Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. Administration and policy in mental health and mental health services research. 2015;42:533-44.
401. Braun V, Clarke V. One size fits all? What counts as quality practice in (reflexive) thematic analysis? Qualitative research in psychology. 2021;18(3):328-52.

402. Terry G, Hayfield N, Clarke V, Braun V. Thematic analysis. The SAGE handbook of qualitative research in psychology. 2017;2(17-37):25.
403. Olmos-Vega FM, Stalmeijer RE, Varpio L, Kahlke R. A practical guide to reflexivity in qualitative research: AMEE Guide No. 149. Medical teacher. 2023;45(3):241-51.
404. Ens TA, Seneviratne CC, Jones C, Green TL, King-Shier KM. South Asians' cardiac medication adherence. European journal of cardiovascular nursing. 2014;13(4):357-68.
405. Jalal Z, Antoniou S, Taylor D, Paudyal V, Finlay K, Smith F. South Asians living in the UK and adherence to coronary heart disease medication: a mixed-method study. International journal of clinical pharmacy. 2019;41:122-30.
406. Adisa R, Alutundu MB, Fakeye TO. Factors contributing to nonadherence to oral hypoglycemic medications among ambulatory type 2 diabetes patients in Southwestern Nigeria. Pharmacy practice. 2009;7(3):163.
407. Konstantinou P, Kassianos AP, Georgiou G, Panayides A, Papageorgiou A, Almas I, et al. Barriers, facilitators, and interventions for medication adherence across chronic conditions with the highest non-adherence rates: a scoping review with recommendations for intervention development. Translational behavioral medicine. 2020;10(6):1390-8.
408. Ho SC, Jacob SA, Tangiisuran B. Barriers and facilitators of adherence to antidepressants among outpatients with major depressive disorder: a qualitative study. PloS one. 2017;12(6):e0179290.
409. Krishnamoorthy Y, Rajaa S, Rehman T, Thulasingam M. Patient and provider's perspective on barriers and facilitators for medication adherence among adult patients with cardiovascular diseases and diabetes mellitus in India: a qualitative evidence synthesis. BMJ open. 2022;12(3):e055226.
410. Lee S-Y, Lee S, Lee W. Association between medication adherence to chronic diseases and shift-work schedules in the Korean working population. Scientific Reports. 2022;12(1):22595.
411. Abdoli S, Doosti Irani M, Hardy L, Funnell M. A discussion paper on stigmatizing features of diabetes. Nurs Open. 2018; 5: 113-9.
412. Kretchy IA, Koduah A, Ohene-Agyei T, Boima V, Appiah B. The association between diabetes-related distress and medication adherence in adult patients with type 2 diabetes mellitus: a cross-sectional study. Journal of diabetes research. 2020;2020(1):4760624.
413. Mulyani R, Suharjono S, Suprapti B, Hermansyah A. What can go wrong with the medication adherence a patient suffers due to diabetes distress? A narrative review. Pharmacy Education. 2023;23(4):16-21.
414. Shivaprasad K, Kannan S, Khadilkar KS, Sravani GV, Raju R. Identifying the burden and predictors of diabetes distress among adult Type 2 diabetes mellitus patients. Indian Journal of Community Medicine. 2020;45(4):497-500.
415. Adugnew M, Fetene D, Assefa T, Asmamaw K, Feleke Z, Gomora D, et al. Diabetes-related distress and its associated factors among people with type 2 diabetes in Southeast Ethiopia: a cross-sectional study. BMJ open. 2024;14(1):e077693.
416. Byles JE, Robinson I, Banks E, Gibson R, Leigh L, Rodgers B, et al. Psychological distress and comorbid physical conditions: disease or disability? Depression and anxiety. 2014;31(6):524-32.
417. Merluzzi TV, Philip EJ, Gomer B, Heitzmann Ruhf CA, Kim D. Comorbidity, functional impairment, and emotional distress: a coping mediation model for persons with cancer. Annals of Behavioral Medicine. 2021;55(10):994-1004.

418. Ainiyah N, Zuhriyah N, Zahroh C, Damawiyah S, Kusumawati DR, Afiyah RK, et al. Influence of Self-Motivation and Health Locus of Control on Adherence to Medication Among Hypertension Patients. Jurnal Keperawatan Indonesia. 2023;26(1):11-9.
419. Vervloet M, Linn AJ, van Weert JC, De Bakker DH, Bouvy ML, Van Dijk L. The effectiveness of interventions using electronic reminders to improve adherence to chronic medication: a systematic review of the literature. Journal of the American Medical Informatics Association. 2012;19(5):696-704.
420. Ryan G, Wagner G. Pill taking 'routinization': a critical factor to understanding episodic medication adherence. AIDS care. 2003;15(6):795-806.
421. Ng CJ, Lai PS, Lee Y, Azmi SA, Teo CH. Barriers and facilitators to starting insulin in patients with type 2 diabetes: a systematic review. International journal of clinical practice. 2015;69(10):1050-70.
422. Rezaei M, Valiee S, Tahan M, Ebtekar F, Ghanei Gheshlagh R. Barriers of medication adherence in patients with type-2 diabetes: a pilot qualitative study. Diabetes, metabolic syndrome and obesity: targets and therapy. 2019:589-99.
423. Helliwell P, Ibrahim G. Ethnic differences in responses to disease modifying drugs. Rheumatology. 2003;42(10):1197-201.
424. Habte BM, Kebede T, Fenta TG, Boon H. Barriers and facilitators to adherence to anti-diabetic medications: Ethiopian patients' perspectives. African journal of primary health care & family medicine. 2017;9(1):1-9.
425. Barker JM, Faasse K. Influence of side effect information on patient willingness to take medication: consequences for informed consent and medication adherence. Internal Medicine Journal. 2023;53(9):1692-6.
426. Kucukarslan SN. A review of published studies of patients' illness perceptions and medication adherence: lessons learned and future directions. Research in social and administrative pharmacy. 2012;8(5):371-82.
427. Huang Y-M, Pecanac KE, Shiyanbola OO. "Why am I not taking medications?" Barriers and facilitators of diabetes medication adherence across different health literacy levels. Qualitative Health Research. 2020;30(14):2331-42.
428. Willis E. Applying the health belief model to medication adherence: the role of online health communities and peer reviews. Journal of health communication. 2018;23(8):743-50.
429. Champion VL, Skinner CS. The health belief model. Health behavior and health education: Theory, research, and practice. 2008;4:45-65.
430. Muiruri C, van den Broek-Altenburg EM, Bosworth HB, Cené CW, Gonzalez JM. A Quantitative Framework for Medication Non-Adherence: Integrating Patient Treatment Expectations and Preferences. Patient preference and adherence. 2023:3135-45.
431. Apriliani ED, Prasetya H, Murti B. Meta-Analysis: Application of Health Belief Model on the Adherence to Antihypertensive Medication. Journal of Health Promotion and Behavior. 2022;7(3):238-49.
432. Wills TA. Downward comparison principles in social psychology. Psychological bulletin. 1981;90(2):245.
433. Brod M, Kongsø JH, Lessard S, Christensen TL. Psychological insulin resistance: patient beliefs and implications for diabetes management. Quality of Life Research. 2009;18:23-32.
434. Tanenbaum M, Kane N, Kenowitz J, Gonzalez J. Diabetes distress from the patient's perspective: Qualitative themes and treatment regimen differences among adults with type 2 diabetes. Journal of Diabetes and its Complications. 2016;30(6):1060-8.

435. COX E, ZENG A, LIN E, XU E, BELL T, BRISTOW TL. 695-P: Emotional Burden of Diabetes Varies by Demographic Factors, Management Strategies, and Duration of Diabetes. Diabetes. 2023;72(Supplement_1).
436. Grose DN, O'Brien CL, Castle DJ. Type 1 diabetes and an insulin pump: an iterative review of qualitative literature. Practical Diabetes. 2017;34(8):281-7c.
437. Hayes M, Frearson S, Keller C, Cartmale A, Lewis-Hayes S. A hermeneutic phenomenological study of why adults with type 1 diabetes choose to discontinue CSII. European Diabetes Nursing. 2011;8(1):12-6.
438. Tanenbaum ML, Adams RN, Hanes SJ, Barley RC, Miller KM, Mulvaney SA, et al. Optimal use of diabetes devices: clinician perspectives on barriers and adherence to device use. Journal of diabetes science and technology. 2017;11(3):484-92.
439. Tanenbaum ML, Commissariat PV. Experience with burdens of diabetes device use that affect uptake and optimal use in people with type 1 diabetes. Endocrine Connections. 2023;12(10).
440. Payk M, Robinson T, Davis D, Atchan M. An integrative review of the psychosocial facilitators and challenges of continuous subcutaneous insulin infusion therapy in type 1 diabetes. Journal of advanced nursing. 2018;74(3):528-38.
441. Silva JAd, Souza ECFd, Echazú Böschemeier AG, Costa CCMd, Bezerra HS, Feitosa EELC. Diagnosis of diabetes mellitus and living with a chronic condition: participatory study. BMC public health. 2018;18:1-8.
442. Kalra S, Jena BN, Yeravdekar R. Emotional and psychological needs of people with diabetes. Indian journal of endocrinology and metabolism. 2018;22(5):696-704.
443. Bajaj S, Jawad F, Islam N, Mahtab H, Bhattarai J, Shrestha D, et al. South Asian women with diabetes: psychosocial challenges and management: consensus statement. Indian journal of endocrinology and metabolism. 2013;17(4):548-62.
444. Kato A, Fujimaki Y, Fujimori S, Isogawa A, Onishi Y, Suzuki R, et al. How self-stigma affects patient activation in persons with type 2 diabetes: A cross-sectional study. BMJ open. 2020;10(5):e034757.
445. Turen S, Yilmaz RA, Gundogdu S. The relationship with acceptance of illness and medication adherence in type 2 diabetes mellitus patients. International Journal of Caring Sciences. 2021;14(3):1824-32.
446. Bonikowska I, Szwamel K, Uchmanowicz I. Analysis of the impact of disease acceptance, demographic, and clinical variables on adherence to treatment recommendations in elderly type 2 diabetes mellitus patients. International Journal of Environmental Research and Public Health. 2021;18(16):8658.
447. Suglo JN, Evans C. Factors influencing self-management in relation to type 2 diabetes in Africa: A qualitative systematic review. PloS one. 2020;15(10):e0240938.
448. Alfian SD, Sukandar H, Lestari K, Abdulah R. Medication adherence contributes to an improved quality of life in type 2 diabetes mellitus patients: a cross-sectional study. Diabetes Therapy. 2016;7:755-64.
449. Majeed A, Rehman M, Hussain I, Imran I, Saleem MU, Saeed H, et al. The impact of treatment adherence on quality of life among type 2 diabetes mellitus patients–Findings from a cross-sectional study. Patient preference and adherence. 2021:475-81.
450. Patil R, Datta SS, Boratne AV. Popular misconceptions regarding the diabetes management: where should we focus our attention? Journal of Clinical and Diagnostic Research: JCDR. 2013;7(2):287.

451. Muksor A, Parmar D. Cultural Beliefs and Practices in Self-Management of Diabetes Among Pnar Women in Meghalaya, India. The Science of Diabetes Self-Management and Care. 2023;49(6):462-76.
452. Abubakari A-R, Jones MC, Lauder W, Kirk A, Anderson J, Devendra D, et al. Ethnic differences and socio-demographic predictors of illness perceptions, self-management, and metabolic control of type 2 diabetes. International journal of general medicine. 2013:617-28.
453. Barnes L, Moss-Morris R, Kaufusi M. Illness beliefs and adherence in diabetes mellitus: a comparison between Tongan and European patients. 2004.
454. Bean D, Cundy T, Petrie KJ. Ethnic differences in illness perceptions, self-efficacy and diabetes self-care. Psychology and Health. 2007;22(7):787-811.
455. Rowlands G, Tabassum B, Campbell P, Harvey S, Vaittinen A, Stobbart L, et al. The evidence-based development of an intervention to improve clinical health literacy practice. International journal of environmental research and public health. 2020;17(5):1513.
456. Svendsen MT, Bak CK, Sørensen K, Pelikan J, Riddersholm SJ, Skals RK, et al. Associations of health literacy with socioeconomic position, health risk behavior, and health status: a large national population-based survey among Danish adults. BMC public health. 2020;20:1-12.
457. NHS. Treatment for type 2 diabetes 2025 [Available from: https://www.nhs.uk/conditions/type-2-diabetes/treatment/.
458. Unni E, Bae S. Exploring a new theoretical model to explain the behavior of medication adherence. Pharmacy. 2022;10(2):43.
459. Dehdari L, Dehdari T. The determinants of anti-diabetic medication adherence based on the experiences of patients with type 2 diabetes. Archives of Public Health. 2019;77:1-9.
460. Feldman EC, Durkin LK, Greenley RN. Family support is associated with fewer adherence barriers and greater intent to adhere to oral medications in pediatric IBD. Journal of Pediatric Nursing. 2021;60:58-64.
461. Fauzia W, Mandaty FA. Improving Adherence to Taking Medication through Family Support for Hypertensive Elderly in the District Area of the Patient. JOURNAL EDUCATIONAL OF NURSING (JEN). 2023;6(2):127-33.
462. Rabinovitch M, Béchard-Evans L, Schmitz N, Joober R, Malla A. Early predictors of nonadherence to antipsychotic therapy in first-episode psychosis. The Canadian Journal of Psychiatry. 2009;54(1):28-35.
463. O'Toole J, Krishnan M, Riekert K, Eakin MN. Understanding barriers to and strategies for medication adherence in COPD: a qualitative study. BMC pulmonary medicine. 2022;22(1):98.
464. Baghikar S, Benitez A, Fernandez Piñeros P, Gao Y, Baig AA. Factors impacting adherence to diabetes medication among urban, low income Mexican-Americans with diabetes. Journal of immigrant and minority health. 2019;21(6):1334-41.
465. Olagbemide OJ, Omosanya OE, Ayodapo AO, Agboola SM, Adeagbo AO, Olukokun TA. Family support and medication adherence among adult type 2 diabetes: Any meeting point? Annals of African Medicine. 2021;20(4):282-7.
466. Busebaia TJA, Thompson J, Fairbrother H, Ali P. The role of family in supporting adherence to diabetes self-care management practices: An umbrella review. Journal of Advanced Nursing. 2023;79(10):3652-77.
467. Lauffenburger JC, Khan NF, Brill G, Choudhry NK. Quantifying social reinforcement among family members on adherence to medications for chronic conditions: A US-based retrospective cohort study. Journal of general internal medicine. 2019;34:855-61.

468. Scheurer D, Choudhry N, Swanton KA, Matlin O, Shrank W. Association between different types of social support and medication adherence. The American journal of managed care. 2012;18(12):e461-7.
469. Bolkan CR, Bonner LM, Campbell DG, Lanto A, Zivin K, Chaney E, et al. Family involvement, medication adherence, and depression outcomes among patients in veterans affairs primary care. Psychiatric Services. 2013;64(5):472-8.
470. Vakil K, Desse TA, Manias E, Alzubaidi H, Rasmussen B, Holton S, et al. Patient-centered care experiences of first-generation, South Asian migrants with chronic diseases living in high-income, western countries: systematic review. Patient preference and adherence. 2023:281-98.
471. Pentaris P, Freund-Williams L, Kapoor V. Religious disaffiliation and sexually minoritised groups: A scoping review of the literature. Journal of Homosexuality. 2024:1-34.
472. Hendricks JJ, Hardy SA, Taylor EM, Dollahite DC. Does Leaving Faith Mean Leaving Family? Longitudinal Associations Between Religious Identification and Parent-Child Relationships Across Adolescence and Emerging Adulthood. Journal for the Scientific Study of Religion. 2024;63(1):23-41.
473. Elhag M, Awaisu A, Koenig HG, Mohamed Ibrahim MI. The association between religiosity, spirituality, and medication adherence among patients with cardiovascular diseases: a systematic review of the literature. Journal of religion and health. 2022;61(5):3988-4027.
474. Abdul Wahab NA, Makmor Bakry M, Ahmad M, Mohamad Noor Z, Mhd Ali A. Exploring culture, religiosity and spirituality influence on antihypertensive medication adherence among specialised population: a qualitative ethnographic approach. Patient preference and adherence. 2021:2249-65.
475. Zagożdżon P, Wrotkowska M. Religious beliefs and their relevance for treatment adherence in mental illness: A review. Religions. 2017;8(8):150.
476. Onyishi CN, Eseadi C, Ilechukwu LC, Okoro KN, Okolie CN, Egbule E, et al. Potential influences of religiosity and religious coping strategies on people with diabetes. World Journal of Clinical Cases. 2022;10(25):8816.
477. Dull VT, Skokan LA. A cognitive model of religion's influence on health. Journal of social issues. 1995;51(2):49-64.
478. Heward-Mills NL, Atuhaire C, Spoors C, Pemunta NV, Priebe G, Cumber SN. The role of faith leaders in influencing health behaviour: a qualitative exploration on the views of Black African Christians in Leeds, United Kingdom. Pan African Medical Journal. 2018;30(1).
479. Alshehri AM, Barner JC, Wong SL, Ibrahim KR, Qureshi S. Perceptions among Muslims regarding fasting, medication use and provider engagement during Ramadan in the United States. The International Journal of Health Planning and Management. 2021;36(3):945-57.
480. Gaborit B, Dutour O, Ronsin O, Atlan C, Darmon P, Gharsalli R, et al. Ramadan fasting with diabetes: an interview study of inpatients' and general practitioners' attitudes in the South of France. Diabetes & metabolism. 2011;37(5):395-402.
481. Savaş E. Attitudinal determinants of Turkish diabetic patients and physicians about Ramadan fasting. Journal of religion and health. 2018;57:47-56.
482. Patel NR, Kennedy A, Blickem C, Rogers A, Reeves D, Chew-Graham C. Having diabetes and having to fast: a qualitative study of British Muslims with diabetes. Health Expectations. 2015;18(5):1698-708.

483. Myers PR, Shoqirat N, Allen DH, Dardas LA. Patients with diabetes observing Ramadan: The experience of Muslims in the United States. Diabetes research and clinical practice. 2019;150:282-7.
484. Lee J, Wong C, Tan C, Nasir N, Lee S. Type 2 diabetes patient's perspective on Ramadan fasting: a qualitative study. BMJ Open Diabetes Res Care. 2017; 5: e000365.
485. El-Rahman M, Gida N, Sobh D. Experiences and needs of patients with type 2 diabetes during Ramadan: A qualitative study. Journal of Diabetes Nursing. 2019;23(6):JDN106.
486. Almansour HA, Chaar B, Saini B. Perspectives and experiences of patients with type 2 diabetes observing the Ramadan fast. Ethnicity & health. 2018;23(4):380-96.
487. Amin MEK, Abdelmageed A. Clinicians' perspectives on caring for Muslim patients considering fasting during Ramadan. Journal of religion and health. 2020;59(3):1370-87.
488. dalam Al-Qur'an KF. An Islamic Perspective on Halal Food and Pharmaceutical Products.
489. Bashir A, Asif M, Lacey F, Langley CA, Marriott JF, Wilson KA. Concordance in Muslim patients in primary care. International Journal of Pharmacy Practice. 2001;9(S1):78-.
490. Abu-Ras W, Gheith A, Cournos F. The imam's role in mental health promotion: A study at 22 mosques in New York City's Muslim community. Journal of Muslim Mental Health. 2008;3(2):155-76.
491. Ali SA, Parveen N, Ali AS. Links between the Prophet Muhammad (PBUH) recommended foods and disease management: A review in the light of modern superfoods. International journal of health sciences. 2018;12(2):61.
492. Acharya S, Butterworth K. Patient perspectives on health in chronic illness. Journal of Patan Academy of Health Sciences. 2018;5(2):35-40.
493. Rana P. Animistic practices among tharus of Dang & Deokhuri.pdf.
494. Patel NR, Chew-Graham C, Bundy C, Kennedy A, Blickem C, Reeves D. Illness beliefs and the sociocultural context of diabetes self-management in British South Asians: a mixed methods study. BMC family practice. 2015;16:1-12.
495. Bhamra SK, Slater A, Howard C, Johnson M, Heinrich M. The use of traditional herbal medicines amongst South Asian diasporic communities in the UK. Phytotherapy Research. 2017;31(11):1786-94.
496. Adhikari B, Mishra SR. Culture and epidemiology of diabetes in South Asia. Journal of global health. 2019;9(2).
497. Ens T, Seneviratne C, Jones C, King-Shier K. Factors influencing medication adherence in South Asian people with cardiac disorders: An ethnographic study. International journal of nursing studies. 2014;51(11):1472-81.
498. Schoenthaler A, Allegrante JP, Chaplin W, Ogedegbe G. The effect of patient–provider communication on medication adherence in hypertensive black patients: does race concordance matter? Annals of Behavioral Medicine. 2012;43(3):372-82.
499. Schoenthaler A, Chaplin WF, Allegrante JP, Fernandez S, Diaz-Gloster M, Tobin JN, et al. Provider communication effects medication adherence in hypertensive African Americans. Patient education and counseling. 2009;75(2):185-91.
500. Young HN, Len-Rios ME, Brown R, Moreno MM, Cox E. How does patient-provider communication influence adherence to asthma medications? Patient education and counseling. 2017;100(4):696-702.
501. Ciechanowski PS, Katon WJ, Russo JE, Walker EA. The patient-provider relationship: attachment theory and adherence to treatment in diabetes. American Journal of Psychiatry. 2001;158(1):29-35.

502. Zolnierek KBH, DiMatteo MR. Physician communication and patient adherence to treatment: a meta-analysis. Medical care. 2009;47(8):826-34.
503. Patel NR, Kennedy A, Blickem C, Reeves D, Chew-Graham C. "I'm Managing My Diabetes between Two Worlds": Beliefs and Experiences of Diabetes Management in British South Asians on Holiday in the East—A Qualitative Study. Journal of Diabetes Research. 2016;2016(1):5436174.
504. Ahmed S, Lee S, Shommu N, Rumana N, Turin T. Experiences of communication barriers between physicians and immigrant patients: A systematic review and thematic synthesis. Patient Experience Journal. 2017;4(1):122-40.
505. Westberg SM, Sorensen TD. Pharmacy-related health disparities experienced by Non–English-Speaking patients: Impact of pharmaceutical care. Journal of the American Pharmacists Association. 2005;45(1):48-54.
506. Robinson A, Sile L, Govind T, Guraya HK, O'Brien N, Harris V, et al. 'He or she maybe doesn't know there is such a thing as a review': A qualitative investigation exploring barriers and facilitators to accessing medication reviews from the perspective of people from ethnic minority communities. Health Expectations. 2022;25(4):1432-43.
507. Pednekar P, Peterson A, Heller D, Brown T. Does the Distance to the Nearest Pharmacy Affect Medication Adherence Rates Among Elderly Patients with Diabetes? Value in Health. 2017;20(9):A483.
508. Census S. Population Report online2022 [Available from: https://portal.saudicensus.sa/static-assets/media/content/AR_20230514_GASTAT_Population_Report%204.06.12%20PM%202.pdf?crafterSite=gastat-portal.
509. General Information about The Kingdom of Saudi Arabia online: General Authority for Statistics; 2021 [Available from: https://www.stats.gov.sa/en/page/259.
510. Saudi Arabia - Urban Legislation, Land and Governance [Available from: https://unhabitat.org/saudi-arabia-urban-legislation-land-and-governance.
511. AlOmar RS, Parslow RC, Law GR. Development of two socioeconomic indices for Saudi Arabia. BMC public health. 2018;18:1-10.
512. Sahab DA, Bamashmous MS, Ranauta A, Muirhead V. Socioeconomic inequalities in the utilization of dental services among adults in Saudi Arabia. BMC Oral Health. 2022;22(1):135.
513. Moradi-Lakeh M, El Bcheraoui C, Afshin A, Daoud F, AlMazroa MA, Al Saeedi M, et al. Diet in Saudi Arabia: findings from a nationally representative survey. Public health nutrition. 2017;20(6):1075-81.
514. Khan SA, AlSiny F, Makki A, Ali A, AlAnsari I, Khan S. Socioeconomic status dependent medical complexities in children with sickle cell disease in Saudi Arabia. Saudi journal of biological sciences. 2020;27(7):1781-7.
515. Naganathan G, Islam F. What is 'South Asian'? A quantitative content analysis evaluating the use of South Asian ethnic categorization in Canadian health research. South Asian Diaspora. 2015;7(1):49-62.
516. DocTransGPT online2023 [Available from: https://doctransgpt.com/.
517. Gurajala S. Healthcare System in the Kingdom of Saudi Arabia: An Expat Doctor's Perspective. Cureus. 2023;15(5).
518. Walston S, Al-Harbi Y, Al-Omar B. The changing face of healthcare in Saudi Arabia. Annals of Saudi medicine. 2008;28(4):243-50.
519. Esposito N. From meaning to meaning: The influence of translation techniques on non-English focus group research. Qualitative health research. 2001;11(4):568-79.

520. Boshra AY, Mariod AA, Massad FAA, Abdalrhman EM, Abbas SM, Hassan AA, et al. Composition, hydrology, and health benefits of Zamzam water. Revista Bionatura. 2021;6(4):2326-30.
521. Prabahar K, Albalawi MA, Almani L, Alenizy S. Assessment of medication adherence in patients with chronic diseases in Tabuk, Kingdom of Saudi Arabia. Journal of Research in Pharmacy Practice. 2020;9(4):196-201.
522. Alqarni AM, Alrahbeni T, Qarni AA, Qarni HMA. Adherence to diabetes medication among diabetic patients in the Bisha governorate of Saudi Arabia–a cross-sectional survey. Patient preference and adherence. 2018:63-71.
523. Basheti IA, Ayasrah SM, Ahmad MM, Abu-Snieneh HM, Abuadas FH. Medications adherence and associated factors among patients with stroke in the Kingdom of Saudi Arabia. Pharmacy Practice. 2022;20(4):1-9.
524. Khalil SA, Elzubier AG. Drug compliance among hypertensive patients in Tabuk, Saudi Arabia. Journal of hypertension. 1997;15(5):561-5.
525. Gabr WM, Shams ME. Adherence to medication among outpatient adolescents with epilepsy. Saudi Pharmaceutical Journal. 2015;23(1):33-40.
526. Al-Jahdali HH, Al-Zahrani AI, Al-Otaibi ST, Hassan IS, Al-Moamary MS, Al-Duhaim AS, et al. Perception of the role of inhaled corticosteroids and factors affecting compliance among asthmatic adult patients. Saudi medical journal. 2007;28(4):569.
527. Klinedinst TC, Opsasnick L, Benavente JY, Wolf M, O'Conor R. The roles of busyness and daily routine in medication management behaviors among older adults. Journal of Applied Gerontology. 2022;41(12):2566-73.
528. Kearney SM. Moderating effects of occupational health exposures and medication adherence: Models for improved adherence: University of Pittsburgh; 2015.
529. Peng Y, Wang H, Fang Q, Xie L, Shu L, Sun W, et al. Effectiveness of mobile applications on medication adherence in adults with chronic diseases: a systematic review and meta-analysis. Journal of managed care & specialty pharmacy. 2020;26(4):550-61.
530. Alodhaib G, Alhusaynan I, Mirza A, Almogbel Y. Qualitative exploration of barriers to medication adherence among patients with uncontrolled diabetes in Saudi Arabia. Pharmacy. 2021;9(1):16.
531. Alosaimi K, Alwafi H, Alhindi Y, Falemban A, Alshanberi A, Ayoub N, et al. Medication adherence among patients with chronic diseases in Saudi Arabia. International journal of environmental research and public health. 2022;19(16):10053.
532. Fadil HA, Sammman WA, Elshafie RM. Prevalence of Nonadherence to Medications among Geriatric Patients in Al-Madinah Al-Munawara City's Hospitals, Kingdom of Saudi Arabia. International Journal of Clinical Practice. 2023;2023(1):3312310.
533. Al-Asmari AS, Aljohani KA, Aloufi MA. Prevalence and predictors of medication adherence among adult cardiovascular diseases patients in al-Madinah. Saudi Journal for Health Sciences. 2021;10(3):178-84.
534. Phillips LA, Diefenbach MA, Kronish IM, Negron RM, Horowitz CR. The necessity-concerns framework: a multidimensional theory benefits from multidimensional analysis. Annals of Behavioral Medicine. 2014;48(1):7-16.
535. Hussein A, Mostafa A, Areej A, Mona A-m, Shimaa A, Najd A-G, et al. The perceived barriers to insulin therapy among type 2 diabetic patients. African Health Sciences. 2019;19(1):1638-46.

536. Almutairi AS, Alhazmi TM, Alotaibi YH, Alfraidi AA, Alsaad AM, Matrood RA, et al. Medication adherence among multimorbid patients with polypharmacy and its relation to social support at National Guard Primary Health Care Centers, Riyadh. Cureus. 2022;14(10).
537. Patel N, Stone M, McDonough C, Davies M, Khunti K, Eborall H. Concerns and perceptions about necessity in relation to insulin therapy in an ethnically diverse UK population with type 2 diabetes: a qualitative study focusing mainly on people of South Asian origin. Diabetic Medicine. 2015;32(5):635-44.
538. Alruwaili MA. Lived experience of having type 2 diabetes: A phenomenological research in three villages in rural Northern Saudi Arabia. Journal of family medicine and primary care. 2021;10(1):149-53.
539. Asaad M, Forde R, AlFares A, Bin Abbas B, Sturt J. Experiences and needs of Saudi mothers when a child or adolescent is diagnosed with type 1 diabetes mellitus: a qualitative study. International journal of qualitative studies on health and well-being. 2022;17(1):2107151.
540. Alosaimi FD, AlMulhem A, AlShalan H, Alqazlan M, Aldaif A, Kowgier M, et al. Psychosocial predictors of patient adherence to disease-modifying therapies for multiple sclerosis. Patient preference and adherence. 2017:513-8.
541. Al-Tarawneh F, Ali T, Al-Tarawneh A, Altwalbeh D, Gogazeh E, Bdair O, et al. Study of adherence level and the relationship between treatment adherence, and superstitious thinking related to health issues among chronic disease patients in southern Jordan: cross-sectional study. Patient preference and adherence. 2023:605-14.
542. Fallatah MS, Alghamdi GS, Alzahrani AA, Sadagah MM, Alkharji TM. Insights Into Medication Adherence Among Patients With Chronic Diseases in Jeddah, Saudi Arabia: A Cross-Sectional Study. Cureus. 2023;15(4).
543. Rhodes P, Nocon A. A problem of communication? Diabetes care among Bangladeshi people in Bradford. Health & social care in the community. 2003;11(1):45-54.
544. Almarwani AM, Almarwani BM. Factors predicting medication adherence among coronary artery disease patients in Saudi Arabia: A descriptive study. Saudi Medical Journal. 2023;44(9):904.
545. Aloudah NM. A Qualitative Study on the Perception of Medication Adherence by the Social Circles of Patients with Type 2 Diabetes. Patient preference and adherence. 2023:973-82.
546. Chadda RK, Deb KS. Indian family systems, collectivistic society and psychotherapy. Indian journal of psychiatry. 2013;55(Suppl 2):S299-S309.
547. Zhai Y, Du X. Disparities and intersectionality in social support networks: addressing social inequalities during the COVID-19 pandemic and beyond. Humanities and Social Sciences Communications. 2022;9(1):1-5.
548. Almigbal TH, Almutairi KM, Vinluan JM, Batais MA, Alodhayani A, Alonazi WB, et al. Association of health literacy and self-management practices and psychological factor among patients with type 2 diabetes mellitus in Saudi Arabia. Saudi medical journal. 2019;40(11):1158.
549. Estacio EV, McKinley RK, Saidy-Khan S, Karic T, Clark L, Kurth J. Health literacy: why it matters to South Asian men with diabetes. Primary health care research & development. 2015;16(2):214-8.
550. Ahmad A, Khan MU, Aslani P. The role of religion, spirituality and fasting in coping with diabetes among Indian migrants in Australia: A qualitative exploratory study. Journal of religion and health. 2022;61(3):1994-2017.

551. Saeed Z, Hayat A, Quadri SSA, Rasool S, Akhter S, Sarwar M. ISLAMIC PERSPECTIVE ON HEALTH MANAGEMENT AND POLICY, CURE IN THE LIGHT OF QURAN AND SUNNAH. Russian Law Journal. 2023;11(5):197-202.
552. Alhomoud F, Dhillon S, Aslanpour Z, Smith F. South Asian and Middle Eastern patients' perspectives on medicine-related problems in the United Kingdom. International journal of clinical pharmacy. 2015;37:607-15.
553. Akhu-Zaheya LM, Alkhasawneh EM. Complementary alternative medicine use among a sample of Muslim Jordanian oncology patients. Complementary therapies in clinical practice. 2012;18(2):121-6.
554. Omar M, Abdullah M, Ahmad AR, Mat Amin AR, Shafei SA, Haron S, et al. Factors affecting the effectiveness of 'ruqyah'treatment among Muslim community in Malaysia. Journal of Spirituality in Mental Health. 2024:1-19.
555. Alzahrani A. Complementary and alternative medicine use in diabetes: Prevalence, factors associated with use and clinical implications: University of Birmingham; 2022.
556. AlQarni K, AlQarni EA, Naqvi AA, AlShayban DM, Ghori SA, Haseeb A, et al. Assessment of medication adherence in Saudi patients with Type II diabetes mellitus in Khobar City, Saudi Arabia. Frontiers in pharmacology. 2019;10:1306.
557. Alghadir AH, Iqbal A, Iqbal ZA, editors. Attitude, beliefs, and use of herbal remedies by patients in the Riyadh region of Saudi Arabia. Healthcare; 2022: MDPI.
558. Gardiner P, Whelan J, White LF, Filippelli AC, Bharmal N, Kaptchuk TJ. A systematic review of the prevalence of herb usage among racial/ethnic minorities in the United States. Journal of Immigrant and Minority Health. 2013;15:817-28.
559. Traylor AH, Schmittdiel JA, Uratsu CS, Mangione CM, Subramanian U. Adherence to cardiovascular disease medications: does patient-provider race/ethnicity and language concordance matter? Journal of general internal medicine. 2010;25:1172-7.
560. Alkhamees M, Lea J, Islam MS, Alasqah I, Alzghaibi H, Alharbi MF, et al., editors. A qualitative investigation of factors affecting Saudi patients' communication experience with Non-Saudi physicians in Saudi Arabia. Healthcare; 2022: MDPI.
561. Abel WM, Efird JT. The association between trust in health care providers and medication adherence among Black women with hypertension. Frontiers in public health. 2013;1:66.
562. Brown MT, Bussell J, Dutta S, Davis K, Strong S, Mathew S. Medication adherence: truth and consequences. The American journal of the medical sciences. 2016;351(4):387-99.
563. Al-Arifi MN. Patients' perception, views and satisfaction with pharmacists' role as health care provider in community pharmacy setting at Riyadh, Saudi Arabia. Saudi Pharmaceutical Journal. 2012;20(4):323-30.
564. Almohammed OA, Alsanea S. Public perception and attitude toward community pharmacists in Saudi Arabia. Saudi Journal of Health Systems Research. 2021;1(2):67-74.
565. Carpenter DM, DeVellis RF, Fisher EB, DeVellis BM, Hogan SL, Jordan JM. The effect of conflicting medication information and physician support on medication adherence for chronically ill patients. Patient education and counseling. 2010;81(2):169-76.
566. Carpenter DM, Elstad EA, Blalock SJ, DeVellis RF. Conflicting medication information: prevalence, sources, and relationship to medication adherence. Journal of Health Communication. 2014;19(1):67-81.
567. Al Saffer Q, Al-Ghaith T, Alshehri A, Al-Mohammed R, Al Homidi S, Hamza MM, et al. The capacity of primary health care facilities in Saudi Arabia: infrastructure, services, drug availability, and human resources. BMC health services research. 2021;21:1-15.

568. Alyami HS, Naser AY, Alyami MH, Al Garsan M, Al-Nahdi AY, Alalhareth IS, et al. Drug shortages in Najran region, Saudi Arabia: A cross-sectional survey. Clinical Epidemiology and Global Health. 2023;21:101305.
569. Bleustein C, Rothschild DB, Valen A, Valatis E, Schweitzer L, Jones R. Wait times, patient satisfaction scores, and the perception of care. The American journal of managed care. 2014;20(5):393-400.
570. Alrasheedi KF, Al-Mohaithef M, Edrees HH, Chandramohan S. The association between wait times and patient satisfaction: findings from primary health centers in the Kingdom of Saudi Arabia. Health services research and managerial epidemiology. 2019;6:2333392819861246.
571. Lee S, Gross SE, Pfaff H, Dresen A. Waiting time, communication quality, and patient satisfaction: an analysis of moderating influences on the relationship between perceived waiting time and the satisfaction of breast cancer patients during their inpatient stay. Patient education and counseling. 2020;103(4):819-25.
572. Mohamed EY, Sami W, Alotaibi A, Alfarag A, Almutairi A, Alanzi F. Patients' satisfaction with primary health care centers' services, Majmaah, Kingdom of Saudi of Saudi Arabia. International journal of health sciences. 2015;9(2):163.
573. Upamali S, Rathnayake S. Perspectives of older people with uncontrolled type 2 diabetes mellitus towards medication adherence: A qualitative study. Plos one. 2023;18(8):e0289834.
574. Atinga RA, Yarney L, Gavu NM. Factors influencing long-term medication non-adherence among diabetes and hypertensive patients in Ghana: a qualitative investigation. PloS one. 2018;13(3):e0193995.
575. Goenka N, Dobson L, Patel V, O'Hare P. Cultural barriers to diabetes care in South Asians: arranged marriage–arranged complications? Practical Diabetes International. 2004;21(4):154-6.
576. Mechta Nielsen T, Frøjk Juhl M, Feldt-Rasmussen B, Thomsen T. Adherence to medication in patients with chronic kidney disease: a systematic review of qualitative research. Clinical Kidney Journal. 2018;11(4):513-27.
577. Ansari M. Barriers to antidiabetic medication adherence among patients with diabetes mellitus in Saudi Arabia: a systematic review. Journal of Pharmaceutical Research International. 2021;33(3):1-12.
578. Ratanawongsa N, Karter AJ, Parker MM, Lyles CR, Heisler M, Moffet HH, et al. Communication and medication refill adherence: the Diabetes Study of Northern California. JAMA internal medicine. 2013;173(3):210-8.
579. Martin LR, Williams SL, Haskard KB, DiMatteo MR. The challenge of patient adherence. Therapeutics and clinical risk management. 2005;1(3):189-99.
580. Jamal A. Identity and strategies of belonging among South Asian Migrant Families in Saudi Arabia: UCL (University College London); 2024.
581. Park CL. Religiousness/spirituality and health: A meaning systems perspective. Journal of behavioral medicine. 2007;30:319-28.
582. Tomai M, Lauriola M. Separate but Related: Dimensions of Healthcare Provider Social Support in Day-Treatment Oncology Units. Frontiers in Psychology. 2022;13:773447.
583. Wardian J, Sun F. Factors associated with diabetes-related distress: implications for diabetes self-management. Social work in health care. 2014;53(4):364-81.
584. Hoogendoorn CJ, Krause-Steinrauf H, Uschner D, Wen H, Presley CA, Legowski EA, et al. Emotional Distress Predicts Reduced Type 2 Diabetes Treatment Adherence in the Glycemia

Reduction Approaches in Diabetes: A Comparative Effectiveness Study (GRADE). Diabetes care. 2024;47(4):629-37.
585. Leventhal H, Phillips LA, Burns E. The Common-Sense Model of Self-Regulation (CSM): a dynamic framework for understanding illness self-management. Journal of behavioral medicine. 2016;39:935-46.
586. Nicklas LB, Dunbar M, Wild M. Adherence to pharmacological treatment of non-malignant chronic pain: the role of illness perceptions and medication beliefs. Psychology and Health. 2010;25(5):601-15.
587. Ross S, Walker A, MacLeod MJ. Patient compliance in hypertension: role of illness perceptions and treatment beliefs. Journal of human hypertension. 2004;18(9):607-13.
588. Horne R, Weinman J. Self-regulation and self-management in asthma: exploring the role of illness perceptions and treatment beliefs in explaining non-adherence to preventer medication. Psychology and Health. 2002;17(1):17-32.
589. Molloy GJ, Gao C, Johnston DW, Johnston M, Witham MD, Struthers AD, et al. Adherence to angiotensin-converting-enzyme inhibitors and illness beliefs in older heart failure patients. European journal of heart failure. 2009;11(7):715-20.
590. Siqueira Péres D, Franco LJ, dos Santos MA. Sentimentos de mulheres após o diagnóstico de diabetes tipo 2 Revista Latino-Americana de Enfermagem, vol. 16, núm. 1, enero-febrero, 2008 Universidade de São Paulo São Paulo, Brasil. Revista Latino-Americana de Enfermagem. 2008;16(1).
591. UK D. Diabetes Education: Learning to look after your diabetes Online [Available from: https://www.diabetes.org.uk/about-diabetes/looking-after-diabetes/education.
592. Jessop DC, Rutter DR. Adherence to asthma medication: the role of illness representations. Psychology and health. 2003;18(5):595-612.
593. Chen S-L, Tsai J-C, Chou K-R. Illness perceptions and adherence to therapeutic regimens among patients with hypertension: A structural modeling approach. International journal of nursing studies. 2011;48(2):235-45.
594. Pourhabibi N, Mohebbi B, Sadeghi R, Shakibazadeh E, Sanjari M, Tol A, et al. Determinants of poor treatment adherence among patients with type 2 diabetes and limited health literacy: a scoping review. Journal of Diabetes Research. 2022;2022(1):2980250.
595. Metwally AS, Atallah IA, Almutairi IK, Alzand MS, Alqabli MS. The Prevalent Use of Complementary and Alternative Medicine Among Patients With Chronic Disease in the Al-Madinah Population of Saudi Arabia. Cureus. 2023;15(12).
596. Horne R, Graupner Ld, Frost S, Weinman J, Wright SM, Hankins M. Medicine in a multi-cultural society: the effect of cultural background on beliefs about medications. Social science & medicine. 2004;59(6):1307-13.
597. Fu CH, Lee LY, Huang LC, Tsay SL, Chen SC. Psychological insulin resistance and its impact on self-management in type II diabetes mellitus patients treated with insulin therapy. International Journal of Nursing Practice. 2024;30(2):e13190.
598. Khunti K, Hanif W, Karet B, Mughal S, Patel K. A practical approach to managing type 2 diabetes in the UK south Asian population. Diabetes & Primary Care. 2011;13(1):47.
599. Ahmed U, Junaidi B, Ali A, Akhter O, Salahuddin M, Akhter J. Barriers in initiating insulin therapy in a South Asian Muslim community. Diabetic medicine. 2010;27(2):169-74.
600. Long DE. Culture and customs of Saudi Arabia: Bloomsbury Publishing USA; 2005.
601. Yates JF, De Oliveira S. Culture and decision making. Organizational behavior and human decision processes. 2016;136:106-18.

602. Asmak A, Fatimah S, Huzaimah I, Khuriah A, Khadijah AS. Is our medicine lawful (Halal). Middle-East Journal of Scientific Research. 2015;23(3):367-73.
603. Halal: Saudi Food and Drug Authority; [Available from: https://www.sfda.gov.sa/en/halal.
604. Farrukh MJ, Makmor-Bakry M, Hatah E, Tan HJ. Use of complementary and alternative medicine and adherence to antiepileptic drug therapy among epilepsy patients: a systematic review. Patient preference and adherence. 2018:2111-21.
605. Mahayosnand P, Ahmed S, Sabra Z. Black seed (Nigella sativa), a COVID-19 medicinal intervention-a recommendation for the Americas.
606. Lindsay S. Five approaches to qualitative comparison groups in health research: a scoping review. Qualitative health research. 2019;29(3):455-68.
607. Irani E. The use of videoconferencing for qualitative interviewing: Opportunities, challenges, and considerations. Sage Publications Sage CA: Los Angeles, CA; 2019. p. 3-8.
608. Albeladi AA. The Challenges of Conducting Qualitative Research in Quantitative Culture: Saudi Arabia as a Case Study. Qualitative Report. 2024;29(4).
609. Forward Translation and Back Translation: Do They Improve Quality? 2023 [Available from: Forward Translation and Back Translation: Do They Improve Quality?
610. Nguyen AW. Religion and mental health in racial and ethnic minority populations: A review of the literature. Innovation in Aging. 2020;4(5):igaa035.
611. Lancaster K, Carter-Edwards L, Grilo S, Shen C, Schoenthaler A. Obesity interventions in A frican A merican faith-based organizations: a systematic review. Obesity Reviews. 2014;15:159-76.
612. Schoenberg NE. Enhancing the role of faith-based organizations to improve health: a commentary. Translational behavioral medicine. 2017;7(3):529-31.
613. Levin J. Partnerships between the faith-based and medical sectors: implications for preventive medicine and public health. Preventive medicine reports. 2016;4:344-50.
614. Holt CL, Clark EM, Roth DL. Positive and negative religious beliefs explaining the religion–health connection among African Americans. The International journal for the psychology of religion. 2014;24(4):311-31.
615. Kang M, Kang SY, Lim J, Kim YS. Religion and health behaviors in primary care patients. Korean Journal of Family Medicine. 2020;41(2):105.
616. Gatrad A, Mynors G, Hunt P, Sheikh A. Patient choice in medicine taking: religious sensitivities must be respected. Archives of disease in childhood. 2005;90(9):983-4.
617. Odukoya OO, Jeet G, Adebusoye B, Idowu O, Ogunsola FT, Okuyemi KS. Targeted faith-based and faith-placed interventions for noncommunicable disease prevention and control in low-and middle-income countries: a systematic review protocol. Systematic Reviews. 2022;11(1):119.
618. Peterson J, Atwood JR, Yates B. Key elements for church-based health promotion programs: outcome-based literature review. Public Health Nursing. 2002;19(6):401-11.
619. Holt CL, Litaker MS, Scarinci IC, Debnam KJ, McDavid C, McNeal SF, et al. Spiritually based intervention to increase colorectal cancer screening among African Americans: screening and theory-based outcomes from a randomized trial. Health Education & Behavior. 2013;40(4):458-68.
620. Wilcox S, Parrott A, Baruth M, Laken M, Condrasky M, Saunders R, et al. The Faith, Activity, and Nutrition program: a randomized controlled trial in African-American churches. American journal of preventive medicine. 2013;44(2):122-31.

621. Kong BW, Miller JM, Smoot RT. Churches as high blood pressure control centers. Journal of the National Medical Association. 1982;74(9):920.
622. Campbell MK, Hudson MA, Resnicow K, Blakeney N, Paxton A, Baskin M. Church-based health promotion interventions: evidence and lessons learned. Annual review of public health. 2007;28(1):213-34.
623. Kaplan SA, Calman NS, Golub M, Ruddock C, Billings J. The role of faith-based institutions in addressing health disparities: a case study of an initiative in the southwest Bronx. Journal of Health Care for the Poor and Underserved. 2006;17(2):9-19.
624. Anshel MH, Smith M. The role of religious leaders in promoting healthy habits in religious institutions. Journal of religion and health. 2014;53:1046-59.
625. Moussaïd M, Kämmer JE, Analytis PP, Neth H. Social influence and the collective dynamics of opinion formation. PloS one. 2013;8(11):e78433.
626. Joo JY. Effectiveness of culturally tailored diabetes interventions for Asian immigrants to the United States: a systematic review. The Diabetes Educator. 2014;40(5):605-15.
627. Joo JY, Liu MF. Effectiveness of culturally tailored interventions for chronic illnesses among ethnic minorities. Western Journal of Nursing Research. 2021;43(1):73-84.
628. Huang Y-C, Garcia AA. Culturally-tailored interventions for chronic disease self-management among Chinese Americans: A systematic review. Ethnicity & Health. 2020;25(3):465-84.
629. Shiyanbola OO, Maurer M, Schwerer L, Sarkarati N, Wen M-J, Salihu EY, et al. A Culturally Tailored Diabetes Self-Management Intervention Incorporating Race-Congruent Peer Support to Address Beliefs, Medication Adherence and Diabetes Control in African Americans: A Pilot Feasibility Study. Patient preference and adherence. 2022:2893-912.
630. Nair L, Adetayo OA. Cultural competence and ethnic diversity in healthcare. Plastic and Reconstructive Surgery–Global Open. 2019;7(5):e2219.
631. Pandey M, Maina RG, Amoyaw J, Li Y, Kamrul R, Michaels CR, et al. Impacts of English language proficiency on healthcare access, use, and outcomes among immigrants: a qualitative study. BMC Health Services Research. 2021;21:1-13.