AN EXPLORATION OF THE CONCEPT OF 'WALKABILITY' IN A HOT ARID CLIMATE: THE CASE OF MAKKAH CITY

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In the Name of Allah, the merciful, the compassionate

Abstract

There has been a growing issue in Saudi Arabia towards the walking environment and its quality to all street users in country with hot and arid climate. The City of Makkah is one of the most prominent world destinations due to its role as the holiest place in the Islamic religion. However, the poor infrastructural state of the city has continually posed a significant to the millions of people visiting and dwelling in the city.

This research investigates the notion of walkability in the context of an urban area in the centre of one of the holiest places in the Islamic world. The primary concept is to explore and understand the factors that make a place walkable and examine the current condition of the area in relation to those overarching factors. Additionally, this research will describe the current situation in a micro-scale street level through people's experience and perception and behaviour.

Data collection and analysis were conducted using a mixed method approach and strategy. To get trustworthy conclusions, data from several sources - physical observation and activity observation on the site, interviews, and questionnaire survey - were gathered, interpreted, analysed, and triangulated. The data from two datasets were triangulated to discover the convergence of the results. Each approach has its own strengths and weaknesses, and triangulation was employed to complement each method in the research findings

The findings of this study identified five critical factors affecting the walkability of streets for users in the central area of Makkah: 'comfort'; 'safety'; 'sense of crowding and congestion; accessibility; and connectivity. As such, these are the primary criteria that must be considered in order to increase the walkability of urban streets in Saudi Arabia. It was discovered that in the case of central Makkah streets, the issue of street design, particularly the width of sidewalks, is severe due to the design or presence of merchants on the majority of sidewalks and covered routes (trees/canopies). It was found that the users' requirements of on central Makkah street depends on physical factors: path context which includes street design, visual interest of built environment, greenery/trees, and path quality which includes width, paving, street furniture, connectivity, accessibility. The findings indicate that safety features impact walking decisions in areas of Central Makkah where particular feelings, experiences, and behaviours occur in response to the physical environment. The experience and behaviour of pedestrians may be a psychological reaction to an uncomfortable feeling, which results in various behaviours related to the walking environment's safety.

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I am thankful to Allah (Almighty God), for letting me through all the difficulties that I face during this journey. Without his mercy and beneficence, I would not be able to achieve this stage. Many people have contributed to this achievement and made it possible to finish my thesis.

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Chapter 1. Introduction

1.1 Introduction

This research investigates the notion of walkability in the context of an urban area in the centre of one of the holiest places in the Islamic world. The study seeks to explore and understand factors influencing a place's walkability based on examining the prevailing conditions in an area in relation to those broad factors. This research explores the notion of walkability, which has been defined as "the extent to which the built environment supports and encourages walking by providing for pedestrian comfort and safety, connecting people with varied destinations within a reasonable amount of time and effort, and offering visual interest in journeys throughout the network" (Southworth, 2005, p.19). In 'What is a walkable place?', Forsyth (2015) states that walkability is in many instances a way of speaking about environments that are in reality better, with walkability representing a holistic solution to enhancing urban areas: slower-paced, more human-scaled, healthier, and happier. A further opinion is that walkability is the basic principle of creating public urban spaces that are available for pedestrians and welcoming for walkers (TuroŃ et al., 2017)

This chapter is divided into six sections (after this one) introducing the research. The research background and matters related to the research topic are presented in the first section. The second identifies the research gap by reviewing the literature that is related to the research topic. This section defines the guiding research questions that trigger the formation of the aim and objectives. The third section describes the aim, objectives, and questions of the research, while the fourth briefly describes the importance of research to the community specifically and visitors to Makkah in general. The fifth section describes the research approach and research design that was used. The structure of the thesis is presented in the last part.

1.2 Background

Infrastructure of all types in the Kingdom of Saudi Arabia (KSA), and Makkah in particular, is challenging due to the dramatic ebb and flow of pilgrims occurring simultaneously with the rapid growth of the population. In response to these difficulties, the government has put into practice a series of different strategies, aimed at providing increased capacity in transport systems, housing estates, and other facilities in the region of Makkah. One such initiative is the

extension of the Grand Mosque, launched in 2011 and developed in 2015 by King Salman, who announced five new interrelated projects to be implemented. These include extending the building itself, as well as adjoining squares, constructing new tunnels and extra service centres, and expanding a ring road around the city. A large segment of the sector growth in Makkah is attributed to hotels and apartments, resulting in a unique rate of hotel development in general, with a prevailing share of high-end provision – four-star, five-star, and luxury options. Aside from this, according to the Ministry of Housing, the country will find itself in need of 3.3 million housing units over the next decade when the number of pilgrims increases. As for transportation needs, a significant improvement is to be introduced with the help of a four-line, 88-station subway system, and a fast bus service network. The underground lines will focus on relieving the pressure and crowdedness of other types of transportation around the Grand Mosque, while other lines are to run on a suspended bridge. Therefore, these are the governmental problem-solving techniques focusing on the physical infrastructure of the city centre. There have also been attempts at crowd management, applied directly during the Hajj period. General entry has been restricted and a strict visa control system introduced, as well as crowd-monitoring helicopters and an increased number of first aid crews located on highway-like ramps built for pilgrims.

In general, although many cities in Saudi Arabia have an issue with walking where the built environment is unsupportive and people rely on their cars as a means of transport to reach their destination, Makkah has a particular problem. The central part of Makkah city has been the focal point of Muslims of the world since the time of the Prophet Abraham. This is manifested at pilgrimage time and during the month of Ramadan, which is the ninth month of the Islamic calendar. It is estimated that the peak time when Muslims come to Holy Allah's mosque is during pilgrimage and the month of Ramadan. The local government has attempted to offer useful solutions such as the use of tunnels to connect the central area to other holy places as part of the pilgrimage journey. However, people still suffer from walking long distances under the burning sun of Makkah, as the tunnels only cover limited distances (see Figure 1). Additionally, because the streets of central Makkah are shared between vehicles and pedestrians, many accidents occur daily, which is one of the main problems during the Hajj period. In addition, merchants in Makkah are very active during this season because of the huge number of customers, which arises, in turn, at the expense of a pleasing and comfortable street. There are no empty public spaces, as they are all full of pedlars and street vendors.

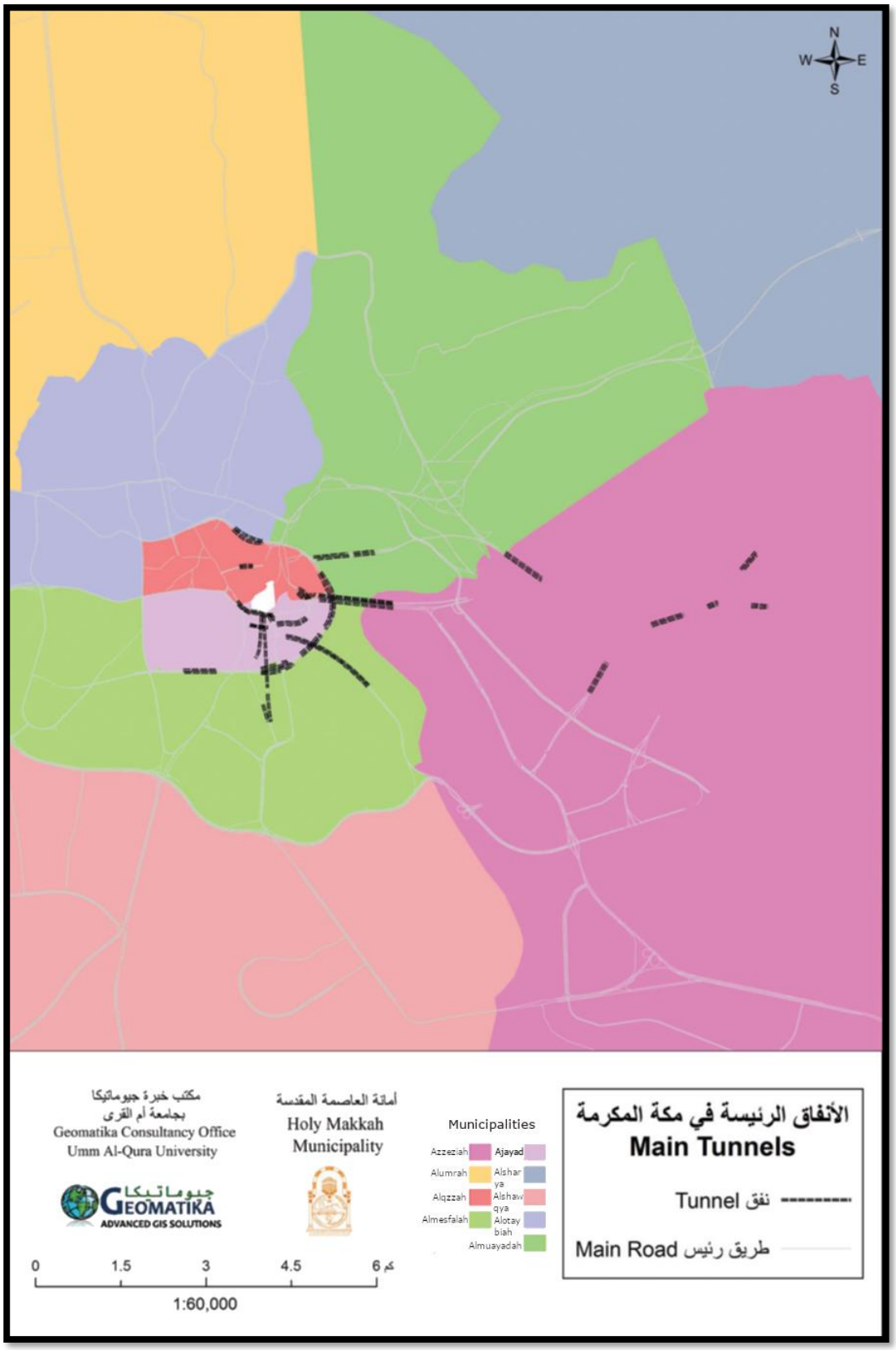

Figure 1.1 Main tunnels in central Makkah. Source: Geomatika Advance GIS Solutions.

1.2.1 ***Statement of Issues***

This study will address urban design concerns relating to walkability from both a global and a local perspective. In recent years, several studies have focused on creating walkable neighbourhoods and communities. Promoting walkability has been a top concern for the built environment and urban design concepts in particular. Determining the relationship between walkability and urban design, however, needs a solid understanding of the main concepts and key elements that create urban form (such streets, public spaces).

Global issues

Walkability is a concept that has been used in Western literature in the last two decades. This is where the built environment supports walking by connecting people safely, quickly, comfortably, and enjoyably to their daily destinations. In a Western context this often means, for example, provision of suitable sidewalks, highly connected routes, and integration of green spaces, such as parks.

This thesis follows an approach that aims to explore and examine the walkability of central Makkah. An urban design that is pedestrian-oriented acts on a human scale, taking into account basic needs and rights, thus being an intelligent and modern concept. Walkability represents a holistic solution to urban improvement, due to it being a contribution to the creation of slow-paced, healthier, and generally happier environments that are welcoming and provide pedestrian comfort (Southworth, 2005; Forsyth, 2015). The Western and Middle Eastern regions have the same issues with sustainability in transportation and health, such as high traffic and increased obesity rates.

Local issues

In the context of Saudi Arabia, the situation is very different because it is a hot arid climate, with temperatures often between 30°C and 50°C during summer, which makes it difficult to walk. The central part of Makkah city has been the focal point of the Muslims of the world since the early 1st century Hijri (6th century CE). Hajj and Umrah are both Islamic pilgrimages, but they are different in their level of importance.

Hajj is an annual Islamic pilgrimage to Makkah and a religious obligation for all adult Muslims who are physically and financially capable of making the trip and providing for their family during their absence. Furthermore, different from Hajj, Umrah only requires pilgrims to visit the Grand Mosque (Islamic Relief, n.d.).

According to the Ministry of Municipal and Rural Affairs and United Nations, the population of Makkah in 2017 was over two million people, but it hosts several million pilgrims during the period of Hajj, which has been classified as the largest gathering in the world (MMRA & UN, 2019). This large number of people come to Makkah at one time to perform pilgrimage for Hajj or Umrah, with the pilgrims competing strongly to reside near the Holy Mosque. The number of pilgrims is growing and will reach 4.3 million in 2020, with an estimated growth rate of 5%. Also, it is predicted that the urban areas will expand, reaching 41,051 hectares by 2020 (Ascoura, 2013), thus causing the central area around the Holy Mosque to become heavily congested. Both vehicle traffic and pedestrians occupy the same streets, and it is here that the problem arises. Al-Hathloul & Mughal (2001) pointed out in their study 'Makkah: Developing the centre of Islam district' that the conflict between pedestrians and vehicular traffic is hazardous, particularly for the elderly, women, and children, and must be avoided. Traffic congestion, noise and pollution, particularly around Al-Haram (the Great Mosque of Mecca), are the result of the increasing number of vehicles in the central area (Al-Hathloul & Mughal, 2001), and it is because of this that the government has been forced to expand Makkah's infrastructure.

The city of Makkah is one of the most prominent world destinations due to its role as the holiest place in the Islamic religion. However, the poor infrastructural state of the city has continually posed a significant problem for the millions of people visiting and dwelling in the city. Consequently, the Saudi government has been making momentous efforts towards enhancing the safety, comfort, and convenience of the city for pedestrians, among which involves the redesigning and reconstruction of the infrastructure around the Grand Mosque. Ultimately, it is expected that the findings of this research will provide plausible recommendations and guidelines that, if adopted by the relevant city agencies, would help to alleviate the challenges faced by city dwellers in manoeuvring around the city while restoring its glory as the most important city in Islamic history.

1.3 Research Gap

Many scholars have conducted research focusing on the walkability of the neighbourhoods, among which are Ewing and Handy (2009). In their view, they establish that different groups and communities have uniquely preferred aspects that constitute a walkable neighbourhood. In their conclusion, however, they highlight that a walkable city is one whose inhabitants, regardless of their age, can access their community with significant ease without the aid of an automobile (Ewing & Handy, 2009). In this case, central Makkah would qualify as walkable if its people could walk more in safer, friendlier, and healthier neighbourhoods. The findings by (Hume et al., 2007) establish that a walkable city needs to have highways and streets with designs and constructions that provide comfortable and safe facilities for use by pedestrians. Ultimately, the city would need to exhibit coherence, which is evident in clear, organised, and understandable streets, sidewalks, and land-use systems that are consistent with their urban functions and scales.

Along with the built environment, the weather plays an essential role in encouraging people to be physically active. Most studies in walking activity/walkability have been focused on cool or temperate climates rather than hot ones. For example, a study on the impact of weather conditions on pedestrian volumes during the temperate and winter months on the sidewalks in Montreal, Canada, used automatic hourly pedestrian counts for five different locations in the city based on density and uses of the area. From this study, the authors found that climate, including temperature, humidity, and wind speed, was a factor affecting pedestrian activity (Miranda-Moreno & Lahti, 2013). In a similar geographical area in Michigan, USA, another study revealed that natural causes such as weather conditions (snow, ice, treacherous footing) were the greatest barriers along with traffic, congestion, and walking infrastructure to walking and cycling (Westphal et al., 2012). Weather has an influence on people's decision to walk or choose a mode of transportation in either the winter or the summer, as was shown by a study that investigated the influence of weather on people's decisions on mode of choice in Sweden in different seasons and regions. The results show that, in the winter, the number of people walking and using public transportation increased, but those cycling decreased, with the opposite occurring in the summer (Liu et al., 2015). In contrast, another study that focused on identifying environmental factors (location, aesthetics, accessibility, safety, weather, age) that influence physical activity unexpectedly found that the weather demonstrated the strongest association with walking for both men and women (Humpel et al., 2004). Clearly, pedestrian volume is based on weather preference in walking, and it is different from one type of weather

to another. Weather may be described as a barrier to walking, while others have said the opposite.

Along with pedestrian volume, the choice of walking depends on how the built environment and existence of pedestrian facilities can promote walking more than other modes of transport. A study examined the factors that influence the choice of walking in Ilesa, Nigeria, based on a questionnaire survey that was distributed to three residential zones of the city (high-, medium-, low-density) based on the classification of political wards. The results of the study found that "vehicle ownership, the relative slowness of the mode and the absence of pedestrian facilities constituted the most significant barriers to walking as an active travel mode in the city" (Olojede et al., 2017). As a result, the association between walking and weather conditions may have a positive or negative impact on pedestrian comfort and experience when using urban space.

Most studies have not obtained enough details to explore the issue of walkability in regions with hot temperature climates more clearly, and no exclusive attempt has been made to study walkability issues associated with such hot, arid weather during a religious event. However, further research is needed to more clearly explore and understand walkability in these climates in a unique urban space such as central Makkah Al-Mukkaramah. This research is expected to reveal the implications that weather has for walkability in such a context and to examine walking facilities and how people respond to them.

1.4 Research Aims, Objectives, Questions

This study aims to explore and examine the walkability of central Makkah from experience, behaviour, and evaluation of pedestrians. In order to achieve this, the research objectives are framed as follows:

- To examine the extent to which walkability may be relevant in a hot arid climate
- To examine in detail pedestrian behaviour and obtain people's perceptions of comfort levels while walking in public spaces
- To examine the physical characteristics that may encourage/discourage walkability in a hot, arid climate, and specifically in Makkah
- To explore the relationship between physical characteristics and socio-cultural, psychological issues that influence people's decision-making with specific reference to Makkah and the Umrah/Hajj pilgrimage

There are five questions that will help to achieve the aim and objectives of the research:

- How relevant, in general, is the concept of walkability in a hot, arid climate?
- How do people perceive their everyday experience as pedestrians in central Makkah?
- How do these experiences relate to concepts of walkability?
  - Do, for example, the current physical characteristics support a pleasant walking experience in central Makkah?
- What can we learn from using the lens of "walkability" to study central Makkah? How may that learning be applied to improve the situation and create friendlier, more comfortable conditions for locals and pilgrims in the future?

1.5 Significance and Nature of the Research

This study is very important because it contributes to solving a problem that involves millions of Muslims from all over the world. Muslims come from different climatic regions, from frozen Siberia to the very hot climate of the Arabian desert, and so this wide spectrum bearing the thermal load of Makkah city deserves an acceptable solution. To achieve an acceptable degree of walking in central Makkah will save both people and the local government a lot of barriers and expenses. Moreover, pilgrims will feel safe and happy, as will their families back home. Additionally, this research will describe the current situation at a micro-scale street level through people's experiences, perceptions, and behaviour.

The focus of this research is to investigate and explore the concept of walkability in a hot, arid climate. A selected case study approach was used, with a heavy emphasis on qualitative approaches. However, a simple quantitative technique was used to ascertain people's perceptions and demands about the area's walkability. This research strategy is applied to ascertain walkability throughout the investigation and to address the research questions stated previously. The principles of walkability used in this research are based on the literature.

The research methods used to understand and explore the environmental, social, and physical factors include interviews, observations, secondary data analysis, and literature reviews.

1.6 Structure and Organisation of the Thesis

The thesis consists of eleven chapters; the following describes the content of each chapter:

Chapter 1: presents the research structure and broad overview of the study. It also presents the study's background, the research question and aims and objectives, the character of the study, the research gap and the approach followed in conducting that study. The last part of the chapter explains why the study is significant and how it will contribute to existing knowledge.

Chapter 2: presents a review of the literature on the subject of the research. It establishes both the key concepts of walkability and overviews the existing body of literature that concerns the key principles that determine walkable places

Chapter 3: presents a review of the role of walkability, and the current set of knowledge concerning the physical and perception characteristics that are associated with walkability and/or walking needs, as well as the present body of literature that is concerned with the main principles determining walkable places. Finally, it presents the current body of knowledge concerning walking behaviour. In addition this chapter discusses urban design quality associated with walkability or walking needs.

Chapter 4: explains the methodology and procedures that was used to understand and explore walkability in central Makkah. It discusses the approaches of the methodology and the process that was used for data collection and analysis.

Chapter 5: presents an introduction of the case study and provides a detailed description of its religious and historical significance. Moreover, the chapter presents a detailed description of the climate conditions in Makkah and focuses on the climatic background about the study area.

Chapter 6: presents the results of data analysis in relation to the research's first and second objectives, which concern the environmental factors that influence walkability

Chapter 7: delivers the results obtained from analysing the data linked to the research's third objective, concerned with the physical factors influencing walkability.

Chapter 8: presents the results from analyses of the data connected with the study's fourth objective which concerns the social factors influencing walkability.

Chapter 9: summarises the main findings raised in earlier chapters. It also emphasises the research's contribution to knowledge as well as its limitations. Finally, it provides some general recommendations and research suggestions for the future.

Chapter 2. The Concept of Walkability and its Principles

2.1 Introduction

This review presents the conception of walkability as an important element in the urban environment. It shows how it is linked to urban design. Walkability is a common concept covered in studies focusing on walking behaviour to describe the readiness of an environment to accommodate walking. During the review, the origins of the idea and its definition, as well as the concepts developed to establish an understanding of walkability, will be discussed, as well as the physical and environmental characteristics that influence walkability.

This chapter is divided into four sections. The first section discusses the idea and definitions of walking, followed by its health, environmental, and behavioural outcomes on people and the built environment. In the second section, the term 'walkability' is identified following the six main criteria suggested by Southworth (2005): ensuring pedestrian comfort and safety, connecting people to various destinations in an acceptable amount of time and effort, and providing visual appeal throughout walking journeys. The last section examines the urban design qualities associated with walkability or walking needs, as well as the current body of literature that addresses the importance of these qualities.

At present, the majority of studies examining the role of urban design in increasing walkability do not specifically apply to Saudi Arabia or other nations with similar environments. However, there are a few studies that emphasise the lessons that may be gained from cities about their public space design, urban morphology, and inherently walkable city centre. Therefore, the purpose of this research is to conduct a literature review on walkability and urban design characteristics and qualities that contribute to a city's walkability.

2.2 Walkability: Concept and Definition

Walking has always been the main mode of human transportation (Amato, 2004) and has been defined by many sources in different disciplines. According to Morris and Hardman (1997),

> *"Walking is the natural form of getting about and the commonest exercise. Walking is a typical dynamic aerobic activity; the major muscle groups of the legs, limb girdle and lower trunk contract and relax rhythmically to move the body from one point of support to the next, muscles of the shoulder girdle*

> *are active as the arms swing in a complementary fashion"* (Morris & Hardman, 1997, p.308).

Walking, as well as cycling, has many purposes, such as leisure, recreation, or exercise, as well as combined purposes such as shopping and/or going to work in one journey (Saelens et al., 2003). Amato (2004) explains that walking in the last hundred years has been increasingly divided, restricted, and limited. At the same time, it has become about choice, involving questions of health and recreation. Frank et al. (2003) explained that physical activity has changed between the present day and much of history (before the 20th century) in the cities. In the pre-automobile times, performing physical activity was part of daily life and was not an issue during the day because physical activity was as ordinary as eating and sleeping. This can be seen through the great development witnessed by the Kingdom of Saudi Arabia, especially in paving roads to facilitate the flow and movement of pilgrims to and from the holy sites.

Today, our relationship with walking has been altered and changed; physical activities are no longer as necessary as they used to be, as everyday life activities require significantly less physical effort than before. However, as stated by the Wisconsin Department of Transportation (2002), walking is considered to be a normal choice of transportation and does not function as an obstacle or distraction to motor vehicles.

Moreover, and of particular note to this study, walking is associated with religious purposes, as it is the basic mode of pilgrimage, and has been throughout history (Solnit, 2001). Solnit (2001, p.45) links pilgrimage and walking "as one of the fundamental structures a journey can take the quest in search something, if only one's own transformation, the journey toward a goal-and for pilgrims, walking is work". Pilgrims come together in Makkah as part of religious tourism, persuaded in part or in whole due to religious duty. It is instructed that all Muslims must visit the Holy Places once in their lifetime, so long as they are physically and fiscally capable (Al-Ageel, 2011). As a result, it is clear that walking is an important component in many people's lives, as it facilitates not only leisure, but also religious activities. Despite the significance of walkability component in the religious activities, no studies have approached this point from religious point of view especially in Saudi Arabia. The current studies approached the issue of walkability from (which are very few) only dealt with walkability from the point of view of tourism, and its impact on the tourist's journey and tourism movement. According to the researcher's knowledge, and until the time of writing this study, there is only few studies that deals with the walkability during the pilgrimage seasons i.e., the study of Kato and Progano (2017) who further investigated the connection between walkability and spirituality during

religious tourism. Moreover, the meaning of walking, the purposes, and the history with the change from the past point out the attention needed to be paid to this aspect.

2.2.1 ***From walking to walkability***

The word 'walkability' is described by Southworth (2005,) as "the extent to which the built environment supports and encourages walking by providing for pedestrian comfort and safety, connecting people with varied destinations within a reasonable amount of time and effort, and offering visual interest in journeys throughout the network"(p.248). Rafiemanzelat et al (2017), on the other hand, argue that walking is separate from walkability, defining walking as short distance movement between two locations. While walkability is a term that relates to how pedestrian-friendly a location is, it also refers to the physical environment in which walking happens. The word 'walkable' can have numerous definitions, including a walkable environment that promotes physical activity and involves a short distance to a destination, and is barrier-free: traversable, without significant barriers, safety in terms of potential crime or perceived traffic, with a range of pedestrian facilities and locations, as well as the pedestrian environment being friendly for upper-middle-class professionals who have other options for moving around (Forsyth & Southworth, 2008).

It is critical that features such as comfort, safety, accessibility, and visual appeal are offered in environments where walking can be encouraged (Southworth, 2005). To accomplish this goal, compact connected urban areas minimise the distances needed to travel between different destinations, which allows walking to become a real option as means of transportation (Azmi et al., 2013). As it meets the need for transport on the lowest possible scale, this scale promotes a person's ability to travel around easily and adaptively (Vasilikou & Nikolopoulou, 2014).

Walkability is seen as a concept that puts together a range of points of interest that lead to improvements in the urban environment and people's mobility. Walking is seen to be the most sustainable and environmentally friendly form of transportation (Alfonzo, 2005).

As a theory, according to Speck (2013), walkability implies that a walk needs to meet four key requirements: these are for it to be useful, safe, comfortable, and interesting. Additionally, Speck argues that the term might be regarded as a straightforward and practical approach to a variety of complicated issues confronting communities, issues that threaten economic competitiveness, public health, and environmental sustainability. By default, walkability was critical in cities where they had to be walkable until the cars emerged where only the wealthy could afford to keep horses, or horse drawn vehicles prior to this era. In fact, the streets of the

pre-industrial city had to be walkable, with fine-grained activity patterns, a high density of residences, and everything connected by a continuous pedestrian route network (Southworth, 2005). The studies support the value of walkable environments, particularly the connection between places, which can connect places of interest. The walkability of an urban area often influences and develop social interaction, sense of space, and emotional connection. It is noted through the analysis of previous studies that they dealt with the walkability in normal city environments, or during the tourist seasons in which the number of walking tourists increases slightly to moderately. This may not apply to the city of Makkah in Saudi Arabia, which annually witnesses (in normal conditions) overcrowding with a large number of pedestrians, which may reach 10 times the normal level.

The term 'walkability' is widely used to describe the quality of the urban environment. A street must be walkable, linking buildings and activities around the street (Carmona et al., 2010). Walkability, according to studies, is described by a number of key factors, including safety, building density, street accessibility and connection, land use balance, and aesthetics. Walking enables individuals to take part in numerous economic and social activities. Appropriate street amenities should satisfy the requirements (physiological, social, and psychological) and be built as a way to facilitate walking as a means of transportation (Al-Azzawi, 2004).

Urban designers must evaluate what is going on in inhabitants' thinking, like the factors that motivate and make it difficult for them to walk: they find challenges linked to security, adverse weather, and finding enough time to walk. Being functional and attractive are the criteria for a good street (Plowden, 2001). Plowden also suggests that, in redesigning streets, they can be not only planned as places for vehicles, but also for pedestrians. streets can be focused on the pedestrian once more – even those modern interventions that were designed without the pedestrian in mind. In light of this, there is a need to review and evaluate the development efforts in the Kingdom of Saudi Arabia in developing the streets to be suitable for walkability of citizens and tourists in particular during the seasons of religious tourism.

2.2.2 ***Public health benefits***

Health and well-being are essential components in people's lives. Evidence shows that physical activity, including walking, has many benefits to health and well-being, and can impact on chronic diseases, overweight, and obesity. A recent study on the importance of physical activity

demonstrated that being insufficiently active can lead individuals to have chronic diseases or functional limitations (Hagströmer & Franzén, 2017).

Muhlbach (2012) has shown that walking is increasingly promoted in many developed nations as a result of the prevalence of chronic illnesses such as diabetes, asthma, and obesity, driving public policy to prioritise walkability. In the United States one of the main drivers of the adoption of walkability is obesity. It is linked to the objective of enhancing citizens' general quality of life and public health by increasing physical activity through ensuring that public spaces are easily accessible for those who wish to walk. Krambeck (2006) posits that walkability discussions in developing cities might similarly be a central part of making the transition from motorised to non-motorised modes of transportation when taking shorter trips or out of concern for the environment, and as a healthy recreational activity. The concern for the environment is a particularly relevant factor in the cases of Europe. The Centre for Disease Control and Prevention also states that lack of physical activity plays an important role in chronic diseases such as diabetes, cancer, chronic obstructive pulmonary disease, and cardiovascular disease. For both men and women, being overweight or obese can cause different kinds of health conditions such as gallbladder disease, osteoarthritis, high blood pressure, and coronary heart disease (Must et al., 1999). In contrast, physical activity such as walking has many benefits, as Southworth (2005, p.248) states: "Walking can promote mental and physical health including cardiovascular fitness, reduced stress, stronger bones, weight control, and mental alertness and creativity". Accommodating time during the day for physical activity, including walking, may help the general public to avoid the aforementioned health problems. For example, Lee and Buchner (2008) explain that the benefits would be great if everyone in the United States underwent 30–40 minutes of moderate intensity physical activity each day. Moreover, the authors also concluded that walking can reduce rates of chronic disease and aid in reducing the increasing cost of healthcare, with only a minor increase in walking related injuries.

Pilgrimage is almost done on foot (walking), which is a basic health behaviour that can lower rates of chronic disease and lower health-care expenditures while only slightly increasing the frequency of activity-related injuries. Walking can help reduce the incidence of chronic disease and lower health-care expenses.

A comparative study was set in Saudi Arabia, which holds the third highest rate of obesity and being overweight after Kuwait and the United Arab Emirates among Western countries, with 34.7% and 69.6% of the population being obese and overweight respectively (DeNicola et al.,

2015). The findings of this study showed that most Saudis are physically inactive and consume low amounts of fruits and vegetables. Furthermore, the work demonstrated strong associations between weight problems and diabetes, hypercholesterolemia, and hypertension (Memish et al., 2014). Time, poor health, and lack of motivation are intertwined with built environment features such as travel difficulties, lack of safety, and inconvenience for pedestrians (Frank et al., 2003).

A study by Smith et al. (2008) found that improved walkability was associated with lower risks of increased body weight. In comparison, an analysis of data found that a doubling of the number of a neighbourhood's residents who walk to work correlated with a 9% drop in body mass index. The study found that the risk of obesity was significantly lower in communities residing in older neighbourhoods (developed before the freeway era) than in those living in younger, less pedestrian-friendly neighbourhoods.

Land use, street connectivity, and higher residential density are the built environment attributes that are associated with walking as a means of transportation (Abrams et al., 2012). This type of urban form can encourage people to walk, which in turn improves physical activity, reducing health problems. In summary, physical activity, including walking, has a positive impact on public health, and numerous studies show that it helps to avoid several diseases. Related improvements in behaviour over time will contribute to better public health in a population. Places that are human-scaled, pleasant, and comfortable for pedestrians will improve walking activity levels, which will in turn encourage greater neighbourhood health (Sallis et al., 2011). Despite the numerous benefits walking provides, it is a forgotten mode of transport in many urban cities due to the over-reliance on vehicle travel, which contributes to an increased incidence of non-communicable diseases. Apart from the advantages presented by walking in relation to health, walking's social facet further contributes to the well-being of involved individuals (Edwards & Tsouros, 2006; Warburton et al., 2006; Morris & Hardman, 1997).

Saudi natives and expats have progressively recognized the value of physical fitness, and as a result, the nation's walking trend is rapidly gaining traction. Riyadh, as the capital, is home to several popular public walkways. The proclivity for walkability in each urban location is determined by a variety of factors. A social, safe, thermally comfortable, easily accessible, and readable urban environment that quickly connects with its users is favourable to a popular walking destination. Enhancing walkability promotes a more leisurely pace of travel, which facilitates beneficial relationships between people (Omar et al., 2016).

Numerous studies have proved the positive link between mental health and physical activity. While everyone is aware that physical activity is beneficial to health, the majority of people are unaware of the range of its benefits. Physical exercise can help improve and enhance the quality of life, as well as lower the chance of developing dozens of physical and mental health issues, including the leading causes of mortality, disability, and suffering in the United States (Abrams et al., 2012). Walking is inclusive, available to practically everyone, requires no extra skills or training (Guo, 2009; Boyce, 2010), and has the potential to improve a sense of belonging in public areas and settings, as well as mental well-being (Boyce, 2010). Walking consistently and for longer distances (some recommend 10,000 steps per day; others recommend 3,000 or half an hour) is healthy and helps us feel good (or at least better). In addition to health benefits, walking improves social competencies – persons who walk more have better communication and other social abilities (Risser & Šucha, 2020).

Finally, walking is one of the most straightforward forms of exercise during pilgrimage in Saudi Arabia, and it is one that includes a lot of adventure that contributes to the spiritual, mental and physical health. Unlike other activities like as swimming and running, it is a more effective technique of increasing stamina, breathing, and cardiac function while also being less stressful on the body.

2.2.3 ***Walking environmental benefits***

Apart from the many health benefits, walking has been found to offer a number of environmental benefits. Bicycling and walking displace trips that in any other case would have required the use of motor vehicles, enabling society to limit consumption of fossil fuels, associated air pollution, and other environmental damage (Komanoff et al., 1993). Also, automobiles require far more space than the physical road (or pavement) per traveller, whereas walking and cycling have no or minimal effect on others losing space, or even on the choices that others can make. This is because of the differences between the space and speed that vehicles need compared with walking or cycling. Walking gives the freedom to move without restraining others' freedom. On the other hand, by using a car, there are no choices other than forcing others to lose or save time (Tolley, 1990).

Additionally, an array of physical and mechanical activities from roadway transport produces noise. Examples of these physical and mechanical activities include the operation of airbrakes, friction between brake shoes and discs and drums, operation of engines and connected

equipment, engine exhaust, and car tyres moving on surfaces, and the pressure- and transmission induced friction. Added to this is the discretionary equipment employed by the driver. Human health, economic well-being, and urban civility are impacted by such noise (Komanoff et al., 1993).

A notable example that demonstrates such effects is the large body of travel within Makkah. In Makkah, the central area around the Grand Mosque becomes absolutely congested, with both vehicle traffic and pedestrians occupying the same street, which may give rise to both environmental and health problems (Al-Hathloul & Mughal, 2001). In contrast, walking is described as a 'green' mode of transport that not only decreases congestion, but also has a small environmental impact, and also preserves energy without air and noise pollution (Forsyth & Southworth, 2008). Other potential benefits from walkable cities that are especially relevant to the Makkah case include a higher level of social capital and trust (Southworth, 2005), which also corresponds with similar concepts of Islamic traditions, and sustainability of living (Forsyth, 2015). These in turn demand attention in Makkah due to its high levels of pollution, arising from the dominant use of cars as means of transport. As stated by Samet (2011), residential areas need to be away from roadways, and the format of urban areas desires to retain open areas and provide walkable routes, barring the introduction of sprawl. Therefore, as discussed above, walking is an environmentally friendly way to protect the air and avoid environmental damage.

Walking for more shorter excursions can help to maintain biodiversity by reducing pollution. Reduced noise and air pollution are the by-products of this process, which also results in lower emissions that contribute to global warming. The importance of our green areas to communities, plants, and wildlife may be demonstrated by demonstrating their worth to us. Despite the significance of this impact, it has not been investigated in hot arid climate and religious contexts i.e., Makkah.

2.2.4 ***Built environment benefits***

On top of the broader environmental benefits from walking, the built environment has its own benefits. Several studies have been done with the aim of determining how human behaviour is linked to the impact of the environment on human lives.

Physical activity has been identified as a critical aspect in integrating physical activity into daily living (Zuniga-Teran et al., 2017). Effective urban design can significantly improve walkability. Walkability is a four-stage process that is further interconnected; the primary stages are the

physical characteristics of the urban area, the resulting urban design attributes, the perception generated in the minds of users, and the user's reaction (Clemente and Ewing, 2005). Physical characteristics of an urban setting are more objective and quantifiable. These physical elements shape the subjective qualities of urban design. In Saudi Arabia, these characteristics of urban design are then processed and experienced differently by different users, resulting in subjective views with a degree of objectivity. Users' responses to this perception, such as their preferences for a place, the amount of time they spend there, and the amount of area they use, are entirely subjective. All of these elements, incorporating individual reactions, perceptions, urban design characteristics, and physical characteristics impact walking behaviour. By examining these intervening variables, we can gain a better understanding of how the built environment's physical characteristics affect walking behaviour (Parashar & Bnayan, 2020).

Surrounding area, such as the built environment, has its own impact on people's activity and movement. The built environment includes man-made buildings and spaces where people live and work (Roof & Oleru, 2008), and can be categorised as 'either contemporary or traditional, automobile or pedestrian-oriented, and urban or suburban' (Ewing & Cervero, 2001, p.88). The built environment has an influence on people's behaviour and their choice to walk. For example, widening a roadway may improve vehicular flow, but at the same time reduces the space for pedestrians and reduces streetscape amenities. Additionally, the increase in vehicle speeds may be hazardous to pedestrians (Frank & Engelke, 2001). Some solutions have been proposed to successfully deliver a built environment that supports walking. Handy et al. (2005) conclude that land use policies, which were designed to reduce distances between people and their destinations and provide viable alternatives to driving, will reduce the use of the car. From a street design perspective, a successful street design may encourage people to walk. Cervero et al. (2009) suggest that, to encourage walking and cycling, street designs and layouts should be considered and given specific attention to make the street more connected. Specifically, they found that grid-street patterns and small blocks will create dense, highly connected networks. Southworth (2006, p.19) states that the "built environment supports and encourages walking by providing for pedestrian comfort and safety, connecting people with varied destinations within a reasonable amount of time and effort, and offering visual interest in journeys throughout the network". Urban design characteristics influence people's decision to walk, cycle, or engage in any activity within a particular place. For example, if the destinations are not close to each other, or are not safe and attractive, people may not walk (Frank et al., 2003). According to the Quality of Life Program 2020, one of the liveability aspirations within the Saudi Arabia 2030 Vision is to enhance people's walking habits and the quality of the environment in order to be

among the top five liveable countries through urban design. Also, as the strategic decision has been made to support the idea of walkability, urban design should focus on walkability as one of the initiatives that enhance liveability in Saudi Arabia. As has been noted above, the built environment has power over people's behaviour. By the design of an area to make people feel safe, comfortable, and connected to other places, they will choose to walk.

Certain aspects of the urban environment will affect the amount of walking people do for active travel – that is, walking as a part of day-to-day routines, such as getting to work or driving to the grocery store, and this subsequently contributes to the average physical activity level of the population (Saelens & Handy, 2008). The physical characteristics contributing to walkability will be discussed in a later chapter.

The sidewalk or pathway that connects destinations is one of the primary characteristics of a walkable area. There are also features of sidewalks that facilitate walking in many areas that are not implemented. Many neighbourhoods are either in poor condition or without proper sidewalks. When conditions are better, lack of walking activities leads to the underutilisation and abandonment of some walking areas. This takes the lead to the assumption that the improvement of active street design will make walking a preferred mode of travel and substantially easier (Ariffin & Zahari, 2013).

2.3 Walkability Worldwide

Walkability is a term that is frequently used in developing countries to describe how many people walk in a city on a daily basis to carry out activities such as working, travelling, shopping, or simply enjoying the environment (Habitat, 2013). Most of the studies linked to walkability have been conducted in the developed countries of the west. Initially, these studies were motivated by the objective to create sustainable urban centres through making pedestrian urbanism easy while discouraging urbanism based on automobiles. In the later stages, the studies have been a result of the recognition that walking is a critical component of community health and economic objectivises (Mack, 2014).

Cities in rapidly developing countries almost always grow faster than other regions (Pieterse & Parnell, 2014), with consistently lower per capita income and infrastructure capability than in the majority of developing countries. This creates plenty of issues for urban systems, residents, and the overall economy. According to Nantulya and Reich (2002), the number of road traffic fatalities in the developed world is between 55% and 70% of the total. Conversely, in the

developing world, walking constitutes a primary means of transport. However, in parts of the world, walking is closely linked to the poverty prevalent in the rural areas as opposed to the enlightened approach to city life. In these developing countries, the sites tend to have high traffic density, limited space for pedestrians and poor walkability (Lukenangula, 2017; Habitat, 2013). In most cities in developing countries, private vehicles are the preferred type of transportation. People often prefer not to walk in those city centres where there is more congestion, noise, and pollution. In other words, people walk in cities out of need, not because they really want to (Gehl & Gemzoe, 2003).

Gehl and Gemzoe (2003), posit that urban centres may be categorised into four groups: traditional, invaded, abandoned, and reconquered. Traditional cities are those that have not been conquered. To obtain a better comprehension of the manner in which urban structure and its qualities impact reliance on automobiles of the degree of walkability in different cities, they provided examples and physical characteristics of cities fitting the different categories as can be seen in Table 2.1. Due to the rapid development occurring in Central Makkah at present, it is difficult to place Makkah in any one of the types below, as it possesses a mixture of each of them but without a full focus on any particular type.

Traditional	Cities serve as gathering locations, marketplaces, staging areas for military parades and for religious processions and festivals, among other things. Streets are intended to facilitate pedestrian movement, whereas public squares are intended to facilitate communal meetings. The dispersal of uses and size across squares and streets, the cities' sizes and the buildings' scale and detail, all correspond to human percentages and mobility choices and enable daily pedestrian movement.
Invaded	In metropolitan locations where automobile traffic has developed a foothold, public spaces undergo dramatic transformations. Car traffic and parking take up all available space along roadways and even pedestrian walkways, utterly dominating the region.

	When additional constraints and irritants like observable pollution, noise, and dirt are included, urban living becomes visually and experientially unfriendly.
Abandoned	In instances facing a dearth of urban tradition and the automobile culture spreads without restriction, a never seen before type of urban centre sprouts. Automobile-based infrastructure has rendered movement by pedestrians outdated and obliterated. Activities connected with foot movement in public areas have all but vanished. Numerous city centres worldwide are wholly covered in asphalt and those areas without buildings or roads are reserved for parking lots. Physically, it has become absurd and impossible to walk in such areas. Apart from the fact that distances between places are very long, those attempting to walk are faced with filthy, unattractive, and frequently dangerous items.
Reconquered	Some cities have reintroduced walking as a part of their public life practices, such as Barcelona, Copenhagen, Melbourne, etc.

Table 2.1 City categorisation based on physical characteristics. Source: (Gehl & Gemzoe, 2003).

2.4 Walkability in Saudi Arabia

Walkability research has received a considerable amount of attention in the developed nations of the west. In Saudi Arabia and other parts of the developing world, only a few studies have been commissioned in Arabic or English.

After the arrival of cars in the 1950s, Saudi cities moved toward a car-oriented infrastructure. The excellent economic conditions and low fuel rates were major factors in the use of private

transportation and the car infrastructure, which was designed for practical, political, and strategic purposes. This mode of mobility also influenced urban growth and changed Saudi cities' urban environments. This adaption of Western styles and characteristics in the design had a negative impact on many Islamic cities, especially on the urban spatial environment (Elaraby, 1996).

Excessive use of automobiles, fossil fuels, and air conditioning has increased the domestic use of energy (Almatawa et al., 2012). In the majority of Saudi Arabian cities, walking as a form of travel is not completely supported, because the streets were built and improved so that vehicles would drive freely and speedily. The pedestrian infrastructure was therefore neglected and abandoned (Ledraa, 2015).

Saudi Arabian cities are now facing a shortage of city centre maintenance, as seen by the poor state of open spaces, pedestrian routes, and street furniture, which have been ignored by successive Saudi administrations (ibid). Consequently, those who decide to walk often do so because they have no other choice when they need to get to places like the grocery store, school, or work. This is opposed to the view of walking as a recreational activity.

2.5 Defining Walkability Principles

Both the terms 'walkability' and 'walkable' have been discussed, but there is no universally agreed definition. According to the *Oxford Learner Dictionary*, the term 'ability' is defined as 'the fact that somebody/something is able to do something'. Walkability has been defined in many sources. The phrase 'walkable' is defined by the *Oxford English Dictionary* as: 'of terrain, a street, a way, an environment, etc.: that is appropriate, fit or secure for walkers'. Turoń et al. (2017) define the term 'walkable' as a basic principle to create public urban space, and available for pedestrians and welcoming for walkers.

> *"Walkability is the extent to which the built environment supports and encourages walking by providing for pedestrian comfort and safety, connecting people with varied destinations within a reasonable amount of time and effort, and offering visual interest in journeys throughout the network"* (Southworth, 2005, p.248).

In the present study, walkability is defined as the level to which the built environment encourages and facilitates walking by making available to the pedestrians safe and comfortable

links to numerous endpoints based on a fair amount of effort and time and ensuring that the network travels are done in a visually appealing manner.

As Gehl (2011) describes, there are necessary activities that take place under all conditions, which include going to school, work, and shopping, with the majority of those activities related to walking. Additionally, Southworth (2005) introduced six criteria to encourage people to choose walking over driving: connectivity, accessibility, land use patterns, safety, path quality, and path context. Consequently, well-planned neighbourhoods help to raise the number of users walking every day; urban design can be conducive to walking if the principles mentioned above been addressed.

The improvement of urban environments in relation to walking has been the subject of a growing body of research over the past two decades. Successful urban design is defined by the effective integration of people into the urban environment (Turner, 2014, p. 56). Walkability is viewed as an essential element of urban quality. It is a measure of how pedestrian friendly an urban environment is (Bieri, 2017, p. 30). The dominant modernist planning approach (based on the principles of CIAM and the Charter of Athens) during the second half of the 20th century separated residential areas away from business districts thereby creating disconnected cities – which led to ever increasing levels of traffic congestion. Walkability is concept that is found in postmodern cities. In the 1960s, it reflected new thinking in urban design away from the modernist model which neglected the traditional role of the city as a social setting that allows people to interact freely.

2.5.1 ***Connectivity***

As a feature of walkability, connectivity is an important theme when understanding a city or neighbourhood. Academic researchers around the world claim that street networks are the key to connectivity. Moughtin (2007) posits that a street is not just a conduit but rather an array of linked places. Frank et al. (2003) categorises street networks into three general types, which are organic, grid, and hierarchical, with both grid and hierarchical falling into the planned growth category as opposed to organic growth. Morris defines organic growth as “the natural, unplanned process whereby an urban settlement evolves from a village origin” (2013, p.8). Frank et al. (2003) explains the characteristics of organic streets, which are narrow and winding; most often, the multiple interconnected streets form small, tight blocks, allowing for short distances and multiple linkages between destinations, yet these features are rarely found in modern urban design and mainly exist in the older cities.

In contrast, grid systems are planned for a network of high connectivity. They are a straightforward arrangement of two sets of parallel streets crossing at 90 degree angles to produce rectangular or square blocks. In the hierarchical type, the streets are based upon vehicular traffic movement, not that of cyclists or pedestrians, as it totally depends on the scale of the grid. The path network's connectivity relies on sidewalks and other paths for pedestrians and by the level of way continuity and lack of critical impediments (Southworth, 2005). Marshall (2004, p.120) discusses different kinds of route properties and states "connectivity is taken as the number of routes with which a given route connects (c). Connectivity reflects both the number and nodality of joints along a route". In terms of time-saving and people's comfort, Southworth mentions the benefits of connectivity as connecting people with different destinations in a reasonable time and providing an interesting environment during their journeys along the network. Moreover, by making people a priority over traffic and linking land use with transport, places become more connected and accessible to all users (Department of the Environment, 2000).

The findings from different studies conclude that connectivity is primarily associated with the density of intersections and block sizes. The type and density of intersections have a major impact on people's movement around a place, whether by walking, cycling, public transportation or (Gebel et al., 2005). Gehl (2011) posits that the most crucial demands that need to be met by a pedestrian arrangement is to ensure that pedestrian movement allows the walker to use the shortest distance between two endpoints. Some design solutions that have been addressed by multiple sources will be the key to increased connectivity (ibid). Connectivity refers to the number of routes via an area (Bentley et al., 1985), and/or intersection length and its design, street design, and other entry points (Pikora et al., 2003; Brownson et al., 2009). Southworth (2006) states that there is usually a correlation between the small block sizes, high density of interactions, and high level of connectivity. Therefore, block sizes and a high degree of intersection could be revealing. Intersection density is the most used objective measurements of connectivity (Brownson et al., 2009). Frank et al. (2005) have identified an important association between moderate physical activity and intersection density. Other metrics include the number of three-or-more-way intersections by unit area or the number of intersections by road length (Brownson et al., 2009).

Small block size and street accessibility are critical in helping a neighbourhood be walkable (Giles-Corti et al., 2009). Connected streets and small blocks enable more convenient routes than larger blocks and unconnected streets. They also have a greater number of alternative routes than do comparatively large blocks. Smaller blocks can break up the streets while larger

ones can cause monotony and be repetitive. Smaller parcels will allow for more blocks and intersections, which will increase connectivity between destinations; larger ones will decrease it (Frank et al., 2003). In contrast to this, Saelens et al. assure readers that streets that are laid out in a grid pattern, with few walls and freeways, have high connectivity to direct travel between destinations.

Numerous scholars, as well as practitioners, have stressed the relevance of the size of urban blocks in increasing walkability (Ewing, 1999; McNally, 2010). McNally, for example, provided a plausible explanation by stating:

> *"Typically, shorter block lengths lead to greater accessibility throughout an area for pedestrians. Shorter block lengths allow for increased opportunities for crossings and provide more direct routes for pedestrians, as well as limiting the time automobiles have to accelerate after intersections. Shorter block lengths also tend to disperse traffic, resulting in fewer roads that are heavily congested by automobiles"* (McNally, 2010, p.11).

Plowden (2001) proposed that three factors are important for people to walk and spend time on the town streets. It is important that stores, schools, parks, workplaces, and public facilities are within a fair walking distance. Connectivity highlights a well-connected urban environment with increased service quality for large numbers of pedestrians. The availability of multiple options, multiple opportunities, and multiple levels of relationship needs to be explored.

The selection of various modes of urban transit, such as the availability of good and efficient public transportation, cycle paths and sidewalks that are both accessible and continuous, and the balancing of the infrastructure's needs to adapt to the different uses that the streets could be put to. They also need to be maintained or preserved.

Carney (2000) asserted that pedestrian comfort is contingent upon the street's 'directness' and 'continuity'. When it comes to the habitats of various species, connectivity is important, meaning that is how easy it is to move from one place to the next. Two critical aspects of connectivity exist: a particular habitat's persistence and the ability of individuals to move across or between distinct types of ecosystems (functional connectivity) (Andersson, 2006). Burton and Mitchell (2006) have proposed that external elements and effects, such as street configurations that physically connect one another, and allow direct views along them, all combine to create connectivity, and that simple junctions help to create accessibility.

Connectivity takes the role of being permeability's functional skeleton (the perceptual ease of mobility within an area). These have to be considered when determining walkability. Not only should the road structure have considered, but also all pathways, formal and informal, and access points. Connectivity is one of the built environment features that is consistently related to a higher level of physical activity (Sallis et al., 2011). Considering the discussion above, it could be noticed that none of the studies were performed in Saudi Arabia. Thus, this will help to design a well-connected area that helps the pedestrian to reach their destination which will, in turn, increase the walkability. As can be seen, connectivity affects the degree to which networks such as streets and walking paths connect people to their destinations.

2.5.2 ***Accessibility***

Beyond providing a well-connected path network for pedestrians, it is important to link and make destinations accessible for all users. Accessibility is another crucial aspect in developing a walkable environment; businesses, activities, and public services must be readily accessible along streets (Jacobs, 1993). Within the city, streets and buildings should be built in a manner that makes them available for all types of users, including those who have mobility and other impairments. An analysis of the literature shows that the terms "accessibility" and "access" are indiscriminately used in literature. However, the word access can be employed to denote accessibility and an individual's perspective when considering the perspective of a location (Geurs & van Wee, 2004).

Access denotes the capability to get to a specific destination based on geographic distance (Talen, 2002). Lynch (1981) suggests 'access' as the main feature of urban form. On a city scale, accessibility is defined as the capacity to successfully meet a pedestrian's daily demands with minimal travel distances and expenditure (Duany et al., 2010). People need to have an accessible and reliable transport system that offers access to basic services. Accessibility helps the individual to meet, enter, walk, and move through areas they wish to visit; accessible streets are connected with local services and facilities which require wide paths, flat footpaths and ground-level crossing signals controlling the pedestrian crossings (Lynch, 1981; Burton & Mitchell, 2006).

Burton and Mitchell define accessibility as

> *"The extent to which streets enable people to reach, enter, use and walk around places they need or wish to visit, regardless of any physical, sensory or mental impairment. Accessible streets have local services and facilities,*

are connected to each other, have wide, flat footways around level signal-controlled pedestrian crossings" (Burton & Mitchell, 2006, p.92).

Accessing the basic amenities or services in a neighbourhood within a short distance is an essential requirement for all residents. Likewise, Yang (2018) describes accessibility as an important way to reach destinations within walking distance of a particular property.

Neighbourhood walkability, and thus accessibility, are closely correlated with the quantity and variation of services or destinations reachable within a short walking distance (Gilderbloom et al., 2015). Southworth (2006, p.20) discusses the necessity of accessibility within a neighbourhood, claiming that "a walkable neighbourhood or city has an accessible pattern of activities to serve daily needs. This means that one can reach most local-serving uses on foot within 10 to 20 minutes or up to ½ mile". Cambra (2012) describes good pedestrian accessibility as having a variety of options within walking range that are easy to access. Handy et al. (2005) conclude that increasing accessibility may lead to a decrease in driving. When destinations like health facilities, dining places, and other services like post offices, banks, grocery stores, and shops are close enough, they encourage people to walk for different trip purposes (Cerin et al., 2007). Ewing and Handy (2009) established that different groups and communities have uniquely preferred aspects that constitute a walkable neighbourhood. In their conclusion, they highlight that a walkable city is one whose dwellers, regardless of their ages, can access their community with significant ease, without the aid of an automobile. The findings by Hume et al. (2007) revealed that a walkable city needs highways and streets with designs and constructions that provide comfortable and safe facilities for use by pedestrians.

Whyte (1980) proposes that in order for a public area to be accessible from a physical sense, barriers to entry should be absent. Such a place also needs to have good connections to the circulation pathways. The same scholar notes that a critical part of access is the connection of a place to nearby sidewalks. Thus, accessibility by pedestrians is also a defining characteristic of walkability, which is defined as the role of proximity to a desired destination or a mix of land use and mobility network connection (Tal & Handy, 2012).

According to Tolley (2003), accessibility can be classified by walking purposes and can be explained as:

- Access mode, or a function such as walking to work, stores, or an educational institution.
- Access sub-mode is the basic form of access to public transportation services.

- Recreational leisure mode consists of walking for the sake of walking, or walking the dog.
- Circulation exchange mode, in which visitors participate in social or cultural events held in public areas, such as window shopping, talking to neighbours, or enjoying a drink at a pavement cafe.

However, Burton and Mitchell (2006) state that sidewalks have to be at least two metres wide to enable wheelchair users to easily pass approaching pedestrians and to allow individuals to move further away from the motorised vehicles alongside on the road. Additionally, they noticed that moderate slopes and stairs are easier to perceive and negotiate for the elderly, as well as persons using wheelchairs, walking frames, pushchairs, and shopping trolleys. However, all stairs and ramps may be made accessible to provide easy access to the sidewalk.

Physical access refers to the physical availability of the place to the public, whereas physical exclusion refers to the inability to access or utilise the environment, regardless of whether it can be seen into (Carmona et al., 2010). People have to feel welcomed by spaces to make them accessible – in basic terms, if you do not feel welcome somewhere you are unlikely to access that place/space. The perceptual component of urban design is valuable because it places an emphasis on how people perceive, evaluate, and both gain meaning from and contribute meaning to their environment. Places that are 'real' to individuals invite, require, and reward participation – both intellectual and emotional – and create a sense of psychological connection.

Numerous physical barriers hinder many people from accessing the public realm – the physically impaired, the elderly, those pushing children in pushchairs, and pregnant women, to name but a few. For example, Hall and Ram (2019) examine how persons with disabilities view the built environment as a series of obstacle courses:

> *"Most buildings are not wheelchair accessible and few contain sufficient tactile colouring or colour contrasts to enable vision-impaired people to navigate with ease. The design of specific items, such as doors, handles, and toilets, are also standardised to the point whereby many people with a range of physiological and/or mental impairments, find them impossible to use"* (Hall & Ram, 2019, p.409).

All of the items mentioned above are essential for promoting and enabling walking. Walkability offers the ability to access the transit infrastructure as well as the ability of the walkways to connect to one another (Pikora et al., 2003; Southworth, 2005). Furthermore, easy access to particular destinations relates strongly with people's willingness to walk to them (Frank et al.,

2003; Saelens et al., 2003). Therefore, the distance that a pedestrian walks and the accessibility with which they are provided should reduce the expense of transport and shorten travel time. Scholars propose that proximity, connectivity, and accessibility are essential concepts to facilitate walking (Frank et al., 2003; Handy et al., 2002).

In this case, Central Makkah would qualify as walkable if its people could walk more in safer, friendlier, and healthier neighbourhoods. Ultimately, the city would need to exhibit coherence that was evident in clear, organised, and understandable streets and sidewalks and in land use systems that were consistent with their urban functions and scales. In summary, accessibility relates to the ability to reach a variety of destinations from home by walking or via the transportation system and is an important aspect of encouraging walking.

Makkah's public transportation system is fairly extensive, including of trains, buses, taxis, and ferries. Each year, millions of pilgrims travel via these systems. Public transportation and pedestrian activities complement one another, as most people walk to and from public transportation. The more comprehensive the public transportation network, the more benefits may be realized from walking. Greater pedestrian access has a substantial structural advantage in Makkah. In this case, Central of Makkah would qualify as walkable if its people can walk more in safer, friendlier, and healthier neighbourhood. Ultimately, the city would need to exhibit coherence, which is evident in clear, organized, and understandable streets, sidewalks, and land use systems that are consistent with their urban functions and scales. In summary, accessibility relates to the ability to reach a variety of destinations from home by walking or by the transportation system and is an important aspect of encouraging walking.

2.5.3 ***Mixed uses and activities***

Further to accessibility, studies show that mixed-use sites also encourage walking. “Sites with a concentration of mixed land uses and activities need to offer a continuous, fine-grained network of walkways that allows people to walk safely between land uses and activities” (Moudon et al., 1997, p.17). “If activities are close enough together to make walking easier, such as in areas of mixed land uses, then more people will walk” (Forsyth et al., 2008, p.1978). Saelens et al. (2003) demonstrate a clear example, addressing the benefit of mixed uses in a particular area:

> *“In older cities there are many residences above street-level shops, making it more convenient to walk to shops or to get to work. In modern suburbs, different land uses are purposefully separated, so it may be practically*

> *impossible to walk from one's home to the nearest shopping centre or place of employment"* (Saelens et al., 2003, p.81).

Moughtin (2007, p.194) further emphasises that one of the most attractive aspects of city life is the proximity to places of work, shopping, and basic social, educational, and recreational amenities. Distance is an important barrier to non-motorised travel; mixing uses is believed to be an important strategy to increase travel on foot or by bicycle (Frank et al., 2003). In many situations, simply having sidewalks and diversified land uses qualifies as a walkable environment. The primary issue with this current state of practice is that when this occurs, the term "walkability" loses significant significance.

As Frank et al. (2003) contend that mixed uses have greater impact on a smaller scale rather than a regional scale, in light of the fact that they will influence car and transit usage; so, they should be on a localised scale in order to impact physical activity. Owens (1993) explored a phenomenon called 'grain', defined as the 'shape, size, and texture of the various zones of activity'. From the study of two neighbourhoods, he found out that when mixed uses are organised as linear fingers or small nodes, the walking distances between them will be shorter, and the opposite applies when uses are on a large scale. A review of 13 prior studies of walking and building environments, conducted by Saelens and Handy (2008), found strong support for walking and two overlapping measurements of different land uses: distances to destinations via walking and land use mix. They also examined prior studies that had demonstrated mixed usage of land for leisure or other activities and for walking as a means of transport. During most of those studies (2005–2006), they observed that the association was maintained between mixed uses and walking as transport, rather than walking for leisure.

Southworth (2006, p 20) asserts that "a small pedestrian district, no matter how well designed, cannot contribute to a reduction in automobile use if it is not well supported by transit and situated within an accessible mix of land uses". Forty-four alternative walkability measures were analysed and showed that further movement is associated only with social land use measurement (e.g., for stores and parks) (Forsyth et al., 2008). On the whole, there is a strong relation between mixed-use sites and physical activity, including walking, and an impact on its increase and decrease.

On the whole, here is a strong relation between mixed-use sites and physical activity including walking and has an impact on its increase and decrease. Besides, in lower-density communities

overseas, planners attempting to revitalize cities have emphasized mixed-use development and enhanced public transit to attract pedestrians. However, urban streets in central Makkah are frequently congested because to high densities, diversified land uses, an efficient public transportation network, and a tradition of satisfying recreational and social requirements outside the house.

2.5.4 ***Safety and security***

Another important aspect is safety. Many sources discuss its various dimensions, such as traffic safety and personal safety. Jacobs (1961) claims that it is a major task for the city to keep its streets and pavements safe Another major element in determining the level of physical activities is pedestrian safety. Safe and pleasant conditions encourage walking (Brown et al., 2007). Dong (2017) also states that when a street is walkable, it attracts more residents and visitors to use it. This means that more people are out in the street and others can join them because they feel safe among a crowd. If spaces are designed to allow convenient, enjoyable, safe, and useful walks, more people may choose to walk (Brown et al., 2007). Speck (2013) linked block size with pedestrian safety, as bigger blocks mean fewer streets, which will be both harder for pedestrians to cross and easier for vehicles to speed on.

Additionally, walking brings in life into streets, and liveable streets promote the overall safety of urban environments. The influence of walking on community safety, accessibility, and social inclusion has risen as a particular challenge to the design of the urban environment (Evans, 2009). On the other hand, there is evidence demonstrating that accessibility and connectivity increase crimes, with some criminologists stating that the permeability of walkable neighbourhoods may undermine safety. Jacobs (1961) commented on the way to increase the safety of the street:

> *"There must be eyes upon the street, eyes belonging to those we might call the natural proprietors of the street … the sidewalk must have users on it fairly continuously, both to add to the number of effective eyes on the street and to induce the people in buildings along the street to watch the sidewalks in sufficient numbers"* (Jacobs, 1961, p.35).

Increasing the number of pedestrians may support the theory of 'eyes on the street' and subsequently increase safety; whereas the findings of the research by Cozens and Love (2009) indicates that neighbourhood permeability may possibly be manipulated through pedestrian

access ways (PAWs) to accomplish the intended results of increasing safety and improving walkability, liveability, and, ultimately, community sustainability and well-being. The usual situation on typical Central Makkah streets is that most of the time they have pedestrians during the day and the late night visiting the Grand Mosque, which increases the eyes on the street as well as safety.

A balanced density is critical in making a safe place. The density ought to be more prominent than a conventional suburb, but not as tall as a high-rise tower (to avoid overcrowding and the resultant increase in crime) (Newman, 1972). Jacobs (1961) "believe that continuous users (including residents and strangers) on streets and sidewalks maintain the number of eyes on the street, making the neighbourhood safer by providing natural surveillance and guardians", as cited in Dong (2017). These findings support the idea that when a neighbourhood is more walkable the residents tend to perceive it as safe (Foster et al., 2010). This can be read to mean that where the level of walkability in a neighbourhood is medium, improving it will not present an additional threat to the area's safety (Dong, 2017). Recent work concludes that land use and safety constitute important elements for both walking motivations. This makes available empirical proof with the potential to guide development toward neighbourhoods that are safe for cyclists and pedestrians and facilitate an amalgamation of land uses to augment physical activity (Zuniga-Teran et al., 2017, p.72).

Safety issues influence our understanding of safety, and thus urban spaces are viewed as less secure than they really are. Burton and Mitchell (2006) claim that protection is an important feature of the streets in people's lives. Safety considers streets with the ability to allow individuals to make use of, take pleasure in, and walk through the outdoor world without being afraid that they may trip, slip, get run over, or be mugged (Jacobs, 1961). It deals with many other environmental issues such as fast-moving cars, air pollution, water toxicity, etc. (Rapoport, 1990; Carmona et al., 2010). On the streets, though, safety primarily concerns traffic safety, based on the work of previous scholars. As Al-Azzawi (2004) claimed, if pedestrians are free of interference by other street users, and injuries or crowding, this will also encourage walking on the street.

Different categories of people experience varying degrees of safety on an urban street. Numerous studies suggest that, across different times and cultures, women, girls, older adults, and individuals with impairments have been targets of attacks out in public areas, making them feel unsafe and uncomfortable about walking there. Consequently, this study will identify the differences between various groups of users. The significance of their characteristics and factors

contributing to safety will be examined in greater detail in a later chapter of this research. Papaioannou et al. (2007) have carried out a study whose conclusion was that the key reason pedestrians believe that they are endangered is driver conduct, and that pedestrians sometimes do not cross the road fast enough. Most people over 50 find it challenging to cross the road and those aged 66–80 feel unsafe.

In developing countries, various road conditions, such as poor crossing conditions, a lack of space between automobiles and pedestrians on busy roads, and a combination of inadequate street lighting and a high volume of people walking at night and merchants on the roadside all have an effect on pedestrian safety (Tulu et al., 2013). When confronted with poorly located or poorly built crossings, pedestrians often do not cross the road, which has adverse economic implications for businesses on the other side of the street; or people cross the road but do not use the designated crossing point, which has adverse road safety consequences (De Arruda Campos et al., 2003).

In brief, safety is considered as fundamental to the quality of life and one of the walkability's principles. However, it was not given sufficient attention in the literature. Therefore, in order to improve walkability/physical activity streets and pavements should be safe for walkers. The direct conflict between pedestrian and vehicle traffic is dangerous where it increased the accidents in Saudi Arabia in general and should be prevented in particular for the aged, women and children. The growing number of cars entering the central city contributes to heavy traffic, noise and pollution, particularly around Al Haram (Al-Hathloul & Mughal, 2001).

2.5.5 ***Comfort and attractiveness***

Comfort is a fundamental necessity for users in urban areas; it is an indication of suitable public spaces. The amount of time someone spends in a public area relies on the purposes for which they use the space and how comfortable they are with it (Carmona et al. (2010). Hence, it is impossible to understand how other requirements would be addressed without comfort (Carr et al., 1992). Comfort corresponds to a person's degree of ease, convenience, and satisfaction, and is subject to various external influences including weather conditions, physical condition, perceived protection, familiarity with the place, other people, and convenience (Mehta, 2008; Alfonzo et al., 2008).

As Cambra (2012) said, the choice of walking as a mode of transport is not purely about accessibility. It is also based on the perceived attractiveness of the surrounding built

environment. Historically, urban design has played a significant role in determining the built environment's attractiveness. Access by individuals with diverse needs, particularly impaired access, is necessary for comfortable walking (Carmona et al., 2010).

Comfort denotes the degree to which the streets make it possible for individuals to visit places they want. Comfortable streets are calm, inviting and pedestrian-friendly (Glanz et al., 2012). Speck (2013, p.10) defines a comfortable walking as that which "buildings and landscape shape urban streets into "outdoor living rooms," in contrast to wide-open spaces, which usually fail to attract pedestrians". Carmona et al. (2010) define and explain the meaning of comfort in space: if people can see into an area before they enter it, they can judge whether or not they would experience comfort and be welcome and protected there. "Comfort is a prerequisite of profitable public spaces. The length of time people remain in an open space is a feature and an indication of its comfort" (Carmona et al., 2010, p 165).

In the case of urban streets, being comfortable requires being able to travel from one location to another without becoming mentally and physically uncomfortable. Comfortable streets are those that are quiet, accommodating, and pedestrianised, with appropriate facilities and services (Burton & Mitchell, 2006).

Streets and sidewalks have to be structured to make walking as comfortable and effortless as possible. Carmona et al. (2010) explain the kinds of features that are successful in this regard; pedestrians will desist from using spaces they feel are uncomfortable. The use and experience of pedestrians in the city environment depends on such elements like weather conditions and pollution. Certain design types can assist in creating conditions that are preferable together with space configuration, and creating shelter and shade using arcades, canopies, trees, walls, and buildings.

> *"Overall, the qualities that may affect comfort levels include urban form features that affect the relationship between the pedestrian and motorized traffic (e.g., traffic calming elements, speed limits, the width and length of streets, and the presence of buffers), the condition of the pedestrian walkway system (e.g., sidewalk widths and sidewalk maintenance), urban design elements intended to offer protection from unfavourable or extreme weather conditions (e.g., canopies and arcades), and features that provide amenities throughout a setting (e.g., street benches, drinking fountains, and other street furniture)"* (Alfonzo, 2016).

Southworth (2005) states that pedestrian paths ought to be continuous, without gaps, and should have a moderately smooth surface without pits, bumps, or other inconsistencies that might make walking and wheelchair access troublesome or unsafe.

Alfonzo (2005) showed that the environmental qualities that support and promote walking have an effect on an individual's level of comfort. Kumar (2009) said that appropriate design, materials, walking space, human size, and suitable surfaces for walking in open space were all critical drivers of pedestrian comfort. Pavements and street networks must be well designed and managed to ensure the comfort of pedestrians (Hence et al., 2006). Additionally, some research indicated that pedestrian walkways and pavements that connect people to regular transportation services with safe crossings are often used (Lo, 2009).

Attraction is also an important factor that can encourage and increase usage of the street. Suppose a particular space makes it attractive to talk, listen, view, stand, or walk, that space is perceived as having the required quality. However, an additional capability is that a large array of other activities for example community gatherings, sports, and play will have a specific basis for improvement. Southworth (2006) also explains the importance of design details, that if the area is empty and dejected, lacking stairs, gateways, holes, and niches, it could be a huge challenge to find places to stop. In general, pedestrian travel is negatively affected by adverse surface conditions. For example, people will steer away from wet and slippery pavements, slush, snow, or water whenever they are inconvenienced under these conditions (Gehl, 2011).

Based on the above discussion, it appears that design details on streets or sidewalks may have their advantages for people's decision to walk and use the space. The physical design of space may enhance the comfort and attractiveness that people need in order to use it. Plowden (2001) suggested that street spaces must be visually attractive in the wider context. This implies that they are well designed, unaffected by motorised vehicles, accessible, clean, safe, and attractive. The third way to motivate individuals to walk is to create a necessity or incentive for them to do so., where functionality and attractiveness are not enough in themselves. Comfort may be characterized as the existence of benches, street trees, or a suitable street orientation, while comfort can be defined as the presence of mixed land uses, adequate connection, and accessibility. Any one of these assumptions, on the other hand, might be erroneous. As a result, as is obvious, the ambiguity of the definition allows for a subjective interpretation of what may be considered walkable.

2.5.6 ***Sociability***

Walking can promote a social environment spatially when the area has mixed use or high density. Speck (2013) explains:

> *"Walkability is both an end and a means, as well as a measure. While the physical and social rewards of walking are many, walkability is perhaps most useful as it contributes to the urban vitality and most meaningful as an indicator of that vitality … Get walkability right and so much of the rest will follow"* (Speck, 2013, p.6).

Most compelling evidence indicates that walkability plays a big role in making a liveable and sociable city. Walking is becoming increasingly important to urban settings and communities. Thus, can be attributed to the fact that the link between socially dynamic neighbourhoods and walking becomes obvious. Built environments that make it easy to walk to different places tend to be more desirable for people looking for homes. Consequently, the values of properties in such areas are higher, lifestyles are healthier, and they have a high degree of social cohesiveness (Jane's Walk, 2013 as cited in Forsyth, 2015).

One of the core purposes of the street is to serve as a stage of social interaction in public settings (Frank and Engelke, 2001). Gehl (2011) states that where the quality of a space is improved, this allows recreational functions and social activities to develop. There are positions that support people socialising in an urban area, such as standing and sitting. Each of these positions requires some design details that will make the space useable. Primary and secondary seating are the two types of seating that may cause people to stay for a longer time in order to socialise. Regarding primary seating, where the need for seating is limited, benches and chairs should be provided in line with users' demands. Stairways, pedestals, steps, low walls, and boxes will form secondary seating when it is necessary for the times and the demand for it is especially great. Another position is standing, which does not make demands on the physical environment when compared with sitting. The purposes for standing may differ from one situation to another: for example, stopping for a moment, standing to talk, and standing for a while. Standing in order to talk can be categorised as a necessary action and one which needs a suitable place. For example, in many southern European cities, specifically in the campo in Siena, square bollards are found as well-defined supports for standing and longer stays (Gehl, 2011). Providing places to sit and stand have a direct influence on people to start a conversation. Whyte (1980, p.94) uses the term 'triangulation' to describe "external stimulus [that] provides a linkage between people and prompts strangers to talk to each other as though they were no". Then, he introduces

items that may have strong social effects on pedestrians such as sculpture, where people can stand under it, touch it, and talk about it. Also, he further discusses street musicians and entertainers and their duty in a space that can draw people together and open a conversation with neighbours. In short, walking can create a social environment in a space with a physical design where people can sit and stand to generate conversation and make the space more active.

People living in walkable neighbourhoods with mixed uses are more likely to meet their neighbours, engage in politics, trust others, and be socially engaged (Leyden, 2003). As people walk, they feel and build a sense of place. This strengthens connections and creates the perception that social space is one whole that is structured in a coherent manner, created of sync-space routines in the daily life of individuals. Sensory and social experiences from our regular walking activities often cultivate a feeling of identity, familiarity, and emotional connections and thoughts regarding specific urban areas (Wunderlich, 2008). A walkable neighbourhood has the potential to encourage social connections and enhance group engagement, resulting in greater social capital. The term "social capital" refers to the social networks and interactions that promote citizen trust and reciprocity. (Leyden, 2003), and it is a significant factor in physical health and mental well-being (Rogers et al., 2011).

Comfort may be characterized provided by certain public infrastructure projects are restricted to a specific social group. For example, public parking lots and road infrastructure are primarily intended for automobile owners, but pedestrian settings such as sidewalks are open to the whole public.

2.6 Urban design qualities influencing walkability

According to Moudon et al. (2006), the definition of a walkable area involves more than merely the ability to walk. Walkability, they suggest, not only refers to mobility or the ability to move; it also refers to sociability with one's neighbours, which has an effect on the physical, mental, and spiritual health of the entire community (Moudon et al., 2006). This statement broadens the concept of walkability beyond *physical* features to include additional aspects such as the presence of other people as a critical component in creating a walking-friendly environment. Unlike car drivers, who prefer an empty road, walkers prefer to see other people on their journey (Burden, 2009). Pedestrian travel, therefore, is about more than just getting somewhere, although that is the ultimate goal. While walking, individuals encounter other pedestrians, exchanging smiles, courteous remarks, and even engaging in brief conversations. According to

Allan Jacobs' book *Great Streets* (1993), pedestrian-friendly streets are magical because people want to be there rather than merely travel, and they are as delightful as they are useful.

As stated by Lovasi et al. (2008), walkability is described as an environment that promotes and encourages walking. To encourage people to walk, not only must the environment be comfortable, but it must also be aesthetically appealing and engaging. Because the walking pace is limited, individuals have a better view of their surroundings; hence, the visual quality of the surroundings is vital. Whatever the reason for walking, nobody enjoys doing so down streets lined with massive blank building façades. A pleasant and interesting walking experience is enhanced by factors such as trees giving shade, groundcover, flowers, and store window displays.

Few studies attempt to address the dearth of empirical studies about the association between urban design qualities and walking. The first of these established measuring techniques for nine prominent urban design characteristics in the literature (Ewing et al., 2005; Clemente et al., 2005). Following that, five of the nine urban design qualities associated with walkability have been effectively operationalised as urban design metrics (also known as urban design measures and urban design attributes): imageability, enclosure, human scale, transparency, and complexity (Ewing & Handy, 2009). Additionally, the studies investigating walkability in the hot a rid areas and religious places are very scarce. Accordingly, the current study aims to fill this gap through reviewing the urban design qualities that influence walkability in Saudi Arabia.

Figure 3.1, produced by Ewing and Handy (2009), depicts the link between the built environment and walking behaviour, as well as the role of urban design features in that interaction. While urban design qualities are influenced by physical features (as detailed in Chapter 3), they are distinct. They indicate how individuals perceive and interact with their surroundings in general.

As Ewing and Handy (2009) emphasise, these urban design qualities are distinct from those such as a sense of comfort, feelings of safety, and the degree of interest, which reflect how an individual reacts to a place – how they appraise its circumstances in light of their preferences and perspectives. Perceptions are precisely that: they are perceptions. They may elicit a range of responses in various individuals. Further discussion can be found in the following sections, explaining each quality concept and comparing it to the case study.

2.6.1 ***Imageability***

A key theme in the area of urban design is the importance of creating a sense of place, which is critical for imageability. People primarily experience, live in, and use the city in the settings they meet throughout their daily activities, creating a general picture of a city not just designed for special occasions. When designing urban areas, the “sense of place” concept in the human emotional attachment to their daily surroundings is important. Every location has a sense of place, even in instances where such a sense might not be deemed desirable (Lang, 2006). According to Lang, sense of place is concerned with two issues: social and psychological. The first is concerned with a society’s or individual’s sense of place within a bigger social unit. On the other hand, the concern of the second is with a sense of belonging to an area and its culture (Lang, 2006). Lynch's concept of 'imageability,' or the amount to which aspects of the environment leave an impact on individuals and an individual’s sense of a place, are also closely related (Lynch, 1960).

According to Lynch (1960) place image is a result of a bidirectional communication process involving an observer and their setting. Therefore, identity, image, and place are interconnected and somewhat replace each other. Carmona et al. (2010) notes that this mix contains a person’s sentiments and perceptions about the place. Lynch (1960) posits that an urban picture is made up of five physical elements: landmarks, nodes, districts, boundaries, and routes (incorporating streets). On the other hand, Rapoport (1977), the creation of place pictures happens through the use of ‘all senses’, including socio-cultural characteristics, visible indications of human activity, visual form, and people engagement.

The characteristics of a place that make it unique, identifiable, and distinctive are often referred to as "imageability" in urban design literature. Moreover, when “specific physical elements and their arrangement capture attention, evoke feelings, and create a lasting impression”, this is referred to as high imageability (Ewing et al., 2006, p. 6). It was found that the imageability of videos had a clear and substantial relationship to the total area walkability grade provided by the expert panel of urban design and planning specialists (Ewing et al., 2005). While the Walkable audit tool by Ewing and Handy (2009) has been created, these essential elements (such as sense of place and imageability) remain uncommon in walkability research. Imageability indicates uniqueness, although this uniqueness might be attributable to good or bad aspects of the surroundings (Lynch, 1960).

Incorporating imageability as a predictor of walkability into the theoretical model developed by Ewing and Handy (2009) is an exception to the rule. Imageability is defined as the characteristic of a place that distinguishes it, makes it identifiable, and makes it memorable (Ameli et al., 2015), a concept that is possibly connected to interestingness. They further continue that imageability is operationalised on the basis of objective criteria like the existence of outdoor dining experiences, building with intricate designs, iconic and historic architecture, vistas and landscape views, and existence of places for public gathering.

An imageable place is defined as having characteristics that distinguish it from other places while also being easily recognised. When the physical components and their arrangement make a substantial impact, feel familiar, and remain in people's memories, then that place has a high imageability (Ewing et al., 2005). As a result, the studies shown in this part make it evident that the imageability level can have an impact on the general quality of a specific urban environment.

Today, an overview of Makkah may be defined as a mixture of architectural styles that represent the city's diverse population. The city appears from any approach point with a backdrop of unstructured and unplanned shelters and small buildings that cover huge portions of the mountains where the majority of foreigners reside, and a mixture of modern buildings that include houses and other buildings (Al-Hathloul & Mughal, 2001). The horizon of that image is defined by modern high-rise buildings, which are mostly utilised by pilgrims and visitors during the Hajj and other seasons. This diverse combination of influences may represent Makkah's cosmopolitan status among the Muslim world as a hub for gathering and thought exchange, absorbing influences from other places.

2.6.2 ***Human scale and sense of enclosure***

To be pleasant, the street needs to have a sense of enclosure (Oktay, 1990). The human scale is widely recognised as a critical factor affecting total walkability (Ewing et al., 2005). Place works on a range of scales (Montgomery, 1998), and scale-related issues might include the following: land use scale, comprising land use concentration, land use types, and land use variety; the demographic scale incorporating issues like resident wealth and commonalities within a community; urban form including such issues like population and employment density,

permeability, and the city's size and spread; and the city's scale, involving the proportion of building heights in comparison to street widths, creating intimate or majestic areas.

For Cullen (1996), enclosure is described as a place that creates an entirely private world, one that is self-sufficient, static, and inward-oriented. Regarding the degree of enclosure provided by streets, width and height have a huge role to play. In the physical sense of the term enclosure, a street is defined by a sequence of buildings on either side, where the road's width's ratio to the enclosing building's height is vital for effective street design (Moughtin, 2007). All feeling of enclosure is lost in instances where a street is either too long, too wide or both, with two-story homes (low in proportion to the width) arrayed along a shared façade (Carmona et al., 2010; Rapoport, 1990; Moughtin, 2007). Jacobs (1996) also observed that a larger street requires greater bulk, or height, in order to be clearly defined. Moreover, street avenue plantation, dense plantation, or both may do nothing to elevate the mood and alleviate boredom of an otherwise open street (Moughtin, 2007). Nonetheless, Gibberd's further advice in Moughtin (2007) regarding the designing of streets is that a broad street is inappropriate for commerce and that a narrow pedestrianised city street with an uninterrupted enclosing wall somewhat taller compared to the street width creates a place that is both functional and appealing for example for shopping. Because of the physical shape of the development, Moughtin (2007) noted that small streets also encourage shopping by facilitating moving from either side of the road to the other to gaze in windows. Narrow streets are, therefore, not a hindrance and, in fact, are attractive.

Scale is associated with a sense of enclosure and place. It is necessary to compare one set of dimensions with another to establish a feeling of a place Oktay(1990) proposes that the link between urban space and building and the size of the human population plays a central role in achieving that sense of place. Concerning these high-rise buildings, they often do not generate human-scale open space. As a result, they demolish the townscape and social life, encourage crime, overpower spaces adjacent to them, and impair the quality of views, air, and light in the urban environment (Alexander et al., 1977). The unit's scale, also called the 'human scale', denotes the ratio of height to breadth measured along a section line and is connected to spatial quality (Oktay, 1990).

Streets that are narrow (6–9 m) and have surrounding buildings that are three or four stories high, according to Moughtin (2007), create the impression of being 'complete'. As a rule, the

vertical-to-horizontal ratios of 1:2 and 1:2.5 are the most effective when establishing a street sense of enclosure (Carmona et al., 2003; Rapoport, 1990). According to Jacobs (1996), based on their research, this ratio may be used to predict the proportion of the population at which street definition is most likely to be experienced. Other scholars state that 1:1 is an approximate ratio for a comfortable street (Jacobs, 1996; Carmona et al., 2003). When the view from the sky is less dominating, the sensation of confinement in the space increases. A street wall height equivalent to the width of the street drastically limits the view of the sky and creates an intense sensation of enclosure (Carmona et al., 2010). However, suppose the height of the surrounding buildings exceeds the space's width. In that case, it will no longer be possible to see the tops of the buildings unless one looks up, which may make specific individuals claustrophobic and decrease the amount of light penetrating the area (Carmona et al., 2010).

The scale of a streetscape and city is critical for pedestrians, as well as for the vibrancy, sustainability, and future economic viability of a city (including inviting inhabitants and employment). The human scale is defined as follows:

> *"a size, texture, and articulation of physical elements that match the size and proportions of humans and, equally important, correspond to the speed at which humans walk. Building details, pavement texture, street trees, and street furniture are all physical elements contributing to human scale"* (Ewing et al., 2005, p.43).

It is impossible to overestimate the significance of 'scale'. According to Fruin (1987), appropriate scales are necessary to offer a precise human identity and picture of a place, making it possible for an individual to traverse confidently and freely around it, in a calm way, with the senses committed to enjoying the environment. Suppose one wants to make a city lively, it is vital to have both the casual and formal, the monumental and personal. This is a view acknowledged by Sert (1956) as cited in Krieger (2009) who posits that all things are a matter of scale and comparative scale contrasts.

The city's scale must correspond to the size, speed, and perceptions of its inhabitants. According to Whyte (2009), downtown areas operate best when they are small and the heart of many good downtown areas is no more than four blocks square. Their small size makes it easy to go about on foot while maintaining continuity and connectivity. Whyte elaborates on this computation, calculating an approximate connection between a city's size and the pedestrian pace when moving, with people in major cities walking at a more rapid pace. Greater distances

and maybe increased intensity inside major cities could explain the rise in pedestrian walking speed.

Additionally, Gehl (2010 p.196) emphasises that several critical urban-related decisions must be taken on the microscale for the human scale to work, and so "a wealth of information should be obtained". Nonetheless, it is uncommon to get full or even trustworthy data on users at this scale, making it difficult and ethereal to deal with. In the context Saudi Arabia, the relevant knowledge about the importance of pedestrian needs in modern street design is not yet available, as Beer and Higgins (2004) explain:

> *"Too often, sites are planned and designed in relation to the designer's own life experience and opinions, without adequate understanding of how those most likely to use a site, who may have different outlooks and needs, might wish to behave within it"* (p. 84).

The situation described above is especially true in Saudi Arabia, where no attempts have been made to observe the behaviour of citizens or collect data using methods like interviews regarding the experience of pedestrians and their perceptions. The dearth of data about pedestrians in Saudi Arabia regarding walking's influential socio-cultural facets and the linked outdoor conditions, results in the erroneous impression that walking is not important in Saudi Arabia. Added to this, it also implies that this erroneous perspective is not being addressed. In Islamic cities, Al-Hathloul (2002) argues that the neighbourhoods are places in which all buildings were related or were in some other way inextricably connected, and gives feelings of being one entity, as shown in Figure 2.1. This supports the idea of the encloser where it is described as the 'glorification of the curved line' by Camillo Sitte (1889) as cited in Carmona et al., 2010). He adds:

> *"The ideal street must form a completely enclosed unit! The more one's impressions are confined within it, the more perfect will be its tableau: one feels at ease in a space where the gaze cannot be lost in infinity"* (p.61)

The streets have always been regarded as semi-private, jointly owned spaces by city residents. Nowadays, in the centre of Makkah and as a result of the way buildings are designed, and partly because the streets prioritise automobiles, the majority of urban streets could not succeed to convey a sense of enclosure, or belonging, to users. Moreover, the higher ratio of aggregate street width to building height, and the increased street width and street wall, tend to lessen the street's sense of enclosure. The debate suggests that the primary factors contributing to a

sensation of enclosure are the building heights, the street's width, and the buildings' continuity along the street. These are regarded as critical in Western countries when it comes to a walkable street.

In this study, the term "human scale" denotes the texture, articulation, size and of physical features correlating to the proportions and size of humans, more importantly, the speed at which people walk. Physical aspects such as street furniture, street trees, pavement texture, and building details, all contribute to the perception of human scale.

Figure 2.1 Curved streets in old Makkah (north of the Grand Mosque) give pedestrians a greater sense of enclosure and enrich the feeling of one entity. Source: (Mirzā, 2005).

2.6.3 ***Transparency***

As an urban design quality, transparency denotes the level to which people can perceive or see what lies beyond a street's edge or other area accessible to the public, and particularly, human activity beyond the edge (Ewing et al., 2005). The best streets are transparent at their edges, where the public and the private meet (Jacobs, 1996). Transparency is necessary to offer people walking on street a feeling of safety and comfort. According to Lynch (1981), transparency is the characteristic of a street that allows people to see and hear the operation of many natural and social processes, activities, and technological functions happening in the streets and providing a sense of life.

Among factors impacting transparency are walls and windows, doors and fences, as well as gaps in the middle of blocks. When doors and windows welcome individuals and provide a sense of what is inside usually help street transparency by acting as a transitional area between the street and the store entrances. Also crucial are windows in order for someone walking down the street to have a feeling of occupancy and possibly comfort or sanctuary within the building, and for residents to visually access the public realm, which serves as a biological monitoring system (Jacobs, 1996; Whyte, 1980). High transparency was shown to be directly and significantly linked with participants' assigned walkability scores in a study in which an expert panel of urban design and planning experts examined a library of video clips (Ewing et al., 2006).

The degree to which individuals are able to discern human aspects in the environment is particularly significant when it comes to transparent environments (Ewing & Handy, 2009). Transparency takes a physical form, such as windows that allow people to see what is inside the buildings lining a street or it can be perceived, such as when it is represented by proof of human activity. However, full transparency is not desired or desirable in some situations; for example, clinics, law firms, etc.: places where privacy is paramount. Perceived transparency, for example with the use of obscured glazing, can nevertheless contribute to the creation of friendlier (and potentially safer) environments. Additionally, threshold spaces – where the public meets the private – can frequently serve as the central location for recreation and socialisation in cities, allowing the flow of activities from the internal space (Stevens, 2006). If these features give passers-by the impression that other people are present in or around the place, the area may feel more transparent, friendly, and safe.

Transparency inside a street is mainly associated with the concept of an 'active frontage', which refers to the interaction between the functions on the building's ground floor that frame a street or space and the people who pass via or 'occupy' it. The front of the store has to be active so that there can be some type of visible or physical link between the people outside and the store's activities. Here, at the most basic level, this may be a simple observation, such as individuals working at a window display; or the people who are there could prompt a passer-by to visit, see an exhibit, come in to pay a bill, and so on. Some of the most engaging fronts seem to eliminate the demarcation between the inside and outside such as those stores displaying some of their products outside their establishments or those cafes and bars allowing some of their patrons to sit outside (Roberts & Greed, 2001). Hillier (1996) acknowledges this view by asserting that

offering an active frontage is crucial when creating new public spaces or re-energising old public spaces. In other words, as Carmona et al. (2010) point out, an active frontage helps public areas be more interesting, dynamic, and vibrant. Moreover, Moughtin (2007) asserts that the greatest way to establish a feeling of place when designing streets is for the spatial volume that the frontages define to be seen as the positive shape, the figure viewed against the backdrop of the adjacent architecture.

At some point in 2003, specifically in Copenhagen, researchers investigated the degree to which activities occur in front of a passive and active façade portion on different city streets. Their results showed an apparent propensity for pedestrians to walk slower and look in the direction of the open and lively façades. Also, they stopped regularly. People's walking pace was significantly faster in front of the closed façades, and fewer turned their heads or paused. The finding indicates that activity levels are seven times higher in front of active façades compared to the front of inactive ones (Gehl, 2010). In the same vein, Ford (2000) convincingly argues that spaces consisting of many street-level entrances, for example, are more favourable to social contact than those with fortress-like structures and blank walls. Equally, neighbourhoods with front porches provide a more social atmosphere than areas with three-car garage doors facing public space.

In the case of Makkah streets, the traditional ground floor elevation was defined by finely articulated wooden doors and screened windows, which serve as a welcome cue for visitors and pilgrims seeking accommodation. The distinctive street-level elevations of each building acted as a navigation device. At the front, there is a semi-public area comprised of a high-windowed *maqad* (guest sitting room), with the services moved to the back (Omrania, 2018). Additionally, transparency is defined in this study as the level to which people can perceive or see beyond a street's edge or other public place, and more precisely, the level to which people can see or sense human activity occurring beyond a street's edge. Examples of physical components that impacting transparency include openings into midblock spaces, landscaping, fences, doors, windows, and walls.

2.7 Conclusion

Recent studies have underlined the connection between religious walking and the ongoing attractiveness of pilgrimage, which connects people to their forefathers and mothers through many years. Beyond the quality of the experience once pilgrims get at their destination, the

recent study suggests that Makkah is one of the cities built to encourage people and visitors to walk.

It should be emphasised that the purpose of this chapter was to highlight walkable concepts that may be employed to fulfil the primary aim of the current research, which is to explore and examine the walkability of Central Makkah based on pedestrian experience, behaviour, and evaluation. This chapter has discussed the concept of walkability in detail.

It demonstrates that the design and supervision of a walkable city have to be based on user needs and in conjunction with connectivity, accessibility, convenience and comfort, mixed land use, and safety and sociability, among other factors. Furthermore, urban design qualities that are linked with walkability or walking requirements were examined in this chapter, as well as the existing body of literature that pertains to these qualities. Additionally, the chapter attempted to highlight the gap in previous literature in terms of concept, definition and principles. The chapter drew attention to the shortcomings that have been identified in the literature on walkability in the City of Makkah and its principles, notably in studies on walking in Saudi Arabia and the City of Makkah that have focused on the experience and behaviour of participants.

Research in many Western countries reveals other major keys that have been used that impact walkability compared with the current study. This chapter also outlined the key principles that were introduced by scholars that influence walkability, specifically the factors mostly related to the case study, as shown in Table 2.2, which have also been used as a starting point for this exploratory research.

In this chapter, this has been covered by the key primers for walkable cities, such as connecting the development of urban areas to the provision of transit, making available accessibility for those walking or using public transport while sustaining realities and perceptions of security and safety, offering mixed land use with numerous activities, and comfort in a walkable city context, among other things. So, the researcher believes that by examining the influence of these rising variables on walking environments in developing nations such as Saudi Arabia, we may enhance the walking environment in those countries as well.

Key principles	Factors impacting walkability	Source
Connectivity	Continuity of sidewalks Width of sidewalks Size of blocks Number of routes and intersections Short distances	Frank et al. (2003), Southworth (2005), Marshall (2004), Gebel et al., (2005), Bentley et al., (1985), Brownson et al. (2009)
Accessibility	Linkage to transport modes Disability infrastructure Closeness to services and amenities Proximity	Talen (2002), Duany et al. (2010), Yang (2018), Gilderbloom et al. (2015), Southworth (2006), Cambra (2012), Burton & Mitchell (2006), Carmona et al. (2010)
Mixed use and activities	Variety of uses and activities Motivation to walk more Scale of use	Forsyth et al. (2008), Saelens et al. (2003), Frank et al. (2003), Moughtin (2007), Southworth (2006), Saelens et al. (2003)
Safety	Personal safety Eyes on street Free from litter/cleanliness Road accidents Enough street lighting Availability of crossing points	Brown et al. (2007), Dong (2017), Beavon et al. (1994), Cozens (2011), Jacobs (1961), Browning et al. (2010), Papaioannou et al. (2007), Tulu et al. (2013), De Arruda Campos et al. (2003)
Comfort	Shelter for protection Quality of pavement Way of findings	Carmona et al. (2010), Mehta (2008), Alfonzo (2005, 2016), Southworth (2005), Kumar (2010), Hence et al. (2006), Gehl (2011)
Sociability	Seating places Stay duration Welcoming Diverse	Speck (2013), Gehl (2011), Whyte (1980), Rogers et al. (2011), Leyden, (2003), Wunderlich (2008)

Table 2.2 Key principles that influence the empirical discovery of the study in the identified literature. Source: Author.

Chapter 3. Physical and Perceptual Qualities/dimensions Influencing Walkability in Central Makkah

3.1 Introduction

This chapter discusses physical and perceptual qualities associated with walkability or walking needs. It also focuses on the literature on the leading principles determining a walkable place. The chapter consists of five sections (after this one). The related physical street features linked to a walkable city are covered in the first section. The second section discusses the influence of social and cultural aspects on walking. The third section looks at the perceptual dimension and psychological issues followed by safety perceptions. The fifth section examines the urban design qualities associated with walkability or walking needs, as well as the current body of literature that addresses the importance of these qualities. The conclusion of the chapter summarises the fundamental attributes that have been discovered in the literature from the earlier studies.

3.2 Physical Features Influencing Walkability (Encouraging people to choose walking)

Urban planning and design literature explores design principles, such as sense of place, scale, safety, convenience, comfort, pleasure, diversity, and context (Alfonzo, 2005; Ewing et al., 2005; Southworth, 2005; Gehl, 2006; Mehta, 2008). Measuring urban design qualities linked to walkability is the focus of a study by Ewing and Handy (2009). In the conceptual framework of Ewing and Handy (ibid), they explain how urban design qualities are perceived to be a facet of the way individuals respond to a place (e.g., sense of comfort, safety, and level of interest). In view of their own attitudes and perceptions these qualities can cause different reactions to different individuals. Ewing and Handy (ibid, p. 67) state that even though urban design qualities "can be measured with a degree of objectivity of outside observers, individual reactions cannot". Certain qualities of urban design listed on Figure 3.1 will be discussed in the next chapter (urban design qualities) in an attempt to fill the gaps in current literature as there is a lack in studies approaching the physical features influencing walkability in hot arid regions.

The physical features of the street may explain the experience of walking in any particular street. In urban streets, certain qualities play an important role in attracting people to them. As Jacobs (1996) points out, the urban public's essential quality is that it addresses user needs.

Streets also play an important part, more than any other aspect, in defining an urban form. Jacobs (1993) notes that streets include certain features that differentiate a city from others by the ways they have developed. They help to decide the time in which the town was constructed, its geographical attributes, functions fundamental to them, political or design characteristics, criteria for technology, philosophies, and local culture.

Cities in the Kingdom of Saudi Arabia have grown greatly in size and population since the early 1970s, owing to rising economic growth and prosperity (Rahman, 2016). Cities' rapid growth has had a number of environmental, social, and economic effects, including increased air and water pollution, increased flooding, rising land surface temperatures, a scarcity of affordable housing, and increased energy demand (Dehwah et al., 2018). Additionally, it increases the total number of vehicles in each city, wreaking havoc on their transportation systems and road networks by increasing traffic congestion, causing frequent accidental injuries and deaths, lengthening average trip times, and decreasing available parking spaces in commercial centres and residential neighbourhoods (Aljoufie et al., 2013). As a result, it has had a direct effect on the walking conditions of citizens in Saudi cities. However, just a few research have evaluated the citizens' behaviour and walking conditions in these cities. Almahmood et al. (2017) investigated the effect of sociocultural factors on the walking behaviour of citizens in Riyadh, Saudi Arabia's capital city. Moreover, Al-Ghamdi (2002) examined pedestrian and automobile accident incidence and injury trends in Riyadh between 1997 and 1999. Kamel (2013) examined the challenges encountered by pedestrians in a tiny national park in Dammam, Saudi Arabia's eastern coastline city, and addressed how smart solutions may be used to alleviate some of those difficulties.

Walkability is frequently related to a variety of suitable characteristics, including landscape (both hard and soft), pedestrian routes, street furniture, street width, acceptable speeds, and pedestrian crossings (Gilderbloom et al., 2015). Physical features have an effect on the quality of walking settings, both directly and indirectly through individuals' perceptions and sensitivities (Ewing and Handy, 2009). Southworth (2005) identifies six urban design components for walking, with two specific to this subject: path context, which includes street design, built environment visual interest, transparency, landscape, and whole exportability. These also relate to 'path quality', which may provide comfort and safety to the user via the infrastructure and design. Each of these components will be discussed in the next two sections.

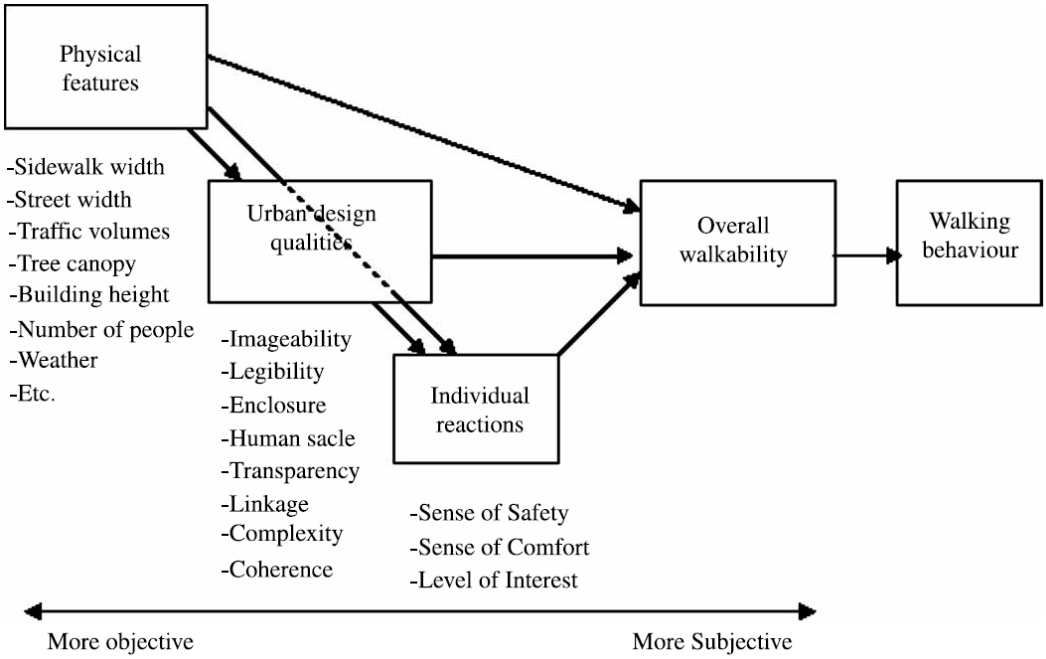

Figure 3.1 Framework conceptualising the physical and perceptual characteristics that influence walking. Source: Ewing and Handy (2009).

3.2.1 ***Footpath context***

Footpath context plays a particularly important role in walkability. Most studies have shown that the footpath is a significant aspect in encouraging individuals to walk and it is the first step to be achieved. In addition, the first most critical aspect forming a city's image is a street, or 'path' according to Lynch (1960). Lynch (1960) posited that pathways appear to be the most visible and memorable city characteristics among the main urban facets like districts, edges, icons, and nodes. It is important to remember that this category often covers other travel channels, including canals, railways, roads, and alleys. A path seems to be the only aspect where people can see the other four items at the same time. Southworth (2006) agrees that path context is important, and we need to deal with it more than other aspects such connectivity, safety, and land use, which cannot engage and interest the user like the path itself. He emphasises the importance of path context as follows:

> *"many aspects of the path context can contribute to a positive walking experience: visual interest of the built environment, design of the street as a whole, transparency of fronting structures, visible activity, street trees and other landscape elements, lighting, and views"* (Southworth, 2006, p.21).

Street design

Urban street design has historically been focused on pedestrian travel. However, starting in the middle of the twentieth century, a worldwide shift towards separating pedestrian movement from automobile traffic by planners and urban designers has become apparent. According to Jacobs (1961, p.37) "… streets and their pavements, the main public spaces of a city, are its most vital organs". The ease of walking depends on the design of the street, which is described as the formation that identifies the city and shows the uniqueness of a city from others (Jacobs, 1993). Streets are classified vertically according to building's height, walls, or trees that line the road, and horizontally according to the length and separation between the two. The horizontal features that define the street are frequently the ground, but can also include buildings, walls, and/or trees (Jacobs et al., 2002). Gehl (2010) stresses that the city at eye level is the most significant scale, and one needs to provide good conditions for people to walk. Walking around the city gives the pedestrians time to explore all the ground floors and to experience all the information and details. A street of shops, transparent façades, and wide windows, with plenty of openings and items on sale, would have a strong soft edge, and there would be a lot to see and touch.

According to Alexander (1987), in order to create 'positive urban space,' urban design requires space that is surrounded by the buildings, not what is left behind when buildings have been constructed. Five elements in physical design are involved in creating 'positive space': gardens, car parks, streets, buildings, and pedestrian space. He also pointed out that space develops into the object of interest, and the buildings are the instruments that generate all this essential space. The outside environment has negative spaces when the space is unformed and when the space has an indistinct shape from the walls or buildings that surround it (Alexander, 1977). Street design is essential as a connection; it promotes individual movement, such as that by pedestrians. Similar to the other literature that emphasises design on the street and ground level, Gehl (2011) also explains how the treatment of buildings on the lower floors has a major effect on urban life. In describing what he calls softening edges, he explains how pedestrians closely and deeply experience such floors. The quality of the elements mentioned by scholars will be discussed in further details in the next chapter.

When wide main roads are positioned at an oblique angle to the prevailing winds, such as at around 30 degrees, they provide urban ventilation in a hot arid climate such as Saudi Arabia (Golany, 1995). Even with this angle, the wind is still able to penetrate into the heart of the

town centre. In addition, the buildings along such streets are subjected to varying wind forces on their front facades; this part is critical for the current study.

Visual interest of the built environment

Visual interest is a further significant factor that persuades people to walk on the street (or not). Whether one considers young or older adults, it can be noted that individuals do not always select a direct route when they are going towards a destination. They select a route based on its attractiveness (Gehl, 2011). The street should have visual interest, signs of activity, transparency (for example, views into and out of buildings) and should be built to be distinctive according to the area's context (Gehl, 2010; Carmona et al., 2010). This is also supported by the statement that visual interest is one of the components for walkability that the pedestrian's path should provide, which may enhance the walking environment, articulated buildings, and landscape quality (Nyagah, 2015; Southworth, 2005).

The general street design can be an effective way of attracting individuals to walk in a specific path. The elements considered here include the presence of other walkers, storefronts that are interactive, spaces to socialise, views, lighting, natural features like trees, visual movement, and transparency of frontage (Ewing et al., 2005; Southworth, 2005; Hoehner et al., 2005; Gehl, 2010; Carmona et al., 2010). Natural features are often emphasised instead of the built environment's design in these areas (Purciel et al., 2009). Texts on urban design highlight the value of visual interest when engaging with the streetscape to entertain the eye (Lynch, 1960; Bentley et al., 1985; Gehl, 2010). The rapidness with which the shift in detail occurs is vital to a pedestrian proceeding at walking pace to ensure that the surrounding environment continues to entertain the pedestrian (Gehl, 2010). Highly walkable areas are identified as being visually stimulating. Diversity in architecture and diverse shapes and scales are a source of visual interest.

A significant part of the visual dimension of the streetscape is the space's aesthetic appearance. Ultimately, a city is seen through the faculty of sight, as the surroundings are virtually entirely perceived through the eye (Cullen, 1995).

As is the case with other aspects of urban design, visual components may be classified according to their appearance, bulk, scale, massing, amenity type, and development size (Carmona et al., 2010). Cities may be visually pleasing when nature, buildings, transportation, and other elements are mixed together, generating suspense; though uniformity can also be appealing when a cityscape is largely harmonious, for example Georgian Bath. The visuality of

a city is experienced as ‘serial vision’ because of the possibility of people moving around it – and those elements that draw people to move from ‘here’ to ‘there’. The diversity of the amenities provided by pedestrian areas may also determine the success of such areas. With the right amenities, pedestrians would want to stay longer in the streets. Other attributes that have a bearing include also ease of access to and from public transportation and away from private transport (Moughtin, 2007).

Walking speed is highly correlated with an individual’s level of interest in a building’s façade. Whyte, reflecting on his observations of cities in the United States, especially New York, concluded the following:

> *“A pedestrian may start out at a brisk 290 feet a minute, then slow down to about 200 feet a minute as he goes past something—a shop window, a merchandise display—and he may sometimes stop for a few seconds. When he resumes, he may go up to 340 feet a minute, as if impelled to make up the pause. Similarly, as he passes a bank or a blank wall, he may step up his pace a bit. Dull blocks are traversed fast”* (Whyte, 1988, p.66).

According to Gehl and associates’ research of Copenhagen’s ground floor façades, pedestrian movement was slow in areas of the street with active façades (Gehl et al., 2006). Additionally, the rhythm of the choices available is critical to the pedestrian experience’s richness: the number of doors, windows, niches, columns, store windows, display features, signage, and decorations is vital (Gehl et al., 2004). Additionally, vertically articulated façades make walking distances appear shorter and more fascinating (Gehl, 2010).

Natural surveillance, such as that created by street-facing buildings, contributes to the aesthetic appeal of the street frontages. It establishes a certain demarcation between private and public spaces (Burton & Mitchell, 2006). Additionally, it contributes to pedestrian safety by reassuring pedestrians that the sidewalk is visible to the residents of the buildings. Congested streets and the eyes of neighbours create a community feeling and convert cities into podiums, where informal monitoring protects the most vulnerable in public space (Ruggiero, 2001). This is consistent with the views of Nasar & Fisher (1993), who discovered that open-view scenarios were considered safer compared to those with restricted views. Thus, physical elements that make a place feel enclosed may lead to a fearful state of mind.

Landscape

Part of the path context is the presence of soft landscape elements. Streets are generally more attractive and more engaging when there are trees and other soft landscape elements. However, soft landscaping elements are not limited to providing interest and comfort to pedestrians, but also contribute to pedestrian safety. While street trees and landscaping contribute to a pleasant walking environment by providing visual stimulation and shelter from the weather, they may also serve as a buffer against noise, air pollution, and traffic risk (Jacobs, 1993; Giles-Corti et al., 2009). On a smaller scale such as the street level, trees, plants, and water have an influence on pedestrians walking. As opposed to providing shade, demarcating the pedestrian and automobile zones, and defining the street, street planting might assist in drawing people's eyes and attention to it (Jacobs, 1996). This is a view also acknowledged by Simonds (1994), who emphasises the fact that having trees, ground cover, and open water away from the open area will lower the surface temperature by 30°C compared with that of paving stones heated by the sun. Thus, planting and creating green space along the street would contribute to lowering the temperature while also providing a safe environment for street users.

Furthermore, it is well established that environmental conditions have a substantial influence on how people behave and use outside spaces (Nikolopoulou et al., 2001). To be effective, those responsible for designing urban areas must deeply understand how urban communities are impacted by change. Following Nikolopoulou et al. (2001), at the moment, it is necessary to consider structures that self-shade streets and protect surrounding spaces from direct sunlight, distributed buildings that permit wind to move through spaces in hot climates, and other issues resulting from having to adapt other architectural vocabulary without regard for the local climate.

Toudert (2005) observed that air temperatures could be lowered by 1.5K if there are rows of trees compared with unplanned streets, and if the row of trees is bigger, differences may be larger – mostly due to the reduction in ground warming under shade.[1] This can be particularly important in hot climates. A research study conducted in Putrajaya, Malaysia, a town that is influenced by tropical climates, found that the high tree density reduces the temperature of urban air between 2.7°C (12.2°F) and 3.5°C (2.6°F) (Shahidan, 2011). However, even in temperate climates this can be significant: Al-Awais (1991) examined the results of research

[1] K is an abbreviation for Kelvin and refers to a measurement period or difference on the Celsius (°C) scale without specifying its location on the scale. For example, 40 Celsius - 10 degrees Celsius = 30K; nevertheless, 15°C as a point on the scale equals 288.15°K, because 0°C equals 273.15K (Szokolay, 2014).

conducted in Frankfurt streets on a hot summer day and it was determined that when compared with an adjacent barren area, urban trees lowered air temperature by 3.5°C. He also found that when air temperature was assessed over a grass lawn with trees, it was 5.6–7.8°C cooler than when air temperature was measured above a barren surface.

Another study conducted in Australia in (Wollongong) found that temperatures beneath native street trees were found to be 2°C cooler than those beneath non-native trees (Aguiar et al., 2014). As a result, Szokolay (2014) emphasises that the selection of plants is essential, and that specialists should be consulted in this process. In hot climate zones, he highly recommends growing trees with a tall trunk to enable wind to move freely near the ground while still shading the pavement for the comfort of pedestrians.

In hot regions, a completely planted urban space is the location where pedestrian heat stress is at its lowest during the daytime. For example, at day time peak hours in a completely planted urban courtyard, Shashua-Bar et al. (2011) observed a temperature of 2.5°C lower than in an open courtyard. Coutts et al. (2016) discovered that in shallow street valleys, trees were highly efficient at decreasing the summer mean radiant temperature during daytime hours, resulting in a reduction in pedestrian thermal stress from 38°C to 32°C. Furthermore, given Saudi Arabia's hot temperatures, trees dominate in establishing the thermal characteristics of street-level microclimate conditions, as stated by the World Resources Institute (Alznafer, 2014).

Moreover, a strip of tall trees might be included in key locations or placed on the sidewalks, depending on the street type and the intended users. Although the ideal position of trees within the street area is determined by factors such as street orientation and street aspect ratio, it is suggested that more than one row of trees be planted on the pavements (Al-Awais, 1991; Sheets & Manzer, 1991; Konarska et al., 2014).

Despite the fact that trees have long been linked with negative consequences (e.g., impeding air circulation and damaging the pavement surface via roots), they play a critical function owing to their dual influence on thermal stress regulation (Alznafer, 2014). In addition to having a general cooling impact on the ambient air temperature due to the evapotranspiration of water via the surface of their leaves, trees are also an efficient provider of shade in the summer. Szokolay (2014) also points out that many urban planners tend to overlook that trees grow and that their effects change over the years. If trees are to be planted, he recommends obtaining landscaping advice on how they will appear in 20 or even more years.

Finally, the width of the streets defines the distance between the buildings on either side of the street, which has an impact on both ventilation and solar utilization potential. When compared to large streets, walkers on sidewalks benefit from superior shading provided by buildings in narrow streets. It is important to have a narrow, twisting or zigzagging alley to get the least amount of sunlight possible, to limit the effect of stormy winds, and to provide darkened area throughout the day. In a hot and humid climate, wide roadways aid in the ventilation of the city, but they will require a lot of shading (Golany, 1995). Because they will receive and absorb significant amounts of solar radiation, they will inhibit foot traffic. Even on vast streets, shade for sidewalks can be supplied by architectural elements on the buildings or by trees planted along the street.

In Central Makkah, the footpath context is well established and considered where the Kingdom where the Kingdom follows the latest international and international standards in designing roads and achieving comfort for pedestrians in the streets.

3.2.2 ***Footpath quality***

Most studies in the literature indicate that the number of people walking does seem to be dependent on the quality of the walking environment. As Southworth (2005) states, path quality is essential to walkability. Providing additional pedestrian walkways would not be useful in increasing pedestrian usage if these paths were unfriendly and undesirable.

Pedestrian infrastructures decide the extent of use. Jacobs (1996, p.11) reveals that "there is magic to great streets. We are attracted to the best of them not because we have to go there but because we want to be there".

Many factors affecting the speed of walking must be carefully considered while walking through a city:

> *"The quality of the route, the surface, the strength of the crowd, and the age and mobility of the walker. The design of the space also plays a role. Pedestrians usually walk faster on streets that invite linear movement, while their pace falls while traversing squares … Weather is another factor"* (Gehl, 2010, p.120).

It is important to remember that there are several recreational and social activities that are only accessible through walking, and those activities are dependent on the good quality of the path context (physical environment). Pedestrian streets and activities are influenced by a variety of

variables, not just physical ones, but also perceptual and cultural (Rapoport, 1987). Additionally, Gehl (2011) claimed that outside environments are affected in part by their quality and characteristics. Furthermore, he stated that if the space's quality improves, activities and functions might be expanded (ibid). Footpath quality is one of the most important attributes, including width, paving, landscape, signage, and lighting (Southworth, 2006), which will be discussed in more detail below.

The street's pavement or walking scape is the city's most vital organ, and the quality of its design will affect the frequency of optional and social events along the street. Previous research has established a correlation between the existence of pavements in open spaces and increased levels of walking (Rodriguez et al., 2008). A pavement's significance in promoting walking is not only psychological; it is also vital for walking in a safe environment. In areas where there are no pavements, pedestrian–vehicle accidents are more than twice as likely (Retting et al., 2003). The presence of pavements on streets cannot guarantee that it would be for walking purpose; but fundamental factors and matters are still necessary, which is essential in regard to Central Makkah, which has a massive number of pilgrims in an extremely hot arid climate.

The pavement is the part of the path that people walk on, and its quality is important for a smooth walking experience. Even though pedestrians can reach the distances easily, the quality of pedestrian networks may discourage walking. If the city creates a comfortable and safe walking environment, it becomes possible to encourage more walking. As Gehl (2010) mentioned, the role of the pavement is to provide comfort to pedestrians while walking, which is an important role. According to Jacobs (1961, p.37), "… streets and their pavements, the main public spaces of a city, are its most vital organs". One of the most essential characteristics of the streets is that people can walk with ease and leisure (Jacobs, 1993).

Several previous studies have also emphasised the importance of wide, high-quality pavements (Cain et al., 2017; Belon et al., 2014). Particularly when land use and other urban environment features remain unchanged, high-quality pedestrian infrastructure, such as pavements, have been shown to increase pedestrian traffic (Saelens et al., 2003). Additionally, Cervero and Kockelman (1997) hypothesised that pavements, as part of other building features designed for pedestrians, would positively influence journeys that were not entirely dependent on personal vehicles. A high-quality, well-maintained walking surface is ideal, as it has associations with both functionality and the user's personal comfort and safety (Southworth, 2005; Richter-Friis Van Deurs, 2009; Pikora et al., 2003; Saelens & Handy, 2008).

Sidewalk width

Pedestrians need a certain amount of space to be capable to manage their movements and walk freely without having to manoeuvre constantly. This space allows the pedestrian to clearly see the movement of other pedestrians, to identify and avoid impediments, and to interact with other pedestrians. People will need time to change their path accordingly and room to avoid objects or obstacles (Ewing, 1999). While the particular space required by a pedestrian differs (depending on individual needs, movement levels, and preferences in culture), the relevant body size and characteristics should be considered. Based on sustained observation, researchers have identified that it is more likely for commuters to select routes that include wider pathways from a transit station to a workplace in the city centre of Boston (Guo, 2009). Similar results were discovered by Samarasekara et al. (2011), who found that walkability was primarily determined by the availability of a safe (separated from vehicle), clear space for walking.

A good, well-maintained sidewalk helps facilitate pedestrian movement. A wider sidewalk provides space for pedestrians with different speeds to pass each other with ease while allowing pedestrians to walk in a more leisurely fashion. At least 1.5 metres is generally considered as the ideal width of footpath (Ewing, 1999; Romer & Sathisan, 1997). This space is large enough for two individuals to walk simultaneously. To allow pedestrians to walk safely along a pathway, more space must be created to allow for clearance or barriers from obstacles and other people and for manoeuvring space, particularly in areas that appear to be overcrowded by pedestrians and/or objects (for example, signage, bus stops, and seating). Enough clear space should be available to allow for a distance of approximately half a metre from objects and approximately 0.80 meters from the edge of the street (Stucki, 2003). According to Fruin (1987, p.34), a path has to be wide enough for people to walk comfortably and avoid conflicts with vehicles at all times. It must be specifically defined for pedestrians to walk safely and comfortably “with senses devoted to the full enjoyment of the space”.

This is partly because of the reason that requirements for path width generally rely on the space and the volume of the pedestrians in a specific location, and are usually issued by local municipality or the authorities in the country. In many of the older Western cities, footpaths are on the side of the road and are between 3.5 and 5.4 metres wide. A standard minimum footpath width on avenues in medium to big cities is 7.6 metres. For larger cities, Alexander et al. (1977) recommended a minimum of 3.6 metres, while Whyte (1988) recommended a minimum of 4.5 metres, and Calthorpe (1993) suggested a minimum of 1.30– 1.8 meters. All of these examples are US cases; in Whyte (1988) the width is specifically for New York.

The nature of the space and environmental conditions contribute to determine the width of the pedestrian's path. In hot countries, the streets were traditionally narrow to provide some protection from the sun through the shadows of the buildings and the narrow space (Moughtin, 2007). A study conducted in a city in Indonesia reveals that the walking space has an average width of approximately 2.5 to 3.5 metres width in a street with a width of eight metres, where there was vegetation and buildings along the sidewalk (Tanan & Darmoyono, 2017). Furthermore, according to Moughtin (2007), streets should be narrow, and houses should be tall, so that the shadows and narrowness of the buildings offer protection from the sun. He emphasised that while functional aspects such as the surroundings are critical, they do not invalidate the importance of considering street composition, proportion, and scale; rather, they provide the discussion parameters.

In contrast, a study was conducted in Riyadh, the capital of Saudi Arabia, showing that the current streets are categorised into three different types (major, minor, local or collector) in a typical neighbourhood, where the width of sidewalks ranged from one metre for local streets (of 18 metres' width), and three metres for major streets (which are 100 metres wide with four lanes) (Al-Mosaind, 2018). This suggests that the street width does not allow for a good sidewalk for people to walk. The large street width and limited pedestrian space reduces the opportunity to provide shade and does not encourage the residents to walk in the neighbourhood. Also, the use of the sidewalk may be affected by its width. Nowadays, narrow sidewalks might not help the flow of pedestrians where the street furniture occupies part of it. A recent study was conducted in the city of Dhahran in Saudi Arabia and discovered that streets in neighbourhoods are not suitable for walking due to their width where the trees, street signals, and illegally parked vehicles are obstacles along the sidewalks (Rahman & Nahiduzzaman, 2019).

A vital prerequisite for comfortable and pleasurable walking is enough space to walk with relative ease, without weaving in and out. Children, the elderly, and those with impairments (mobility, visual, etc.) have specific requirements when it comes to being able to walk freely. There might be some potential conflict in the requirements for those users, which is challenging to achieve and apply, as described by Burton and Mitchell (2006). However, general requirements for streets such as accessibility, safety, pleasantness to walk around, and services provided are characteristics for all. Walking space is often needed for people pushing strollers, shopping carts, and walkers. Young people are usually the most patient when it comes to getting about in crowds (Gehl, 2010).

Finally, in Saudi Arabia, in order to meet greater anticipated pedestrian loads, sidewalk requirements should allow for an expanded frontage zone as well as extra street furniture such as garbage receptacles, bus stops, signage, and bike share stations to be installed (Benfield, 2012). In an urban context, the sidewalk is the area where individuals have the greatest direct contact with one another as well as with commercial establishments. Using landscape strips between sidewalks and roadways can assist pedestrians feel more comfortable walking down the street by providing a buffer from moving vehicles and street noise, and by making them feel more secure when walking along the street.

Pavement conditions and obstructions

Surface conditions may have a negative impact on pedestrians in general. Where possible, people stay away from wet and slippery pavements, as well as water, snow, and slush (Gehl, 2011). Similarly, Cain et al. (2017) discovered that surface impediments and hazards had a negative correlation with walking. According to Plowden (2001), there is a need to redesign the street to represent its significance as a place for pedestrians and vehicular traffic to create a 'living street'. Roads should be reallocated so that people are not forced to huddle on congested sidewalks. This should be easily implemented and makes it safer to cross the street. Obstacles and barriers should be removed to ease movement. Pedestrians should be able to determine their location and route to their destination on foot by referring to street signs and maps. This supports the statement by Gehl (2010) that providing people with dry, non-slip surfaces is an important feature of the wholehearted invitation to walk in cities in all world and in all seasons. Among major obstacles that may cause hazards to pedestrians are those which are placed wrongly such as street furniture, lighting, and many others. Similar findings from the Saudi Arabian case study have been seen by Rahman and Nahiduzzaman (2019), who state that the usability of walking space is limited for two reasons: it is blocked by palm trees, lamp posts, and street signs placed in the middle of the sidewalks, plus the width of the sidewalk is less than one metre.

Topography is one of the major obstacles for pedestrians that impacts those with mobility issues; for example, the elderly, children, and people with impaired mobility. Topography – hills and slopes – has various effects on different individuals (Rapoport, 1990). Elderly people have a hard time tolerating areas with many activities (Carr et al., 1992). Some topographies require the ability to walk and may contribute to the decision to walk or not for these groups. A path's slop (gradient) often impacts the decision to walk, since walking along a steep route

requires much more effort than walking on a flat surface (Southworth, 2005; Brownson et al., 2009; Pikora et al., 2003). It has been shown that while hills or a steep gradient have a negative correlation with walking, they are positively linked with leisure walking (Moudon et al., 2006; Hoehner et al., 2005).

Pavement materials have a significant role in the walking environment. They do, though, have an effect on the climate (Akbari et al., 2001). The results from Al-Azzawi's (2004) research study showed that the comfort of using the street is influenced by appropriate sidewalk surfaces. Many aspects of the city's physical structures, including the surface materials, will influence the urban climate, providing comfort and pleasant street environments (Mofidi, 2009). Pavement materials differ from one place to another, especially depending on climate. According to Bourbia and Boucheriba (2010), cities' open spaces come with various formats and surface characteristics. The same scholars highlight that many factors affect these space's microclimates microclimate of these spaces, including urban geometry, vegetation, water levels, and surface properties. They discovered that the temperature differential is mostly due to the quality of the surfaces that cover the study area. Every climatic region has prerequisite pavement materials that may provide people with a comfortable and pleasurable walk. Gehl (2010) categorised two different regions in terms of the materials used; in warm regions, materials could raise the air temperature to unacceptable levels, while the opposite is true in the cool and windy regions.

The pavement materials used by urban spaces and sidewalks affect the comfort of pedestrians. As mentioned previously by Gehl (2010), when it comes to materials selection, each climate has specific requirements that contribute to providing comfort for people walking on the pavement. Previous studies proved that cool materials prevent an increase in the ground temperature, which is closest to pedestrian level. A study by Akbari et al. (2001) reported that the use of 'cool materials' with high reflectivity to solar radiation and improved spectral emissivity helps to increase urban albedo. He also added that a pavement that is composed of dark asphalt, which has a low albedo, contributes to the heat island. In hot climates, the use of cool materials is debated as promising, because during the summer, they promote thermal comfort by reflecting light and keeping the ground temperature from rising. Due to their poor albedo, asphalt and black materials are not recommended in hot arid climates (Akbari et al., 2001). The amount of shortwave radiation absorbed is determined by the reflectivity, or albedo, of surfaces, which is mostly determined by the surface colour, which varies significantly in urban areas. Based on Table 3.1, the albedos of asphalt and concrete pavements are low. As a result, raising the albedo of these huge portions of urban surfaces would be an effective solution

to reduce the urban heat islands effect, with dark materials covering urban surfaces often proposed to be replaced by those with high albedo around the world (Synnefa et al., 2007; Akbari & Konopacki, 2004; Akbari et al., 2001).

Material	**Albedo**
Asphalt	0.05–0.2
Concrete	0.10–0.35
Red brick	0.30
White marble chips	0.55
Gravel	0.72
White plaster	0.93

Table 3.1 The albedo of common urban surface materials. Source: Oke (2002); Baker (1980); Santamouris (2013); Bretz et al. (1992).

Lighting

Lighting plays a vital part in creating a comfortable and safe environment for pedestrians to walk. When night falls, lighting becomes vital. Southworth states that (2005) pedestrian-scale path lighting will increase night-time walking while still offering a sense of protection. To improve the actual and experienced sense of security, adequate lighting on people and their faces, as well as comparatively good façade, niche, and corner lighting, is required along the leading routes used by pedestrians, as well as sufficient illumination on steps, surfaces, and pavements to enable pedestrians to manoeuvre in a safe way (Gehl, 2010).In their analysis of standards for street lighting design, Choi et al. (2006) argued that exterior lighting should help the area and the building's design concept, have a particular orientation, and be comfortable. They emphasised that quantifiable light aspects, like prescribed illuminance and brightness and related uniformity, need to be validated and implemented for cars and pedestrians equally, particularly for street lighting, as shown in Table 3.2.

The importance of lighting in terms of protection cannot be stressed enough; particularly at night, lighting must give adequate illumination (a minimum illumination range of four metres and a maximum range of ten metres) to identify the purpose of approaching individuals (Fotios & Raynham, 2011). Lighting may either improve or detract from an environment, so it must be carefully considered. A recent study explores its relationship with people's level of physical

activity, specifically if street lights promote walking after dark, and reveals that increasing light levels will influence physical activity (Bhagavathula & Gibbons, 2017).

Classification	**Recommended illuminance (Ix)**
Commercial area	30–100
Intermediate street	10–30
Residential area	3–10

Table 3.2 Recommended illumination of light for outdoor use in accordance with Korean standards. Source: Choi et al. (2006).

People tend to be afraid when it is dark. It has also been demonstrated that street crime during the night happens regularly in areas where pedestrians are few, as these areas lack natural surveillance (Shahriah et al., 2004). Darkness at night makes isolated locations, particularly well-known crime zones, much more attractive to criminals (Alexander et al., 1977). Enhanced lighting is still an important element for women when it comes to making city centres feel safer and more secure (Worpole, 1992). According to Brawley (2001) and Campbell (2005, individuals over the age of 40 require twice the amount of light as those under the age of 20, while those above 60 require three to five fold the amount of light to attain the corresponding degree of visual acuity. Reduced visual acuity impairs the ability to look ahead, to distinguish things to the left or right, to read small text, and to detect intricate detail or faces, particularly among older adults (Burton et al., 2006). Whyte highlights the importance of providing light in open space by stating:

> *"Urban open spaces shall be illuminated throughout with an overall minimum average level of illumination of not less than 2 horizontal foot candles (lumens per foot). Such level of illumination shall be maintained throughout the hours of darkness"* (Whyte, 1980, p.113).

3.3 Influence of social cultural aspect on walking

Numerous cultural and social backgrounds perform an essential part in relation to the requirement for and use of street spaces, other than the physical environment. Gans (1993) believed that in an urban setting, the influence of the physical environment is much lower than

that of the social environment. This can be attributed to the reality that physical activity is linked to both self-reported and demographic participation barriers. Being involved is influenced by factors such as skill, proximity to facilities, expense, motivation, and time limits (Craig et al., 2002). Lawson (2007) has argued that different cultural/ethnic and social groups have distinct customs, clothes, and behaviours regarding street use.

In urban design, it is essential to understand the link between people (society) and their environment (space) (Carmona et al., 2010). Research on the social aspect of the street have been conducted for over 50 years and are still ongoing. The majority of the research studies in this category (Jacobs, 1961; Gehl, 2011; Jacobs, 1996), for example, have stressed the importance of a street as a vibrant and lively social space rather than just a path for transportation.

Miles (2007) posits that the city constitutes a cultural product because it provides the theatre where the majority of culture is created and consumed. Activities in urban environments are culturally based as part of their function as social spaces. They can be used as locations for a variety of culturally related activities; for example, an urban street may be used for funeral and wedding celebrations. A street may be a venue for live music, for example. As a result of different cultures in different places, the urban space's socio-cultural life (especially the street) could differ.

In social and cultural studies, an urban street is a public area within a community that encourages people to engage with one another, to see and be seen (Whyte, 1980). For instance, in the context of the city of Makkah, there is the cultural background in terms of male and female segregation, as well as limitations on leisure time due to religious obligations; moreover, there is a dress code in public, food restrictions, alcohol usage, and physical connections (Alamoudy, 2017). The urban street is characterised as a rectangular theatre prepared for interactions, gossip, sports, conflicts, jealousies, romance, and shows of pride (Rossi, 1984). These human-centred behaviours contribute to the street's relevance and significance in a socio-cultural context, transforming street life into:

> *"a concern of anthropologists, sociologists and landscape architects among many others, and it is the result of these diverse perspectives that have led to many studies of how people use street space, and the spatial context that promotes different social potential"* (Wall & Waterman, 2010, p.56).

Indeed, socio-cultural context affects how people do things, and it also influences how people walk on the streets (Rapoport, 1991). Carr et al. (1992) describe lowering rates of urban space use as a socio-cultural dimension, and hence any shift in outdoor lifestyle should be accompanied by commensurate improvements in physical space.

Besides that, Carmona et al. (2010) emphasises the need to perceive every urban space as an interface between physical space and human activities, or 'socio-cultural behaviours', a link that is frequently relegated to physical space only. According to Carmona et al. (2010), Gehl and Svarre (2013), Hass-Klau (2015), and Saliba (2015), any public place should be perceived as more than a physical setting; rather, it should be perceived as a container for public life, including the norms and practices that occur within it. Carmona et al. (2010) state the following in this context:

> *"The public realm has 'physical' (i.e. space) and 'social' (i.e. activity) dimensions. […] the physical public realm means the series of spaces and settings – which may be publicly or privately owned – that support or facilitate public life and social interaction. The activities and events occurring there can be termed the sociocultural public realm"* (Carmona et al., 2010, p.135).

Rapoport (1991) claims that cultural factors are the most important factor in any kind of street life, including walking and other activities. Culture shapes behaviour and explains whether people use public spaces or not. This statement indicates that walking on the street is mostly a context-dependent issue that differs by culture. The physical environment, on the other hand, may be either positive or restraining. Urban planning attempts struggle to meet demographics of the population or socio-cultural preferences, or are based on invention guided by developers, are more likely to fail to deliver thoughtfully accessible, pleasant services in the future. The capacity to walk easily, see well, and be self-sufficient is fundamental to the development of every human life, and it will continue to grow over time.

A society has its own culture, which influences how people live and communicate. Saudi society's culture has been heavily influenced by (a) the Islamic religion, (b) its history, and (c) its geographic location, which sets it apart from other cultures. Additionally, many cultural influences have been identified as having influenced the formation of the typical Saudi built environment (BaHammam, 2006). The effect of such factors on the creation and transition of traditional dwellings has been thoroughly discussed (Al-Hathloul, 1981; Al-Naim, 2008; Jaber, 2013).

In this context, Sidawi (2013) emphasises that in this sense, the typical Arab city was constructed and has evolved in such a way that it could adapt effectively and dynamically to the physical, cultural, social, physiological, and religious demands of its people. A local street, with its adjacent mass of houses, has far more dynamic social and cultural meanings (Abdelmonem, 2015). Makkah has evolved from a simple city to a cultural gateway that reflects the uniqueness of the Kingdom's commitment to Islamic law as a way of life and civilisational growth, as both are evident in the layout of Makkah in general and the core area surrounding the Grand Mosque in particular.

Active modes of transportation had not been permitted in Saudi Arabia due to cultural norms and social taboos that prohibit women of all ages, social groups, and educational backgrounds from participating. However, this varies according to education level, socioeconomic status, and rural versus urban distribution. The issue of gender imbalance can be remedied by increasing mass education to dispel religious and cultural preconceptions, higher social awareness, and urbanization. As a result, active transportation has gained greater popularity as a result of increased acceptance.

In the next section, the variations in how people use urban environments and space depending on age group, gender, and ethnic group will be discussed based on previous studies.

3.3.1 ***Age group***

Age is definitely a crucial variable to pay attention to when it comes to inequalities in the usage of urban space. In their research, Sisiopiku and Akin (2003) discovered that responses from participants of various ages vary significantly. Different age ranges have different physical conditions, as well as conflicting perspectives of open space (Forsyth, 2003). When creating outdoor areas for older adults, social relationships, culture, safety, ease of exercise, mobility, and accessibility should all be considered, (Harrison, 1997, as cited in Turel et al., 2007).

Older adults, women, children, and ethnic minorities are always at the risk of social exclusion in all major cities around the world; a problem that has been elevated to the forefront in terms of comprehending urban areas and establishing policies through which they are managed (Madanipour, 2004).The most frequent users of public areas appear to restrict others from using them, as they are perceived as attempting to occupy the space. Loukaitou-Sideris (1995) found that adults aged from 19 to 39 tended to differentiate their interests between the attractiveness, social, psychological, and relaxation attributes of urban parks, while older consumers emphasised social interaction. Elderly people have a hard time tolerating areas with a lot of

events (Carr et al., 1992). Nevertheless, the topography, for example slopes and hills, has various impacts on different individuals, such as the elderly or handicapped (Rapoport, 1990).

Suppose the built environment does not overcome these issues, as people grow older. In that case, they may encounter an array of mental and physical challenges, which negatively affect their ability to function in numerous ways (Burton & Mitchell, 2006). In comparison with younger people, elderly individuals are significantly more likely to injure themselves by falling; fall is the main cause of death in people over 75 years old and over in the United Kingdom (Campbell, 2005). In their analysis of what challenges older people face as they go out, Burton et al. (2006) discovered that difficulty walking, fear of falling, and fear of being lost are among the causes. Burton et al. (2006) also cited how participants felt the outdoor experience should be changed.

3.3.2 ***Gender***

Gender is another factor that influences how people use streets and perceive walking on them. Previous studies on streets discovered a substantial variation in answers from participants of different genders (Sisiopiku et al., 2003). The logic of social superiority and safety limits has affected many women's perceptions and usage of urban space (Whyte, 1980; Tonkiss, 2005). For females, urban spaces represent both a source of danger and freedom. Their apprehension regarding being on the receiving end of male violence can be represented by a fear of space (Tonkiss, 2005). This is in line with Whyte's (1980) assertion that women are often discriminatory and vulnerable to annoyances, including in public spaces. Women make slightly more trips walking on streets than men, according to Al-Azzawi (2004), but men prefer to walk further. Specifically in the context of preforming Hajj, aside from the physical and financial capabilities, two additional prerequisites must be met by a woman: first, she has to be in the company of a *mahram* (marryable male) who plays the role of chaperone (Islam Web, 2010). Secondly, she must not have been in *iddah* (waiting time), the period following a husband's death or divorce lasting four months (Nourudhin, 1999).

3.3.3 ***Ethnic groups***

Oktay (1990) emphasised that places have varied meanings and responsibilities for different cultural groups, and that centres should have an interior that can be perceived as different from the outside, rather than being clearly designated by physical features. In addition, according to Sideris (1995), urban space design should be place- and context-sensitive in order to respond

to cultural needs. As a consequence, she continues, the design does not promote conflict between various groups, but rather peaceful living.

When it comes to Makkah, it has benefited from the ethnic diversity of its pilgrims, who have come from all over the world since the beginning of Islam and the Prophet Mohammed's teachings. Hajj attracts approximately three million Muslims from 188 countries every year for just five to six days (Ministry of Hajj and Umrah, 2014), and approximately 7.8 million pilgrims visit Makkah to conduct *Umrah* during the year (Jones Lang LaSalle, 2010).

As with other cultures, Islamic culture has explicit characteristics that distinguish it. Islamic culture is shaped by rules given by Allah, the Almighty, through the Holy Qur'an and His messenger (PBUH). The cultures of Islamic nations and regions have both similarities and contrasts, where the similarities reflect Islamic principles and commands. A few instances of what this implies can be seen during Ramadan and the period of Hajj, when Muslims come to the Holy City, Makkah. They come from everywhere around the world to perform the same rituals and worship even though they dress in different styles.

Makkah's distinct character is formed in part by the fact that it is made up of people of various races and ethnicities, making it one of the most diverse cities in the Islamic world, with over 100 ethnic groups represented (Fattah, 2005). Furthermore, Muslims who travel to Makkah come from various genders, ages, languages, backgrounds, groups, nationalities, and races. However, they all come together for Hajj and *Umrah*. Another cause of this diversity in such a place is migration, as many people have decided to stay in Makkah. As stated in his research conclusion, the influence of diversity has contributed positively to the city's differentiation, making Makkah a creative city in many ways in the Kingdom where walking was frequently practiced by a wide variety of Saudis and Non-Saudis. In 1884, for example, the country's first newspaper was established there (Alamoudy, 2017). Lots of early Saudi ministries were founded in Makkah, and a lot of early Saudi ministers, scholars, authors, physicians, and engineers were either born in Makkah or studied there.

3.4 Pedestrian perception and psychological stimuli

Perception may affect the way people use the place and their reaction depends on their understanding of sensory information; moreover, while the majority of humans are dominated by their ability to see the environment around them, perception is influenced by all human senses. A sense of psychological comfort, according to Carr et al. (1992), may be a requirement for relaxation. People in urban environments desire liveliness and some type of interaction with

the city's activity rather than retreating from it, according to Whyte (1980). Natural elements are influences that contribute to relaxation in urban environments (Carmona et al., 2010).

The term 'perception', therefore, is applied by environmental psychologists to explain how we process, incorporate, and interpret complex, often significant stimuli in our daily lives (Bell et al., 2001). In other words, perception, according to Ewing and Handy (2009), is defined as the process of being aware of and comprehending sensory information. What an individual sees is the result of interactions between his or her previous experiences, cultures, and interpretations of what they perceive.

Although research associated with street design pays most of its primary focus on physical activity's psychosocial correlates and the impact of structural features concerning deciding to walk in the neighbourhood, environmental psychologists and designers of urban areas see the physical environment's perception as both an object and location. Appreciating and being aware of environmental perception, specifically of experience and perception of "place" is a crucial facet in urban design (Carmona et al., 2010). They further added that perception includes three activities: collecting, organising, and making sense of one's surroundings, as well as classifying them in ways that allow us to understand.

Kusenbach (2003) correlates the perception of the environment with a sequence of veils through which people's views get filtered. Such veils reflect people's capabilities (previous experiences, skills, beliefs, tastes, and emotions), which are sensitive to and influenced by social settings. Perceptions may change significantly throughout an individual's life and from one moment to another. Human beings are usually not aware that what they notice in the environment is a product of a complicated and subjective mechanism (Kusenbach, 2003).

Much research has explored human perception and its relation to the environment. People and the environment have a complicated relationship, with several interconnected aspects, because people do not typically perceive the physical environment as a distinct entity apart from the activities they take or experiences they possess (Bell, 2013). Similarly, travel behaviour is a complex issue, making it impossible to understand the role of specific urban elements in isolation from user behaviour (Crane, 2000).

Physical features concerning walking, among other things, influence perceptions of the walking environment, according to Ewing et al. (2005), which assess overall perceived walkability and walking behaviour. As mentioned in section 3.2, Ewing and Handy (2009) put forward a conceptual framework (see Figure 3.1) to explain how the built environment influenced behaviour, the relationship between built environment characteristics and user reactions (sense

of safety, comfort, and level of interest) and perceptions of walkability, which eventually contributes to walking behaviour.

Therefore, while the built environment contributes greatly to walkability, perception or experience can be studied in determining the micro-scale elements/features that stimulate or discourage walking. In this current thesis, I argue that environmental triggers filtered through perception and experience of the surroundings can create certain behaviours or reactions during walking. Indeed, the study of walking focuses on subjective feelings and perceptions. The same study connects them to actual physical features. From this perspective, the micro-features encouraging or discouraging walking are determined. For example, Johansson et al. (2016), in their experimental study, also showed that there are important predictors to walking purposes and attitudes in the presence of green and micro-equality infrastructures. Comparably, Brown et al. (2007) discovered that a lively social environment is linked to a higher perception of walkability, and overall, writers emphasise the importance of perception in understanding the drivers of walking. On a more negative note, Andrews et al. (2012) examine how residents' feelings of distress or isolation may bias environmental perceptions, which may discourage walking.

A deep comprehension of the manner in which features of macro-scale urban design result in better user experience, and eventually more walking is advocated for by Adkins et al. (2012). The same scholar investigated how 'green street' sustainable stormwater management features, and other built environment aspects positively contribute to how users perceive walking environments. From the findings, it can be inferred that when green streets are designed well, the attractiveness of the walking environment is a result of the unrestricted openness, parks, pedestrian network connectivity, separation of pedestrians from automobile traffic. A study by Johansson et al. (2016) examined the association between perceived urban design qualities and the pleasurability of walking paths without considering other qualities such as accessibility and safety. The results indicate that the link between walking and built features is not always straightforward at the individual level. Therefore, these results are helpful in comprehending the psychological processes at play by emphasising the practical experience of various sites along walking routes. More attributes that could promote walking and contribute to its perception were found by a study that examined the characteristics and attributes that promote walking activity by pedestrian perception (Ariffin & Zahari, 2013). These findings demonstrate that accessibility to destinations, pleasant weather, safety, and well-designed pedestrian amenities all have a significant role in improving the perception of the walking environment. A study by Lindelöw et al. (2014) was conducted to explore perceptions of walking in the built

environment, and in the context of everyday activity, was used as a standpoint for examining walking behaviour among residents in three neighbourhoods in the city of Malmö, Sweden. The aim was to investigate how individuals' everyday activity schedule and their walking environment were perceived for their most frequent walking trip. The findings of the study revealed significant associations with walking frequency, where feasibility was of importance for both fixed and flexible walking trips, which could suggest that flexible trips must also fit into everyday life in order to be carried out.

Findings from transportation studies by Bozovic et al. (2021) analyse the association between perception of safety and walking behaviour. The aim of the study was to examine the comparative importance of a range of possible perceptions, motivations, and individual characteristics on walking levels. Findings revealed that strong predictors of walking included the use of public transport, if walking was perceived as saving money and avoiding parking difficulties, age group, and overall satisfaction with walking. More relative to walkability and pedestrian perception, a study by Gkavra et al. (2019) was undertaken to assess the walkability of Thessaloniki, Greece, via individuals' perceptions about the influence of environmental factors on their pedestrian behaviour such as functionality, safety, aesthetics, and points of interest. The study found that the study areas were insufficient, and the functional characteristics received the lowest evaluation. In terms of the pedestrian safety environment, it was perceived to be at medium level. On the other hand, it was perceived as higher in Thessaloniki City. The Thessaloniki mentioned poor aesthetics of the surrounding and discomfort caused by air pollution. On the other hand, the nearness of the points of interest were found to be extremely satisfactory.

The majority of the literature on the urban environment and walking has concentrated on the extent of walking as the measure of the outcome. This is understandable, given that the aim of most policies is to improve walking. However, from the viewpoint of urban design, success should be measured not only in terms of the number or length of walking trips, but also in terms of the efficiency of such trips in terms of user experience. The literature indicates, perception and the availability of attractive destinations – quality walking environments – are some of many significant factors affecting walking activity. Therefore, gaining a better understanding of how micro-scale built environment characteristics affect user expectations of quality may result in both an enhanced user experience and more walking (Adkins et al., 2012).

The current studies try to fill some gaps related to pedestrians' perception and psychological stimuli influencing walkability. Few studies have included demographic information and

physical ability about the pedestrians. Where the focus related to safety was limited to traffic and crime. Few studies have addressed the psychological factors related to physical environment such sense of comfort and safety which contributes the walking behaviour. For example, it is possible that in the presence of a more walkable physical environment, the combined psychosocial influences of social support, self-efficacy, and positive attitudes regarding physical activity are more closely related to behaviour. Individual environmental characteristics related to walkability, on the other hand, can interact with basic psychosocial correlates to encourage further walking. For instance, a person who believes that being physically active has a high benefit is more likely to be affected by street connectivity than a neighbour next door who believes that being physically active has a low benefit (Saelens et al., 2003). The physical environment and psychological interactions are also important components of a pedestrian event, according to a transactional approach. Walking in the green rather than the in urban setting has been linked to happier moods and lower blood pressure in previous studies (Hartig et al., 2003).

3.4.1 ***Comfort and (micro)climate***

As examined above, our perception of place is directly influenced by all our senses. While there are five basic senses – touch, taste, smell, sight, and hearing – some senses are more complex such as thermosetting, the human ability to sense heat. These may also greatly influence our perception of place as well as our sense of comfort. Heat is of particular interest to this thesis because of the hot arid climate of Makkah; however, this is a complex issue not least because humans adapt – at least in part – to heat and other climatic conditions. Therefore, there are no universal values in terms of what is an acceptable temperature for walking, for example.

Several scholars in the field of environmental psychology have published a significant number of studies based on the 'people–climate relationship' (Westerberg et al., 2003), This is notwithstanding the reality that academics only started addressing the issue of climate as an element that is still present in the study of behaviour and the environment in recent years (Bergström, 2004). The quote below illustrates the significance of including outdoor thermal comfort:

> *"Thermal environment of urban spaces plays a great role on the quality of life in a city. It directly affects people's behaviour and usage of outdoor spaces. Therefore, an environmentally conscious urban design solution should give high priority to the thermal comfort implications of urban microclimate"* (Sharmin et al., 2012, p.1).

Jan Gehl and others have started to understand the significance of the urban microclimate and how it must be carefully considered if open spaces are to be used. Good weather is one of the most important criteria to ensure the ease of people's mobility in cities, according to Gehl (2010), who emphasises the importance of microclimatic conditions as a decisive factor in the use of outdoor urban areas for social life and activities.

In urban areas, vegetation and trees constitute the main features to make relaxation available to users. This assumption is attributed to the fact that apart from offering physiological comfort, they also offer physical comfort. Sheets and Manzer (1991) conducted two studies in urban environments to measure cognitive and affective responses to vegetation. In one group, participants examined line drawings of streets with and without trees, while in another, they examined slides of a suburban highway. In both situations, the addition of trees to the view increased the respondents' perceptions of quality of life and environmental land usage. Sheets & Manzer (1991) also noticed that the participants were likewise interested in learning more about the topic:

> *"Reported more positive feelings when viewing tree-lined city streets; they felt friendlier, more cooperative, less sad, and less depressed […] vegetated scenes were rated as better, safer, and cleaner places in which to live, and as easier places in which to make a living"* (Sheets & Manzer, 1991, p.302).

Many observational studies have shown that urban plants are important in decreasing the temperature of the urban microclimate. In the hot environment of Arab cities, trees have been found to affect the microclimate of city streets, reduce atmospheric temperatures, and afford a psychological cooling effect (Jaber, 2013). Despite this, due to the arid climate, Saudi Arabia has few large trees today, with the exception of palms and drought-resistant non-native (exotic) trees. As a result, in the Kingdom, one of the most important roles of urban trees is to moderate the harsh climatic conditions. In this discussion, psychological comfort linked factors are primarily based on Western authors. However, there is still a need to evaluate the attributes' applicability in the context of Saudi Arabia, specifically in Central Makkah.

Temperature is an important component of the climate that plays a fundamental role in pedestrian comfort, and is one of the ways of encouraging people to walk and create a friendly environment. One study explored the combined effect of neighbourhood walkability, temperature, and rain on walking time among seniors living in Barcelona, Spain, in which the data was extracted from a project on a related topic and official governmental weather data.

The results showed a positive association between low walking activity and low temperatures for residents living in low walkable areas (Delclòs-Alió et al., 2020). This suggests that if the neighbourhood is not walkable enough and the temperature is too low, this may have an impact on walking activity. Without relying on secondary data to understand the concept of walking, one study examined the characteristics that could promote walking activity versus people's perceptions of it. It used a survey questionnaire and walkability audit to measure the perception of the urban walking environment, with the questionnaires distributed to neighbourhoods in Kuala Lumpur and Putrajaya. Based on the questionnaire responses, the findings from the study claimed that weather conditions were the main factor that encouraged people to walk, but acted as a limiting factor that discouraged people if the weather was bad (Ariffin & Zahari, 2013). As well as this, another study examined resident perceptions of their neighbourhood walkability, opportunities for physical activity, food choices, and neighbourhood selection. A focus group was used to examine the perception of participants by discussing the definition of walkability and how the neighbourhood supported it. The study confirmed that weather negatively influenced behaviour related to physical activity (Montemurro et al., 2011), showing that the weather is a major factor that may have a positive or negative influence on pedestrian walking.

In Arabian Gulf countries, the climate is described as a subtropical, dry, hot desert climate, which plays an important factor when considering walkability. Few studies have explored the association between walkability and weather in this region. One such study investigated the effect of the season on the walking behaviour of pedestrians in different conditions based on type (family, single, varied, couples) and time of day, using logistic regression, which is a model developed to predict the probability of a pedestrian walking at a particular time. Based on observational surveys in a high-density mixed-use neighbourhood area in a Qatar city centre, the study results suggested that more people walked in the winter seasons (in which hot weather was less prevalent) on weekdays, preferably during evenings and mornings (Shaaban et al., 2018). However, the purpose of walking and transport mode were not among the variables that were included in this study, which would give more insight and could be achieved through instruments other than observational surveys.

Another study investigated three factors of walkability: accessibility, willingness, and travel conditions of residents in Dharan, Saudi Arabia. A survey questionnaire was distributed to understand the perception and willingness of the residents concerning walking, and based on this questionnaire survey it was found that half of the respondents were willing to walk, and the other half were hesitant due to the hot weather and poorly designed sidewalks (Rahman & Nahiduzzaman, 2019). Similarly, a study by Silva and Akleh (2018) investigated the

relationships between the built environment, the climate, walkability, and physical activity in Bahrain. The data was drawn from an international physical activity questionnaire for the sample of 1359 participants, regarding their activity levels for two different seasons (summer and winter) over two years. The results from the study revealed that 67% of walking took place in winter, which indicates the role of weather in motivating people to undertake more outdoor activities. As a result, the above studies agree on the effect of weather conditions on increasing or decreasing walking activity.

3.4.2 ***Comfort and crowding***

Crowding is another complex issue, which involves multiple senses, and the levels of what crowding is acceptable is in part culturally defined. Crowding is a broad term that refers to the 'packing' of people into a small space, which may arise in a variety of settings including households, public spaces, and larger populations (Smith & Mackie, 2007). Some concepts of crowding emphasise spatial mass, while others focus on how people perceive that density. Crowding, on the other hand, has been described as a psychological state associated with being exposed to a dense environment (Cox et al., 1984). Another study explored all meanings of the word and pointed out that it does not have to be a traumatic experience (Novelli, 2010). As a result, being among other people can be a source of experience and pleasure and something that an individual may desire and seek.

Due to the fact that walking is a major method of transit and also a mode of transportation, it needs adequate space to allow for continuous walking (Gehl, 2011). Lynch (1981) emphasised that it is vital to guard against having too many people to the extent that walking becomes unpleasant or difficult. The number of individuals on the street has an effect on one's sense of safety when walking. Crowding is a subjective or psychological feeling based on the realisation that one has less space than desired (Krupat, 1985). The problem of crowding occurs when a space is usually filled by fewer people, or when a space is shared by an increased number of people (ibid).

On the issue of crowding, there has been a significant quantity of research published. Given the negative effects of high population density, Freedman (1975, p.7) raised the question of how people living in those environments may survive. He mentions literature suggesting that dense areas (crowding) do not always result in decreased interaction and other antisocial behaviours in people, nor do they always result in behavioural, physical, or social pathology. In contrast, people who live in densely populated areas are almost as happy, safe, and diverse as those who live in less densely populated areas. Other scholars argue that the crowd has always been

associated with adverse reactions and consequences, such as augmented feelings of claustrophobia while shopping and higher levels of discomfort and stress for commuters (Evans & Wener, 2007). Smith and Mackie (2007) observed in their review of the literature that confining many people within a small area will increase blood pressure, violence, and decrease the degree of contentment.

In the Central Makkah context, in a paper that was presented at the European transportation conference by Temple et al. (2013), noted that the city of Makkah has attracted over 2.8 million pilgrims and over five million other annual tourists to conduct the rites of the pilgrimage at the Grand Mosque in the city centre. Every year, domestic pilgrims from Jeddah and the countryside visit Makkah to conduct the pilgrimage. Unlike the Hajj pilgrimage, *Umrah* can be completed at any time during the year; however, it is in the month of Ramadan that demand is highest.

Makkah is not only a tourist destination, but is also a significant city in its own right, with a population of more than 1.8 million people according to the (General Authority for Statistics, 2010), while the Comprehensive Plan for Makkah and Mashaer (2011) projected that the population would be more than 2.4 million by 2023. Over the next 15–20 years, both the city's population and the number of visitors is projected to rise rapidly. Furthermore, according to Temple et al. (2013), by 2029, the city's transit infrastructure will be used by 2.2 to 2.9 million people, 3.5 million Hajj pilgrims, five million foreign *Umrah* visitors, and an unquantifiable number of domestic visitors.

Gatherings in such a place are viewed from a different perspective than crowds that were previously negatively described. Clingingsmith et al. (2009) conducted a study after the Hajj to determine the psychological effect on Pakistani pilgrims of conducting the Hajj pilgrimage to Makkah. They interviewed 1,605 participants after the Hajj. They compared pilgrims with a matched sample of people who applied but were unsuccessful in the lottery for permission to attend. According to their findings, Hajj attendance strengthened pilgrims' feelings of harmony, equality, and unity with fellow Muslims and demonstrated more desirable views towards females and boosted belief in peaceful and harmonious existence with individuals from other religions. It also prompted a shift in Islamic beliefs and practices from regional to global and increased tolerance and peaceful relations.

According to Al Nabulsi's (2015) thesis, a huge number of pilgrims attending the Hajj is not a risk to the safety of those in attendance. Rather, this crowd is viewed as a foundation of comfort

and support for attendees. Building projects exemplified by the Jamarat Bridge redesign have greatly strengthened the safety of the Hajj's recent years. The current study's psychological insights into the Hajj crowd will help to ensure the safe and smooth operation of future Hajj events. This proves that the effects of redesign and paying attention to the characteristics of the place may have an effect on users both physically and psychologically.

As previously stated, the degree of crowding varies depending on the user group. There is a possibility that those who use streets in Central Makkah do not exactly agree with studies concluding that vehicles and people and people are crowding the area.

Pedestrian perceptions and psychological stimuli have tremendous relevance in the evaluation process of the street environment. In order to identify and develop a safe and pleasant walking environment, the pedestrians are the most appropriate group to examine their perception, knowledge, and attitude towards the streets. Perception features boost the enjoyment of walking by promoting exploratory activity. Personal safety is one of the pedestrian concerns when utilizing a pedestrian path against neighbouring vehicles. Image is made of a person's beliefs, ideas, feelings, expectations, and perceptions about a location. Street activities are the factors of the views of people on the street environment and contribute to an individual's picture of a street. This probably reveals why individuals are appreciative of particular aspects of the street environment and prefer strolling or activities near certain streets. Therefore, street image may be seen as a combi nation of a certain identity and how a location is perceived (feelings and sensations) (feelings and impressions). This suggests that representations of place are created by combining cognition (understanding or knowledge) and perceptions, along with individual, social, and cultural "personality" constructs, or meanings.

As previously stated, the degree of crowding varies depending on the user group. It is possible that the quantity of people and vehicles on street that previous studies found congested are not considered congested by street users in central Makkah, or conversely.

3.5 Safety

Safety perceptions are a widespread issue and a concern in all urban environments, and they must be explored independently of a more general consideration of comfort. Burton (2006) asserts that safety is a necessary element of streets for living. Safety means that people can walk, work, and live without fear in both the daytime and night-time; that they are not afraid of strangers on the street; that they can walk alone and feel at ease; that there is no fear of crime;

that there is a feeling of safety; and that people who are comfortable and feel at ease with a diverse blend of physical designs and social interactions (Dong, 2017). Streets permitting people to move freely, use, and enjoy the surrounding without being afraid that they could be mugged, abused, run over, or trip and fall are safe streets (Jacobs, 1961). This may be linked to, among other things, water contamination, air pollution, fast-moving vehicles, terrorism, criminal activities (Rapoport, 1990; Carmona et al., 2010). Though, according to earlier experts, street safety is primarily concerned with crime and traffic safety, and the current research will focus on the latter.

Different groups of people using the street have different perceptions and levels of safety. A large body of literature illustrates that, through multiple cultures and epochs, people living with disabilities, older adults, females, children, and people with disabilities have the most obstacles and have been challenged in public areas, reducing their sense of security and comfort. As a result, the distinctions between different groups of pedestrians are considered in this research. In a later chapter, the significance of the elements and attributes related to the safety of users in the Central Makkah setting will be assessed.

3.5.1 ***Fear of traffic/accidents***

In relation to modern living, scholars suggest that traffic congestion constitutes one of the most significant environmental stressors. It is frequently associated with adverse affective outcomes (van den Berg et al., 2018). Some studies have shown that traffic has a negative impact on affective factors over the medium to long term. For example, recent research examined the effect of automobile traffic on perceived urban stress and concluded that locations and streets allow pedestrians to walk because such areas do not have heavy automobile traffic negatively correlate with stress levels (Knöll et al., 2018).

It has been proven that implementing a pedestrian and traffic segregation strategy has improved traffic flow while also increasing the level of pedestrian safety (Talha, 2008). People will enjoy using the street if it is constructed for low speeds and users (pedestrians and cars) may safely interact with one another, according to the Design for Pedestrian Friendly (urban design compendium). Five principles (the five C's) are identified as being important in the following to encourage walking on urban streets: connectivity (pedestrian routes link people to their destinations); convenience (direct routes and easy crossings with a wait of less than ten seconds to cross roads); conviviality (variety, well-lit, and safe); comfort (the pedestrian walkway is

wide and of good quality with no obstructions); and conspicuousness (easy to find and follow a route, decent surface treatments, and signs to guide pedestrians) (Davies, 2000).

One physical factor that will lower feelings of crowding and provide street users with a sense of security and comfort is the separation of automobiles and pedestrians. Kerbs and sidewalks are the most effective methods of distinguishing pedestrians from traffic and thereby securing them (Jacobs, 1996). Pedestrians might be physically separated from vehicles, but there is not always a sense of security or peace. By planting trees along the kerb edge, particularly if they are close together, a pedestrian zone with a sense of security is created. Allowing automobiles and pedestrians to interact without a physical barrier between them, such as a kerb, might be a preferable option, especially on busy and narrow streets (Jacobs, 1996).

Traffic movement has increased as a result of the pedestrian and traffic segregation strategy, and pedestrian safety has improved as well (Talha, 2008). Separation of pedestrian paths, such as alleys, may be a convenient way of linking to other walkways; but whether they are lined by clear walls or fences or pass-through areas that are rarely visited, individuals may feel exposed and hesitant to use them (Burton, 2006). As a result, segregated pedestrian and vehicular pathways should be shorter, connect to a busy street, and be visible from doors and windows.

In the context of Central Makkah streets, Makkah is among the top regions in the Kingdom of Saudi Arabia regarding the occurrence of road traffic accidents. According to the Holy City Traffic Department data, there was a significant increase between 2016 and 2018 by an average of 498 accidents, which seems to be higher compared with the whole of Makkah.

3.6 The Modern Challenges of Religious Tourism

On May 13, 2000, more than one million pilgrims gathered at the Basilica of Our Lady of Fátima in Portugal for the beatification of Pope John Paul II (which is the first stride toward sainthood) for two children, Jacinta and Francisco Marto, who reportedly experienced apparitions of the Virgin Mary in 1916-1917 with their cousin, Lucia dos Santos. This religious ceremony at Fátima, which witnessed a record number of faithful crowds, is not something unusual; as more than five million pilgrims visit the Basilica every year (Tilson, 2005).

Other traditions of faith also regularly attract massive crowds to sites regarded as sacred. For example, more than two million Muslims travel to Mecca and Mina annually, as part of the Hajj, two months after Ramadan to be done at least one time during the life of a Muslim.

Traditionally, pilgrims visit the Grand Mosque of Mecca, Islam's holiest place, and in Mina throw pebbles at pillars made of stone; symbolizing the devil who enticed Abraham to disobey Allah.

In India, the Tirupati temple is dedicated to Sri Venkateswara in Hindu cosmology, the seventh-century Vishnu manifestation and the preserver of creation. This temple attracts 12 million pilgrims annually. Furthermore, in 1998, the 100th anniversary of the Sivaratri festival in Mauritius was celebrated by more than 400,000 Hindus for the worship of the Hindu god Shiva and a multi-day-observance, which created a five-hour traffic jam with more than 70,000 cars (Tilson, 2005).

While secular in nature, other locations are also seen as meaningful and attract their share of tourists every year. For instance, more than 50,000 devotees of Elvis Presley attended a vigil on candlelight at the Graceland mansion in Memphis as well as more than 150,000 pilgrims gathered in 2002 for a weeklong celebration: marking the 25th anniversary of Elvis's death. Also, hundreds of thousands visit Abraham Lincoln's home annually in Illinois, which has become something like a sanctuary for the secular saint of America. In Arizona, nearly 5 million tourists travel to the Red Rock Country of Sedona annually to search for enlightenment, renewal, and inspiration that the devotees of the New Age believe comes from local vortex areas and sites that emit energy (Shorey, 2002). In Utah, the USA, the highest area in the district's ski hills attracts skiers and tourists from every part of the globe who consider the hills a snow sanctuary and 84 pilgrimage place (Shelton, 2002). Millions of tourists travel to distant and neighbouring locations every year around the world that they believe sacred and spiritual in a journey to experience feelings beyond their usual existence. Some tourists seek to travel to a specific secular or religious site or shrine (Tilson and Chao, 2002). Other pilgrims might not be enthusiasts in a ritualistic sense; yet, are quite as curious as others. Another group of tourists may simply be focused on visiting unusual and exotic locations. Whatever the motives and reasons behind these journeys, spiritual or religious tourism has become an international phenomenon and created a fundamental socio-economic impact on nation-states and local communities (Tilson and Chao, 2002; Shorey, 2002; Tilson, 2001).

The previous events and journeys create an essential aspect that leads to identifying methods in which stakeholders can identify the positive outcomes, values, and outputs of worship and non-worship visitors to sacred places. This helps in identifying whether these places and their properties must be open for tourists or kept shut to enable worship and conserve heritage. The main issue here might be whether it is presently cost-effective to treat these locations as cultural

sites of heritage. Another issue is the critical extent to which sacred locations, and the entities that manage them, consider or value these locations as religious or cultural sites of heritage for the benefit of the locations or the tourists. If one considers public strategy and policy for regional development of tourism, it is then important to determine how religious tourism can face the challenges of preserving these locations, in urban or rural locations, how religious tourism can adopt more effective and stronger relationships with tourists, and how religious tourism can assist these locations in sustaining their structure (Griffin and Raj, 2012).

So far, one can notice a current and actual need for religious sites to raise awareness from tourists about the maintenance costs of these sites and save restoration for many years to come. In addition, the chance to approach religious tourism as a development strategy that can contribute to the religious sites and community members positively through enhanced revenues, which is experienced in local and global contexts. Not only do tourists offer a stream of income, but they also create chances for career development in health, safety, and management, all the while improving the investment return on religious infrastructure and offering employment and potential diversified and new skills in these locations (Shackley, 2005).

It is generally acknowledged that in developing relationships between religious locations and tourists for the purpose of maintaining religious locations, modern strategies aligned with rejuvenation and restoration can be necessary as a long-term plan, which needs painstaking and detailed reflection and work for the time of preserving these sacred locations (Lane, 2005). Management's main focus in exploring religious tourism as a preservation opportunity for the religious locations does not prevent the need to consider sacred and spiritual practices, which are experiences that offer consumption meaning by a wide range of tourists and, above all, offer an inspirational journey (Rivera, Shani, and Severt, 2009).

3.7 Conceptual Framework:

To re-establish walking on Saudi Arabia streets, the topic must be examined within a framework that links the society's most vital components and is deeply rooted in the local environment and circumstances. This is because design of street is based on a single set of design rules that applies to all circumstances has been demonstrated to be problematic, flawed, and insufficient (Abu Dhabi Urban Planning Council, 2013).

As a result, further attention have to be paid to the features of urban areas to address the resulting deterioration of outdoor life in Saudi Arabia (Al-Saud, 2006; Alznafer, 2014). They point explicitly to a shortage of design interventions as the core issue aimed at mitigating the severity of urban microclimate conditions, whereas Al-Abdullah (1999) places a premium on taking into account the dominant socio-cultural characteristics of Saudi Arabia as the primary factor influencing the built environment's final form.

Indeed, these studies expressly advocate for an innovative, context-sensitive strategy aimed at confronting developing urban environmental effects and meeting the increasing need for a sustainably constructed environment in Saudi Arabia. On top of this argument, the study examines the relationship between environmental features, street characteristics at the microscale of the street space, and social cultural attributes. The research hypothesises an interactive link between the street space's current conditions and the two other variables.

Thus, the research proposed a study model elucidating the connection between these three interrelated aspects which plays the role of a conceptual framework that may assist in accomplishing the research objective and related inquiry. Improving walkability into street space is mostly influenced by these elements, and as such, they must be researched together, with no one factor having a greater influence on this process than the others (Figure 7.9). Certainly, each factor is supported by a theory or notion that will be examined and described in subsequent chapters.

An analysis of the model shows that to establish urban streets that can be defined as walkable in Saudi Arabia, there is a need to alter the spatial and street's physical characteristics, with people playing the role of driving the establishment of public spaces. Such changes need to take into account sociocultural and climatic factors. It can also be posited that walking areas, apart from street space, constitute some type of behaviour modification. Thus, changing behaviours creates the need for changing the environment where they happen (Shaughnessy et al., 2015).

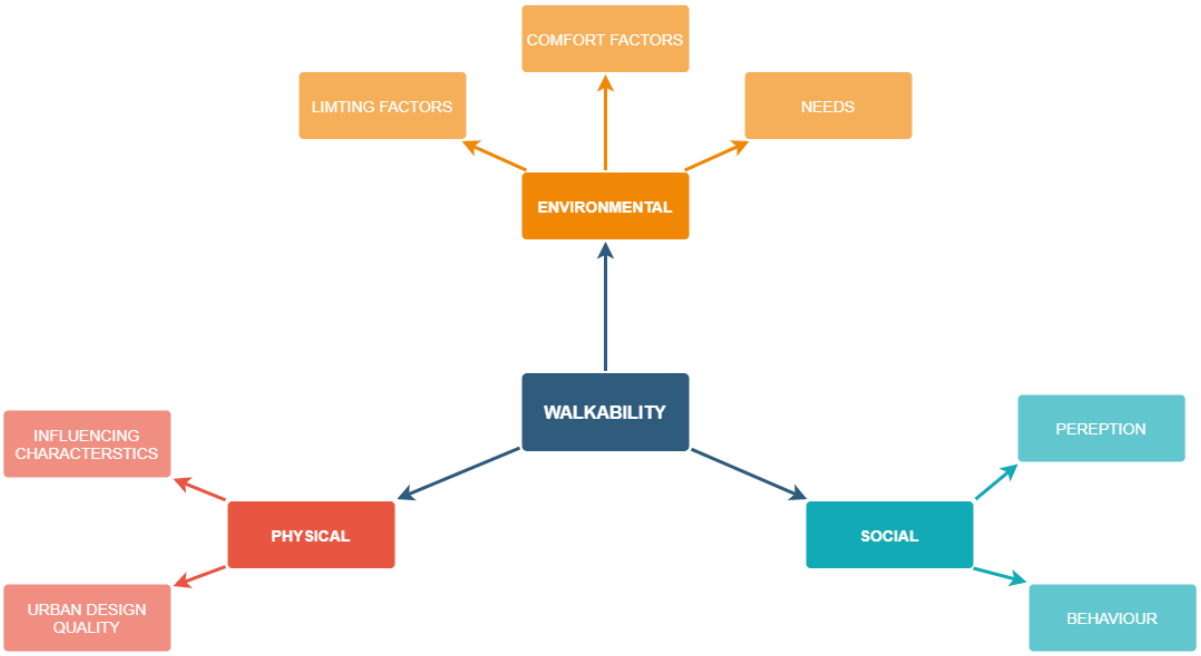

Figure 3.2 The proposed conceptual framework. Source: Author.

3.8 Conclusion

Physical and perceptual factors that are linked with walkability or walking requirements were examined in this chapter, as well as the existing body of literature that pertains to the primary principles that determine whether a place is a walkable area. Sections of this chapter are grouped into four categories. The first part identified the physical elements of the street that are connected with it being a walkable street and described them in detail. The second part dealt with the effect of social and cultural aspects on walking habits and behaviour. The third part examined the visual component as well as psychological difficulties, and the last section discussed the walking behaviour of the subject in question.

The characteristics linked to the physical features and the built environmental attributes, in the physical and perceptual qualities, which are the focus of Chapter 2 served as a benchmark for this study when examining walkable streets in Makkah Al-Mukaramah's city centre.

This symbiotic relationship between walkability and urban design qualities demonstrates how strongly the quality of the urban environment can either encourage or discourage pedestrian movement in a public space. It assists in determining which qualities of the urban environment are most conducive to pedestrian movement and which are most detrimental. Once discovered, these qualities may be utilised to improve our cities' walkability and general quality of life.

The majority of the theory or notion in this chapter is devoted to the concept and characteristics of walkable streets. The majority of the characteristics and features covered in this chapter are universal and do not pertain especially to Saudi Arabia or other countries with a comparable environment. As a result, studies frequently refer to open spaces in general, not particularly to city centres, during such a religious event. The needs of pedestrians concerning open spaces were also mainly derived from the Western and European point of view, rather than from the perspective of street users in Saudi Arabia or similar contexts. This demonstrates a lack of studies in a comparable environment in the existing literature, highlighting the need to fill the knowledge gap on this subject.

Chapter 4. Research Methodology

4.1 Introduction

This chapter is an integral part of this research, and its primary purpose is to describe the research methodology that was adopted to achieve its aim, which was to understand the walkability of central Makkah and its quality. This chapter focuses on the form of the methodology applied in this research and will explain in detail the research design and strategy to collect the data in order to answer the research questions.

This chapter is divided into eight sections following this one. The first presents the research methodology and strategy approach. The second section explains the case study and selection criteria and the research design. The third section will address the data collection techniques and design, while the fourth section describes the data collection procedure. The fifth section describes the kind assistance during the data collection. The sixth section describes the data analysis procedure. The seventh section identifies the limitation that researcher confronted during the data collection, followed by the conclusion of the chapter.

4.2 Methodology Approaches

Selecting the research method is the initial step in the research design. The qualitative, quantitative, and mixed methods are the most common research designs used in academic studies (Creswell, 2014). The qualitative approach is defined as a way to explore and understand individuals or groups regarding social or human problems and rely on text and image data. On the other hand, a quantitative approach is one in which investigators test an objective theory by scrutinising how variables are linked (Creswell, 2014). This quantitative paradigm comprises a deductive inquiry that seeking a cause–effect explanation (ibid; Groat & Wang, 2002). A mixed methods approach is one that "focuses on collecting, analysing, and mixing both quantitative and qualitative data in a single study or series of studies. Its central premise is that the use of quantitative and qualitative approaches, in combination, provides a better understanding of research problems than either approach alone" (Creswell et al, 2006, p.5).

This research will be conducted with mixed methods of both the quantitative and qualitative research approaches. This needs to be undertaken due to the multidimensionality of the term

"walkability". Walkability means allowing people to walk from one place to another, providing destinations at a walking distance, providing a safe environment to walk, and providing a physically attractive environment with full pedestrian facilities that will provide a liveable and sociable environment (Forsyth, 2015). For comparative purposes, data will be gathered from numerous previous reports that are statistically and numerically rich in, for example, demographics and numbers of pilgrims, in order to extract the recurrent tendencies and the positive and negative outcomes of implemented approaches as a form of secondary data. The study will rely on a descriptive approach, which presents a picture of the details of a situation and gives an idea of the concept and describes it (Neuman, 2014). The practical approach will have a mixture of research designs such as in-depth interviews, direct observations, and face-to-face questionnaire surveys. Every research design is characterised by specific characteristics in terms of collecting data, analysing, and interpreting it, as is shown in Table 4.1 below:

Quantitative Methods	**Mixed Methods**	**Qualitative Methods**
Predetermined	Both predetermined and emerging	Both predetermined and emerging
Instrument-based questions	Both open- and closed-ended	Both open- and closed-ended
Performance data, attitude data, observational data, and census data	Drawing on multiple forms of data	Drawing on multiple forms of data
Statistical analysis	Statistical and text analysis Text and image analysis	Statistical and text analysis Text and image analysis
Statistical interpretation	Interpretation across databases Interpretation of themes, patterns	Interpretation across databases Interpretation of themes, patterns

Table 4.1 Research Methodology Framework. Source: Creswell (2014).

4.2.1 ***Choice of methodology approach***

The nature of this research and time period were restricted thus limiting the methodological approach to the study. Pragmatic decisions, therefore, had to be made in order to enable the

research questions to be answered effectively within the resources available. An extensive body of research has used mixed methodology from the Western and Eastern contexts as a data collection that is related to the built environment and walkability. Zeisel (2006) used a combination of mixed methods such as observations and interviews in his study conducted in Boston about observing physical traces. One study was conducted in Tripoli, Libya, using methods such as observations, interviews, and questionnaires to understand walkability in an urban space (Mohamed et al., 2016), whereas another study by Jansson and Persson (2010) used both qualitative and quantitative methods, including interviews and questionnaires, to evaluate how well existing standard-influenced playground provisions matched needs and preferences. A recent study in 2019 used interviews, observations, and surveys to identify the main physical characteristics of the built environment that were related to improving walkability around mass public transportation stations in São Paulo, Brazil (Lamour et al., 2019). Another study evaluated walkability in 12 neighbourhoods in Riyadh, using both qualitative and quantitative measures to carry out the evaluation at both macroscale and microscale street levels of the inner city, urban areas, the city centre, and suburbs. Ledraa (2015) conducted a study to collect urban design characteristics as well as site observations in order to investigate three factors of walkability: accessibility, willingness, and travel conditions of residents in Dharan, Saudi Arabia. This was conducted in three phases. First, GIS was used to examine the distribution patterns of the community services, after which a survey questionnaire was distributed to understand the perceptions and willingness of the residents regarding walking. Then, site visits were carried out to examine the condition of the neighbourhood walking infrastructure (Rahman & Nahiduzzaman, 2019). Another research employed observations and interviews as part of their field survey approach to assess the conditions of comfort that people experience and their perception of the environment (Nikolopoulou & Lykoudis, 2006). Because each data collection technique has strengths and weaknesses, employing several approaches allows the researcher to mix strengths and fix some of the drawbacks of a single data source (Patton, 2014). The mixed methods approach has been praised as the appropriate methodology for discovery, for investigating a new area [especially] when augmenting, validating, or highlighting quantitative data gathered from the same context (Miles et al., 2020). Indeed, the "case study" advises against:

> *"a single source of evidence [...] most of the better case studies rely on a variety of sources [...] All sources of evidence were reviewed and analysed together, so that the case study's findings were based on the convergence of information from different sources, not quantitative or qualitative data alone"* (Yin, 2014, p.114)

As previously stated by Creswell (2015), the mixed methods study may be utilised as a methodology or as a means of data collection; however, it was used in the current study as a data collection method, integrating quantitative and qualitative approaches for both numeric and narrative analyses. To obtain a full understanding of the walkability of Makkah, applying this combination of instruments will help to examine and find a solution that can explore walkability in central Makkah.

4.2.2 ***Justification of the selection of mixed methods***

A number of writers have emphasised how using a mixed methods approach can provide significant advantages, rather than using only one type of data (Stake, 1995; Yin, 2014). It also allows the researcher, especially in a field study, to obtain rich insights and a thorough knowledge of what was occurring and why it happened the way it did. Much more crucially, though,

> *"The use of mixed or multiple methods in case study research usually contributes to increasing accuracy and complexity/coverage in a study, more so than generality. A mixed-method approach is likely to provide confirmation and disconfirmation of some beliefs and feelings of participants collected during [for example] interviews by examining data collected using alternative methods within the same context"* (Woodside, 2010, p.33).

It seemed natural to employ mixed methods as a technique of data collection and analysis, since the variables impacting the choice of a person to walk have several facets. As a result, while any one approach might be sufficient to address a portion of the research objectives, it would be insufficient to address the primary aspects related to walkers' reluctance to use urban streets, as:

- It was necessary to employ multiple techniques and skills in order to gather data because of Saudi society's sensitive socio-cultural aspects: namely, limits on male–female interviews, which include female privacy, and the potential that pedestrians are illiterate; this necessitated the use of multiple techniques and skills;
- It enabled the researcher to merge the strengths of many sources of data, and to rectify some of the study's own shortcomings, thereby giving mutually supporting data on the environments and pedestrians;

- The actual places where people walk may cover may include a wide variety of variables in addition to the phenomena being studied. Therefore, examining this subject using numerous research sources makes available a wide-ranging perspective of all potential factors that contribute to the reduction in street walking that the real walkers experience. Because mixed methods research enables the extraction of both inductive and deductive reasoning, the results are considerably more robust than those of single method research, particularly in case study research (Kitchenham, 2010); and
- It is the more practical way of determining– from different points of view – if the pedestrians' willingness to walk on the streets is mainly impacted by street design, environmental factors, socio-cultural elements, or a combination of all these variables.

To conclude, as explained above, to fulfil the purpose of this research, qualitative and quantitative methodologies are used. The researcher found that this approach was best to conduct this type of research due to time limit and culture of the case study. Thus, qualitative data was gathered from participants via interviews and observation, and quantitative information was gathered through a questionnaire survey in the form of scores; both methods should provide the same findings. This provides a deeper knowledge of the research issue without requiring as much time and/or resources as some other approaches. Other strategies might be used to obtain further information, which can consume a lot of time. For example, there are other alternative strategies for collecting data such as focus groups, social media analysis, the use of video analysis of street movement, etc. could not be used because of the limited time the research had but can be more beneficial for future studies.

4.2.3 ***The type of design used and its definition***

Several research undertakings embraced an amalgamation of approaches, or what is often called the triangulate/convergent strategy, in which validity is strengthened by collecting data from numerous sources. According to Creswell's (2014) book Research *Design: Qualitative, quantitative, and mixed methods approaches*, mixed methods have three basic types of design or strategies, including convergent parallel, explanatory sequential, and exploratory sequential. In this research, a convergent parallel mixed method design would be applied to provide a complete analysis and the greatest understanding of the research problem. The core of this design has been described as where "the investigator typically collects both forms of data at roughly the same time and then integrates the information in the interpretation of the overall results" (Creswell, 2014, p18). Detailed data will be obtained from participants qualitatively

using interviews and observation, and quantitatively by questionnaire surveys in the form of scores, which should both have the same results. This will give a better understanding of the study problem without being time-consuming like other designs. To achieve the aim of this study, both qualitative and quantitative techniques are adopted.

Many studies have used parallel methods to collect both qualitative and quantitative data in their research. A study that was conducted in the city of Leeds in the United Kingdom used an interview while walking and an on-street questionnaire to assess the pedestrian environment from a pedestrian's perspective (Kelly et al., 2011). Another study aimed to investigate the relationship between objective and subjective measures of walkability for seniors in Toronto, Canada, and used the convergent design to compare or relate the results between the quantitative and qualitative data (Lee & Dean, 2018). One study in 2013 used the triangulation approach by converging both qualitative and quantitative data to identify the elements and factors that make urban commercial streets friendly to users in Malaysia (Rahman, 2013). Each approach has its strengths and weaknesses, with convergence allowing cross-checking of these. For example, collecting statistics from a large group may help to offset interviews that were conducted with fewer people. The research will involve collecting and analysing two independent components of quantitative and qualitative data in a single phase, merging the two datasets, and then seeing if they are convergent or not, or contradictory, or if there is a relationship between them.

4.2.4 ***Challenges in using this design and examples***

Different methods have distinctive strengths and various weaknesses (Gillham, 2000). The integration and interpretation process of information from both qualitative and quantitative data is challenging. Still, by using different methods, a comparison of the similarities and differences can be identified, boosting validity. Additionally, using multiple research techniques to solve a problem will decrease the chance of falsely consistent results and improve reliability (Zeisel, 2006). Gillham (2000) explained that the differences between two approaches are due to the fact that there is a significant disconnect between what individuals think of themselves and what they are doing. For example, in interviews, people are more convincing but sometimes do not give accurate details. Zeisel (2006) clarified that in interviews people tend not to report the activities that they think are unimportant, so observation is a useful tool that can reveal all such activities. Another challenge in this design is that during data analysis there are several ways to merge the two datasets (Creswell, 2014).

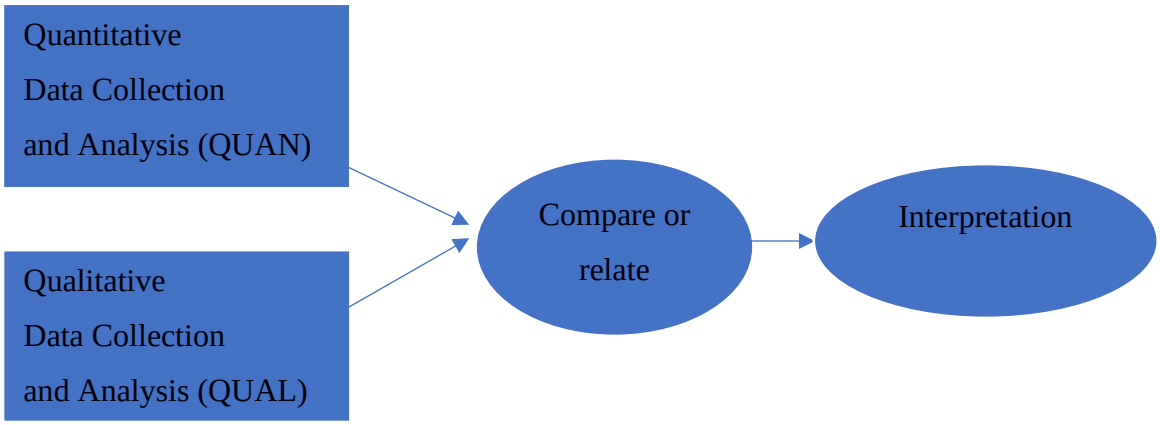

Figure 4.1 Convergent parallel mixed method design. Source: (Creswell, 2014).

4.3 The Case Study and Selection Criteria

Case studies are one of the qualitative approaches used in social sciences and have been identified as part of the qualitative method that "investigate[s] a contemporary phenomenon (the "case") in depth and within its real-world context, especially when the boundaries between phenomenon and context may not be clearly evident" (Yin, 2003, p38). In this research, a single case study was used. One rationale for the selection of an individual case study is its ability to represent the critical test of significant theory (Lune & Berg, 2016). Yin (2003) added that a single case study may capture the circumstances and conditions of an everyday situation; for example, a street scene and its sidewalk vendors may be the case about which to learn. There are two elements concerning the use and meaning of case study approaches, as described in (Lune and Berg, 2016). First, for deep examination of the case, case studies require multiple sources of data, and second, the case study should be associated with a broader category of events where the case is presented (ibid).

The central area of the city of Makkah Al-Mukarramah is the chosen case, which is the destination for all Muslims coming from around the world, with most of the pilgrims wishing to live close to Al-Haram (Al-Hathloul & Mughal, 2001).

There are several reasons for choosing this case to study. The central area of Makkah Al-Mukarramah was selected because of the following reasons:

- Historical significance: Since the city has existed it has been a destination and central business district for many people for trading, pilgrimage and immigration (Al Sudairy, 2015; Al-Hathloul & Mughal, 2001).
- Religious significance: Makkah is considered the capital for Muslims worldwide as a destination and is visited annually for pilgrimage (Ascoura, 2013).
- Economic significance: "The Holy City of Mecca annually accommodates more than three million pilgrims coming from all over the world and also from the different regions within Kingdom of Saudi Arabia" (Office of General Statistics and Information, General Census of Pilgrims, 2011).

The motivation and rationale for selecting this case study was because of multiple aspects; first, the case study area is in the centre of the city and contributes to solving a problem affecting millions of Muslims from all over the world. Second, Muslims come from different climatic regions, from frozen Siberia to the scorching climate of the Arabian desert, and this broad spectrum of differences when bearing the thermal load of Makkah city deserves an acceptable solution. Thirdly, achieving an acceptable degree of walking in central Makkah will save both people and the local government a lot of obstacles and expenses. Moreover, pilgrims will feel safe and happy, as will their families back home. More details about the case study will be described in the next chapter.

4.4 Research Techniques and Data Collection Design

This section represents the techniques and procedures that was used to collect the data (Figure 4.2). The data gathering process was conducted between 1 July and 20 September 2019. The data procedures were performed in two phases: the first was a preliminary investigation, and the second was the actual data collection (see Figure 4.3).

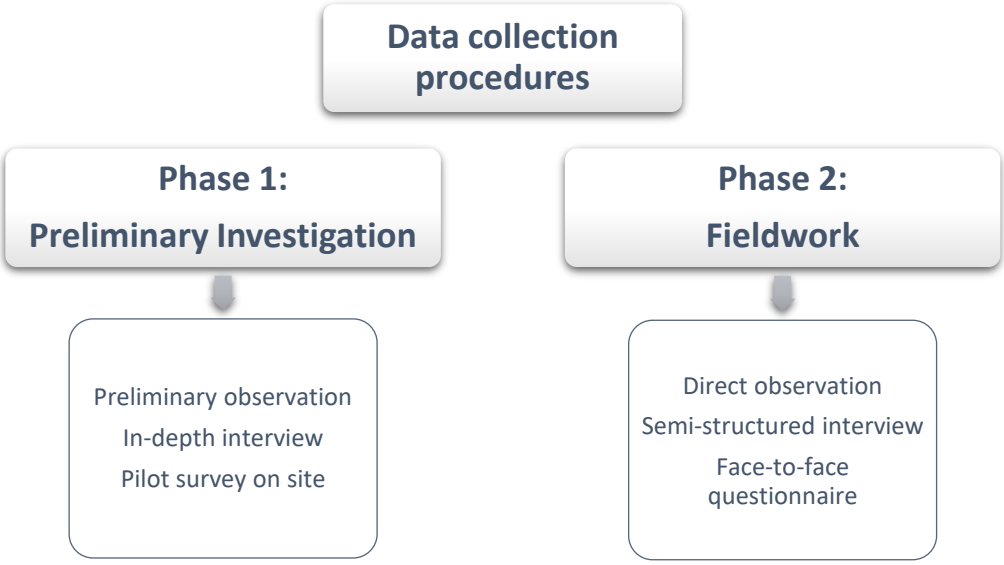

Figure 4.2 Data collection procedures. Source: Author.

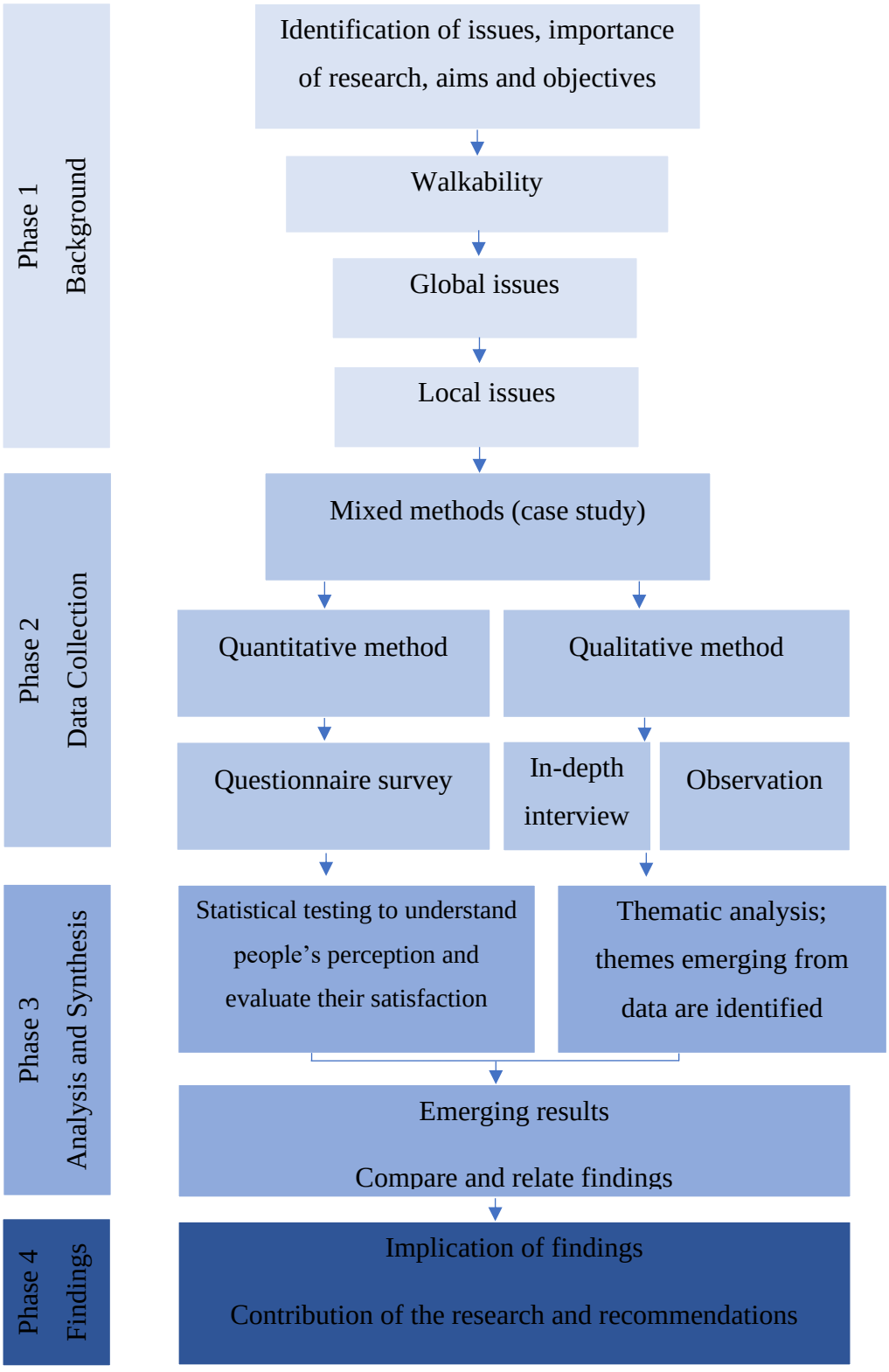

Figure 4.3 Research Phases Plan. Source: Author.

4.4.1 ***Preliminary investigation***

The first phase of the data collection included observation on site, semi-structured interviews, and pilot surveys on site.

Preliminary observation

The preliminary observation on site was conducted from December 2018 to January 2019, which involved direct observation in capturing the current picture or situation of people walking on Makkah's streets. It also captured what type of users used the streets, the physical characteristics of the streets, and people's behaviour.

In-depth interviews

Semi-structured interviews also took place to understand people's feelings and experience walking on Makkah's streets around Al-Haram. There were two formats of questions for the interviews; the first was the walking interview, which was carried out with residents and visitors of central Makkah. In the second one, there was contact between the researcher and some elite interviewees who were willing to take part in the study. Tests on the questions were conducted by asking architects and planners, and PhD students and professionals.

Questionnaire survey

Prior to beginning fieldwork, a pilot survey was conducted to ensure the validity of the questions, scales, and format. As well as this, it indicated the number of people that would answer the questionnaire and the duration of each one. A pilot survey was conducted to assess the questions' clarity and to make them more understandable.

After this, I sent some copies to some PhD students who specialised in statistics to look at the questionnaire questions and obtain their feedback. A friend of the researcher agreed to assist in translating all questions from English to Arabic. This friend holds a master's degree in language interpretation and translation.

The approach of pretesting the questionnaire in two stages, as well as the additional methods mentioned subsequently, are most likely what distinguishes the methodology of this research. There were a few weaknesses about the questionnaire concerning both the questions themselves and the clarity of the interview that were identified during the pilot study. Some of the questions had some words that might not be understandable by the public, and the hierarchy of questions

was not well organised to ease the flow of the questions. In addition, there was a need to add an open-ended question at the end of the questionnaire survey.

The questionnaire's final form underwent substantial modification because of testing and reviewing the first and edited versions prior to field implementation. At first, a prototype version was tested in March 2019 with a small individual of Saudi students studying in Newcastle; then, in June 2019, an amended version was evaluated on site on central Makkah's most popular walking street.

Notwithstanding the reality that the initial test was conducted indoors, instead of actual implementation, the main objectives where: first, determine the weaknesses and strengths of the questionnaire. Second, ensure that the questions developed were socio-culturally suitable. Third, obtain guidance and advice on improvements from other PhD students, especially those who employed the questionnaire technique.

There are three sections in the face-to-face questionnaire, which was divided accordingly into the user's information, evaluation of the current condition of the walking environment, and user perception.

Five more questions were implemented as a result of constructive actions that were performed on the questionnaire before conducting the fieldwork. These questions were centred on the evaluation section of the current conditions of the walking environment that the researcher had previously excluded or had never considered measuring in the past. For instance, the questions consider the issues about some physical characteristics associated with automobile use, which are discussed below. According to the preliminary version, the rationale for including such questions was due to the effect of other researchers' work, which showed that environmental issues are one of the contributing causes to the decline in walking in the Gulf nations (Fraser, 2012). Although most participants indicated their dissatisfaction with such a preconception during the questionnaire's piloting, questions pertaining to this area were included in the final form as a result of the pilot results.

Furthermore, as a consequence of the piloting of the questionnaire, the final draft's structure and questions were adjusted in accordance with the following guidelines:

- The questionnaire was divided into sections, each containing a set of questions that were connected to each other, to make it easier to analyse the responses;

- In order to ensure that all questions were thoroughly worded, because the wording of a question has a significant impact on the answer (Brinkmann & Kvale, 2015; Bryman, 2015), the questions were written in simple language, with the use of technical terms avoided to the greatest extent possible;
- Questions that were uncomfortable or might be considered embarrassing were avoided;
- Questions that were ambiguous or that might be interpreted in more than one way were not included in the survey; and
- To the greatest extent feasible, leading questions were avoided.

4.5 Data Collection Procedure

Primary data collection took place throughout the summer of 2019 and took approximately one month for each instrument, as shown in Table 4.2. Direct observation, followed by a semi-structured interview, and finally a face-to-face questionnaire were all used to collect data for the study's first phase. According to the findings of the pilot observation, the majority of the data was obtained between the hours of 6 a.m. and 9 p.m. In certain circumstances, the procedure was extended until 11 p.m. There are five popular routes that pilgrims take to access the Grand Mosque, and these were the streets that were chosen for data collection (see Figure 4.4).

Date/Time	Method
July 1–30	Direct observation
August 1–31	In-depth interview
September 1–23	Face-to-face questionnaire

Table 4.2 Data collection plan during the fieldwork.

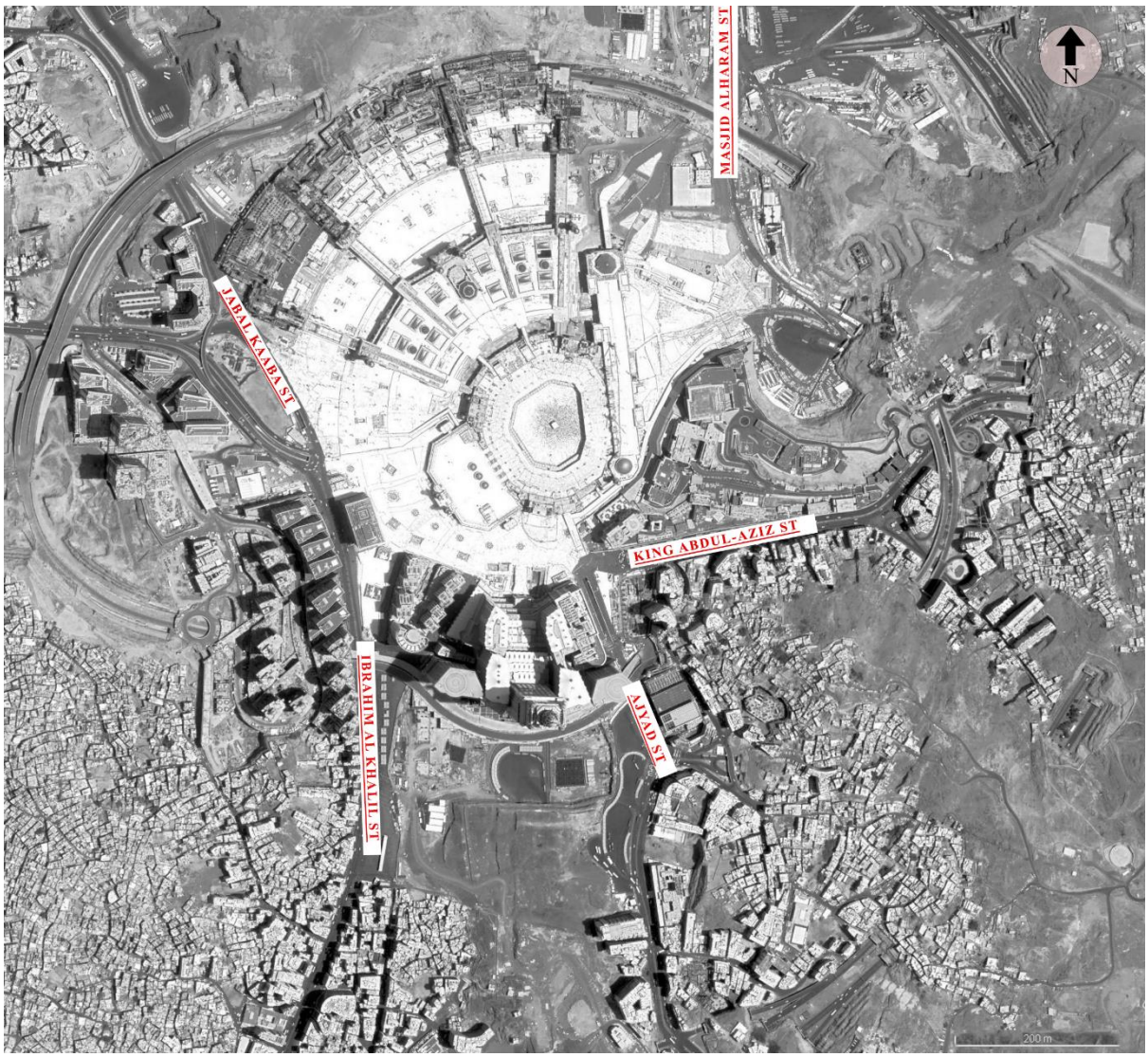

Figure 4.4 The main streets in the central Makkah city area.

4.5.1 ***Observation***

Researchers use interviews to obtain information from participants about their experience or what people think they do, but observation is used to look at their actual actions without them knowing they are being observed. Observation will provide data about people's activities and relationship to others, all uses including expected or new uses, and about behavioural opportunities and limitations that the environment provides (Zeisel, 2006). Creswell (2014) advises that observation is suitable for ethnographic and qualitative studies. Bernard (2017) defined direct observation as watching people and recording their activities in a particular place. The situation of this method has been applied in "studies of practically all aspects of the behaviour of young children, and it has been quite widely applied in classrooms, camps, homes,

discussion groups, playgrounds, museums, studies of the behaviour of adults, and special situations" (Jersild & Meigs, 1939, p.473).

Marshall & Rossman (2014) stated that "observation is a fundamental and highly important method in all qualitative inquiry" (p. 76). Direct observation will be used in this study to observe individuals' activity, such as walking in the study area and how they use the particular place. Many studies have used direct observation to study urban space and human behaviour. For example, Whyte (1980) observed urban life through urban spaces by looking at the uses of the surrounding urban setting and the activities of people, and viewed these spaces as a set of social life. Based on his observation, Whyte (1980) revealed that some elements such as sun, wind, trees, and water have an effect on the use of space and users' comfort and satisfaction. In the same manner, the sun in Makkah is one of the problems that restricts people from walking, but people still walk to the Grand Mosque uncomfortably under the burning sun. To study visitors' behaviour in urban spaces and to examine the streetscape elements that may encourage people to walk in such situations, direct observation needs to be carried out. In a study by Gehl (2011) in the centre of Copenhagen, it was found by using direct observation that the number of pedestrians tripled between 1968 and 1986 after closing a street to vehicular traffic. The conflicts between vehicular traffic and pedestrians in central Makkah are hazardous, particularly for the elderly, women, and children, and are an aspect that needs to be examined. The observer in this kind of observation makes no attempt to control or manipulate a situation, but simply reports what occurs, which gives more accurate data than the use of particular methods. The value of direct observation is specifically related to the evaluator's ability to capture detail, decide what is significant, and interpret what has been observed (Holmes, 2013). Furthermore, physical observation is part of the process to record the physical features of the street; for example, height of building, block length, and width of street and sidewalk width, which can be measured to identify the quality of the walking environment (Ewing & Handy, 2009).

This method is applied when other methods in procedures such as surveys and questionnaires are not viable, and the goal is to assess ongoing behaviours, activities, or events (Holmes, 2013). The researcher will use some of the observation techniques introduced by Gehl and Svarre's (2013) book *How to Study Public Life*, such as mapping activities, people, and places in order to get a sense of their usual activities and routes. The photographing technique is helpful, as the researcher can capture visual data on site in qualitative and ethnographic studies. Ball and Smith stated that:

> *"Photographs of people and things stand as evidence in a way that pure narrative cannot. In many senses, visual information of what the people and their world look like provides harder and more immediate evidence than the written word; photographs can authenticate a researcher's report in a way that words alone cannot"* (Ball & Smith, 1992).

The initial observation was undertaken to identify a broad spectrum of users who use the place. The weather in Makkah during the fieldwork is extremely hot, as it is the summer season, so the researcher tries to observe and capture the walking environment and individual reactions or situations in such temperatures. Tracking individuals to register movements allows the researcher to obtain details about their destination points and the route that is taken. This is a useful method to observe and measure walking speed and certain activities such as stays and stopping that take place along the route (Gehl & Svarre, 2013). This will express the special needs that people have when walking on streets in central Makkah and any issues or conflicts that people face while walking.

Direct observation procedures

During the field observation, two key parts of the data are pursued for (Figure 4.5). First and foremost, the purpose of this observation is to observe what individuals are doing on the site. In this study, structured observation was used to document the behaviours of users, with notes and a map being used to keep a record of what was happening. The main focus of this part of the observation was to watch people's behaviour for a specific time during the day and use a specific way to count and classify what could be seen (Gillham, 2000).

In this observation, field note sheets and photographs were taken to record people using the space and their interaction with the physical settings. During both weekends and weekdays, observations were conducted from the early morning to the night (Table 4.3). Activities such as walking, eating/drinking, or standing and sitting were recorded on the map with specific symbols for each activity. To obtain the whole picture of the actual situation in the space, activities, number of people, weather condition, gender of users, and pedestrian classification (individual, family) were recorded using the observation sheet (Appendix A).

Secondly, it was important to identify the physical features of the street, including the dimensions, patterns, and details (Appendix B). The variables relating to walkability and quality

of the walking environment were taken from the literature and past studies from different disciplines in urban design, culture, and psychology. The variables of qualities were selected and categorised. Physical observation was conducted using a checklist on the five selected streets, which were each divided into two zones (Appendix B). Photos were taken to record the physical appearance of the space.

During observation, tracking people's movement without their knowledge was carried out on the site. This is a useful method to register where and when certain activities take place and people's acts such as stopping, turning, and making unexpected movements along a route (Gehl & Svarre, 2013). The observer followed different individuals and small groups at a reasonable distance in order to avoid catching their attention and notifying them that they were being followed.

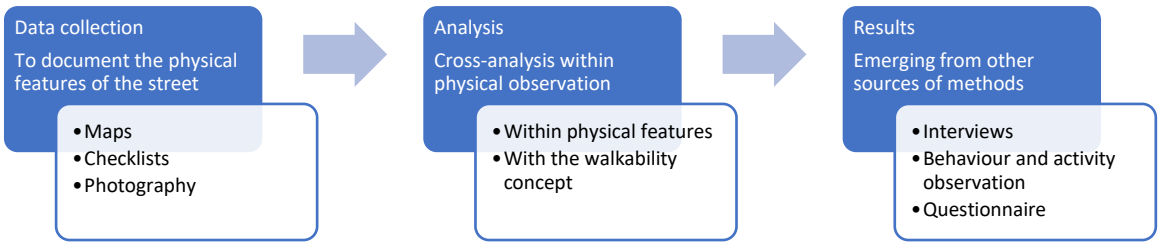

Figure 4.5 Physical observation procedure. Source: Author.

	Day	Time
Weekdays	Monday–Thursday	6am–8am 10am–12pm 1pm–3pm 5pm–7pm
Weekends	Friday–Sunday	6am–9am 12pm–2pm 4pm–7pm 8pm–10pm

Table 4.3 Observation times during the fieldwork

4.5.2 ***In-depth interviews***

Interviewing has been applied as a data collection method in urban design and landscape architecture by various researchers. Carpiano (2009) explains the use of "go-along" interviews as a type of data collection method in his article; this allows for the purpose of exploration with reference to people's lives and their places. Here, the researcher tries to obtain information on the experience of place from the participants. Ingold and Lee (2008, cited in Evans & Jones, 2011, p. 856) suggest that "walking with interviewees encourages a sense of connection with the environment, which allows researchers to understand how, for example, places are created by the routes people take". It is important in urban design that researchers understand how people feel and act in a specific place. Kinney (2017) defined walking interviews as when the researcher walks with the interviewee in a selected location, which is increasingly being used to explore the connection between a place and a person. Regarding familiarity with study areas, Evans and Jones (2011) depict a different typology of the walking interview, where each type has a different route that can be determined or undetermined by interviewee or interviewer (see Figure 4.6). To determine the current state of the streets and the sidewalks from people's experience in central Makkah, the walking interview needs to be part of a data collection method both with residents, who are familiar with the area, and with pilgrims, who are not. Conducting an interview while walking outside thus helps the researcher to collect data to design or resolve an issue they are experiencing on a daily basis.

The researcher needs to be focused while carrying out the walking interview with participants, as some words and locations may be lost. As a result, using GPS and audio recording is recommended in the method described here "to avoid overburdening the researcher and participant (already wired up for GPS and audio recording) with additional technology such as video cameras" (Evans & Jones, 2011, p. 851). The recording of the interview process enables an understanding of how accessible and frequent various everyday activities are for locals/visitors of central Makkah to do on foot or by another mode of transportation. Moreover, the camera is an essential part of the walking interview, which allows the researcher to record what has been seen and discussed (Kinney, 2017). As has been noted, the interview is an important tool for data gathering in this field and was therefore considered as one of the data collection methods in this research. One part of the interviews uses in-depth interviews with knowledgeable sources such as Makkah authorities, architects, and planners.

Here, some structure is provided by the researcher based on the interviewees' interests, which allows them to respond to questions in a more flexible way, providing more details and further descriptions (Brinkmann, 2014). In this situation, the interviewee controls the amount of information provided in answer to the questions, which helps the research to have a more complete understanding and receive more details from the respondents. In a semi-structured interview, there will be open-ended questions at the start of the interview, but it is important to note that it may take a lot of time to ensure understanding and to clarify the details to be analysed qualitatively by the interviewer (Harris & Brown, 2010). The interviewer then tries to obtain all the necessary information by encouraging the participant to generate more details to reach a specific point, which is more flexible than other types of interviews and helps to expand the interviewee's responses.

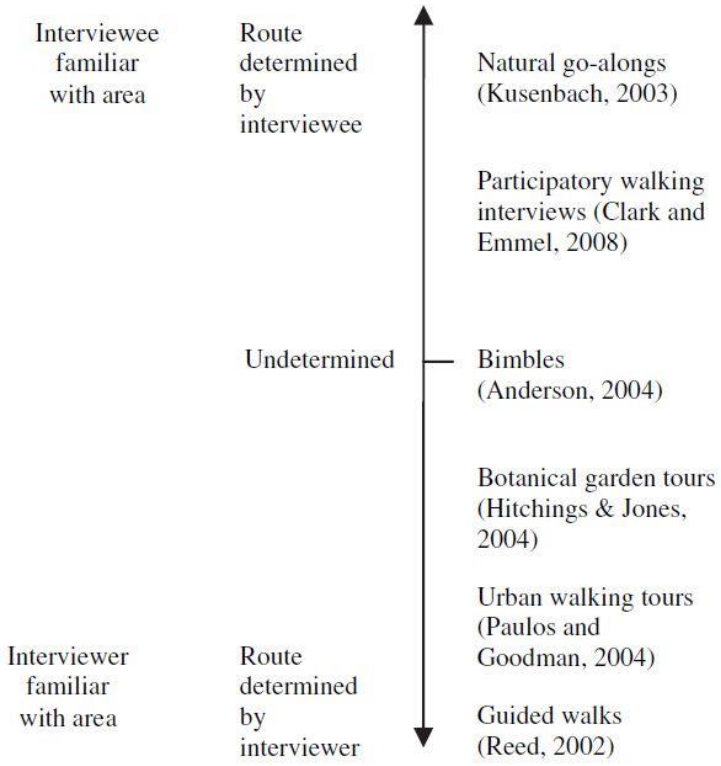

Figure 4.6 Typology of the walking interview. Source: Evans & Jones (2011).

Interview procedure

For the walking interview, there were four steps that were taken. First, stop random participants coming out of the mosque or their residence, then introduce the research to them and ask them

to participate. Second, once they are willing to do so, walking and talking starts while proceeding to their designated destination, with open questions being asked at the beginning of the interview before the detailed questions. The questions asked can be seen in Appendix C. Third, to ensure that there was no discomfort or misunderstanding, the respondents were informed that the researcher would be taking notes and photographs while they were under way. Indeed, one of the benefits of piloting the interviews was that it allowed for a more accurate estimation of how long the session would take. As a result, the participants were informed of the importance of recording such information as well as how it would be utilised. The purpose of taking this approach was to make it possible to interview certain persons who had no prior interviewing experience. Finally, at the end of the interview all participants were asked if they had any questions or remarks to add.

Walking interviews were planned to take place at different times of day, from early morning to night, whereas the interviews with the elite were desk interview-based and were scheduled in advance.

4.5.3 ***Questionnaire survey***

A questionnaire survey was used as a data collection method. In social research, questionnaires have usually is often used to determine the requirements of participants in evaluations, as well as in environmental and behavioural research studies (Bechtel et al., 1995). “Standardized questionnaires are used to discover regularities among groups of people by comparing answers to the same set of questions asked of a large number of people” (Zeisel, 2006). The researcher designed a questionnaire to evaluate people’s satisfaction with the street or the sidewalk quality in its current condition and presented it to people at random during the Al Hajj season and umrah. Also, survey data was employed for the purpose of identifying characteristics making a street friendly for individuals to walk on. To achieve simplicity in receiving responses, the research used face-to-face surveys, as Doyle (2014) describes the significance that this method may offer in terms of the amount and complexity of data that can be collected. Also, more than other methods, face-to-face surveys offer advantages in terms of data quality and allow researchers a high degree of control over the data process and environment. In the Makkah case study, the ease of the participants’ responses made face-to-face surveys preferable for the targeted group of respondents, as they were mostly visitors rather than local. Because of this, they were on site, which made it useful to conduct the survey without facing any difficulties in reaching the respondents, especially among people with poor writing skills or a disability,

compared with using techniques such as telephoning or mailing. In this research the format of the questions that the researcher followed is the Zeisel (2006) style; for example, using open-ended and close-ended questions, and Likert attitude scales. The level of measurement started with the first few questions giving respondents the feeling that the interviewer really wanted to find out what was wrong with a particular place, followed by a multiple-choice method using a Likert scale.

4.5.4 ***Sample size***

In the quantitative method, the sample size depends on the population of the case study. In a developing country such as Saudi Arabia, failure to update the census still occurs, which makes it hard to identify a reliable sample for the case study. Based on sample size calculators available on the internet and Krejcie and Morgan's (1970) study *Determine Sample Size for Research Activities*, the required sample size for the face-to-face questionnaire is 384 from a given population as a minimum (Table 4.4).

In the qualitative method, the goal is usually to gain in-depth insight, so the sample size will be determined by the researcher's experience in the field. Ragin & Amoroso (2018) explained saturation as the point at which the researcher keeps adding instances and stops learning new things about the case study. According to Bryman (2015):

> *"One of the problems that the qualitative researcher faces is that it can be difficult to establish at the outset how many people will be interviewed if theoretical considerations guide selection. It is impossible to know, for example, how many people should be interviewed before theoretical saturation has been achieved"* (Bryman, 2015, p.425)

The researcher continued conducting interviews and adding respondents until failing to gain any new information from the last few interviews. Qualitative studies tend to work with small sample sizes that can generate insight and in-depth information about a particular case (Willig, 2013). With elite in-depth interviews, the researcher used the snowball technique, which is described as " a process in which contact is made with participants appropriate for your research through whatever access route you can find, and through these first participants, you are introduced to others of similar/relevant characteristics for your research" (Edwards & Holland, 2013, p.6).

As this research applied a qualitative method, there were 29 interviews that were conducted during the fieldwork for the following groups:

1- Users: pilgrims who visit Al-Haram (14 participants);
2- Users: residents of the city (5 participants);
3- Users: shop owners/workers who work in the building around Al-Haram (2 participants); and
4- Local government: officials within different departments such as the Ministry of Hajj and Umrah, Holy Makkah Municipality, and the Development of Makkah Region Authority (8 participants).

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size.
S is sample size.

Table 4.4 Determination of sample size from a given population. Source: Krejcie & Morgan (1970)

Face-to-face questionnaire procedure

The face-to-face questionnaire was conducted on a walkthrough basis, with pedestrians being picked at random and requested to complete the questionnaire. As noted earlier, however, a very high percentage of participants chose to participate in structured interviews in which the researcher asked them the questions from the questionnaire and they responded, where there was an option to answer using the paper or iPad with the questions to do so. This tendency might well be interpreted as a preference for "face-to-face" situations (Appendix D).
A characteristic scenario involved the researcher approaching a random stranger and explaining that he was conducting a United Kingdom-based scientific study as part of the requirements for attaining a PhD in the subject. It was explicitly emphasised that participation was entirely optional, and that all information gathered would be kept fully confidential. Additionally, the participants were informed that the questionnaire should be completed in no more than seven minutes at the absolute maximum.

The pedestrians were given the chance to look at the questionnaire before deciding whether or not to participate, in order to ensure all of the questions were of the multiple-choice variety and can be answered by selecting one of the options. The purpose of using this technique was to make it possible to interview particular persons who had no prior experience of questionnaires.

Respondents' profile

This section will deliver the general profile of the sample. This will be accomplished using the respondent's socio-demographic data descriptive statistics. An aggregate 400 respondents took part in the face-to-face survey (Table 4.5). The respondents were categorised into two groups before the questionnaire survey was conducted: visitors and residents. The respondents were selected randomly within the boundaries of Central Makkah in order to ensure that all respondents were familiar with the area or at least used the street to the Grand Mosque.

In this questionnaire, most of the respondents were male (76%), with female respondents making up 25%. The male respondents showed more interest and were willing to participate more than the female respondents, which could be explained by the cultural and religious background contributing to the unwillingness to participate and answer the questionnaire questions. The majority of the respondents were visitors (74.5%), who showed more interest in being part of the survey and answering the questionnaire compared to the resident respondents. From this, majority of users are visitors and only 25% of the users were residents.

Types of users		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Local	102	25.5	25.5	25.5
	Visitor	298	74.5	74.5	100.0
	Total	400	100.0	100.0	

Table 4.5 Types of users participating in the survey.

Age of the respondents

From the results, it can be noted that the majority of respondents fall under the age group 31 40 (31%) and 41-50 (25.5%) (figure 4.7). This is due to the fact that the majority of the area's visitors fall within this age range. Because of the language barrier and difficulties in reading, elderly people were 21.5% with an age group above 50 years old.

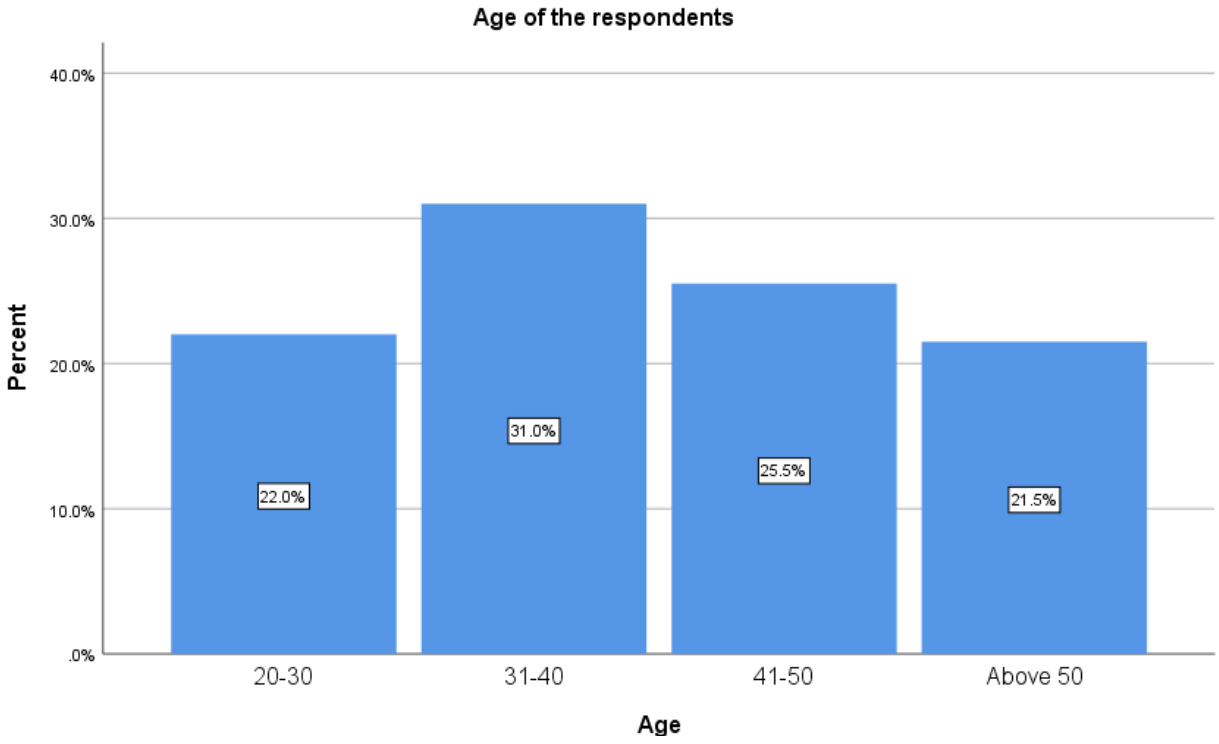

Figure 4.7 Participant age group.

Nationality of respondents

In respect of nationality, the users were categorized based on Saudi and non-Saudis. The respondents were mainly non-Saudis (69 %) while the rest were Saudis. This is because the city hosts many people/pilgrimages from around the world, so nationalities were limited to the

two categories. This suggests that there are always a higher number of pilgrims who come from outside of the city or the country.

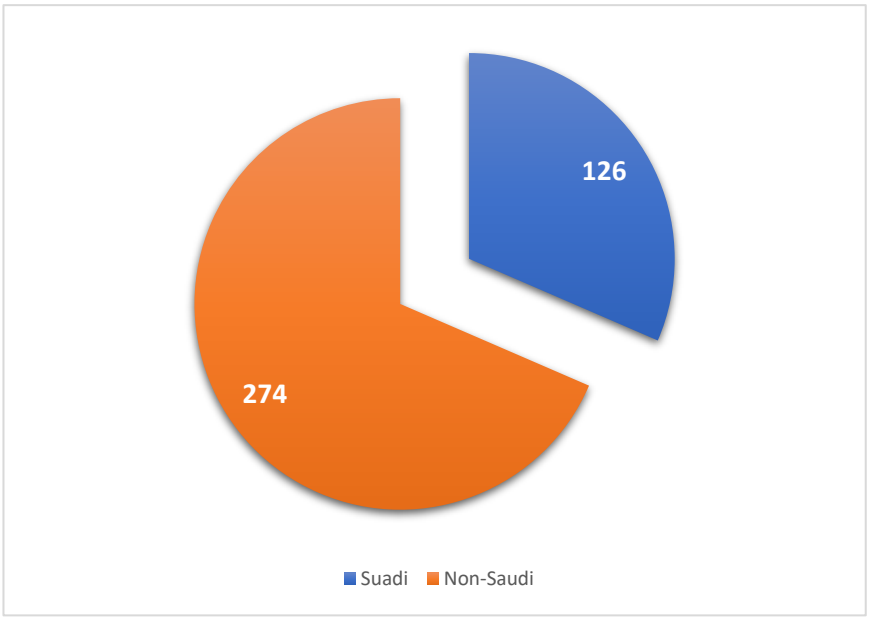

Figure 4.8 Nationality of participants

Secondary data

This study's secondary data came from written literature (articles, academic papers, textbooks, and journals), and statistics and numeric documents relevant to the case study (Makkah Al-Mukarramah). Five primary sources provided the data for the analysis. First, the information and statistics include demographics and the number of pilgrims produced by the Saudi central Department of Statistics and Information. Second, the Development Commission of Makkah and Al Mashaer produced the comprehensive Master Plan, which introduced policies to advocate the use of guiding principles, which act as a framework to create an environment for high-quality places to worship, live, and work. Third, statistics and information on heat stroke and heat exhaustion accidents, produced by the Ministry of Health. Fourth, data and statistics on pedestrian accidents on streets from 2013 to 2019, produced by the Traffic Department of the Holy Capital. Additionally, the Presidency of Meteorology and Environment (PME) provided information and statistics about the Makkah climate, including temperature, humidity, wind, and rainfall.

4.5.5 ***Instrument of data sources***

The following tools were used for the data collection:

1. Notebook: to record pedestrian behaviour and activities using the space during the observation.
2. Camera: to capture the physical settings and street behaviour to gain detailed evidence of how the street is used.
3. Video camera: for recording and showing the situation of the activities and behaviour of people at a certain time, and the dynamic of people using the space.
4. Counting tool: to get a sense of the numbers of people using the street at various times during the day.
5. iPad: used during the face-to-face questionnaire with Internet access to collect the participant's answers, which had the potential to be a useful survey tool.
6. GPS by phone: to capture the route of the participant during the interview while walking.

4.6 Data Collection Assistance

To accomplish their tasks in studies involving outdoor activities that require interaction with the public, researchers often require additional support. One of the advantages of having a non-study-affiliated aid staff is that they can help you with the study is that the data may be collected more unbiasedly as a result. Because of such restrictions, and the desire by the researcher to sustain a cheerful and consistent attitude, while gathering both essential samples and data, there was a need to co-opt certain assistance during the fieldwork.

It was necessary to follow this procedure since the researcher had no control over the chosen places in terms of their open character, which made obtaining a illustrative sample difficult, nor did the researcher have control over the pedestrians who frequented the sites, particularly on weekends, and because the researcher needed to ensure that a sufficient sample size was obtained that included all community layers; as a result, the researcher enlisted the assistance of one volunteer, which was a woman who only sometimes assisted the researcher, a family member of the researcher who also had a Master in architecture.

Considering that interaction between males and females in Saudi Arabia can be a sensitive area, it was inevitable that this study enlisted the help of a female assistant so that sufficient data could be collected from the female members of the sample. It is likely that women might have been unable to participate in this study if such support had not been provided. Another factor that contributed to the research's novel methodological approach was the inclusion of women in outdoor-related studies, which is uncommon (if not impossible) in Saudi Arabia. In fact, women are almost never involved in outdoor-related studies in the country.

For the following reasons, the fieldwork assistance was divided into two groups, each with 2 members, and the data collection procedure was carried out at the same location, at the same time:

- To confirm that the procedure was appropriately applied, and that data were productively gathered under the researcher's direct guidance and supervision;
- To make it easier for the researcher to intervene when more explanation was required, or even to demonstrate that the field study had been granted formal permission to be conducted (see Appendix E); and
- The presence of this number of assistants in one location helped to formalise the process, which aided in establishing the credibility among the participants, which was one of the socio-cultural issues.

4.7 Data Analysis Procedure

Both primary data and secondary sources were applied in gathering data for this study. The primary data were collected using walking interviews with visitors and residents of the Makkah Al- Mukarramah central area, and direct observation of pedestrian activities and behaviours using the space. Other sources, like government reports and articles were used to gather secondary data. Both quantitative and qualitative methodologies were used in processing the data to find a connection between them. The study relies on the data that were collected from the fieldwork using observations, interviews, and face-to-face questionnaires. By using this mix of methods, the findings are stronger and allow for a more in-depth exploration before triangulation. The data were collected and analysed independently for each method.

The gathering of data was conducted from 1 July to 19 September 2019. The interview was one of the qualitative methods used to answer some of the research questions, which focused on the experience of walking and the extent of walkability in a hot, arid climate such as Makkah Al-Mukarramah. The questions were formulated to obtain the participants' experience walking in central Makkah and were translated into Arabic in case some of the interviewees spoke Arabic as well as English. There was contact between the researcher and some elite interviewees who were willing to participate in the study.

As stated earlier, 21 participants were interviewed while walking with the interviewer, where audio and GPS were in progress for recording. The participants in the walking interview fell into different categories of residents, such as visitors and shopkeepers or workers, with most of the interview routes determined by the interviewees. After being transcribed, the recorded interviews were translated from Arabic to English. Elite interviews were desk-based interviews that were carried out using the semi-structured interview method with influential and knowledgeable sources and influential people such as city planners and officials from the local authority, to obtain their opinions and challenges on the current/future situation.

Qualitative data was collected from open-ended questions that were analysed descriptively. The observation data were analysed to investigate the patterns of the street in terms of people's behaviour and functional settings. Data help to explain the variations in behaviour settings by pedestrians and understand the physical setting of streets – how the surroundings or layout and features help pedestrians to walk. The semi-structured interviews were focused on obtaining information and clarifying certain behaviours from direct observation. The audio recordings of all interviews were transformed into text, after which these written forms were analysed. The analysis was carried out using a qualitative method called thematic analysis.

Thematic analysis was used to help the researcher represent the findings in an organised and systematic way. This technique is a method used to organise and describe data in detail after identifying and analysing themes within them (Braun & Clarke, 2006). Thematic analysis moves through three phases: seeing important information, encoding it, and explaining or translating the meaning of it (Boyatzis, 1998). By using this type of analysis, the researcher was able to identify themes that were based on the ideas that recurred most.

The second set of data was from the face-to-face questionnaire and was analysed using Statistical Package for the Social Sciences (SPSS) software. The software is used for descriptive and inferential analysis in order to determine the characteristics of respondents and the

connection between variables. The software created descriptive analysis, which was displayed in the form of tables and figures.

The results are shown in both qualitative forms (descriptions/statements) according to issues concerning walkability, and quantitative forms (percentages/frequencies), with the use of tables and graphs. This action was completed to enable a conclusion to be derived from the two data sets via comparing patterns (themes and categories), relating variables (identify the relationship between), and relating the findings to the whole study.

4.8 Limitations and Ethics of the Methodology

Ethically, confidentiality was an important part of conducting the fieldwork because it was carried out in public, which is a factor that needs consideration and that participants need to be made aware of. The authors of the book *Landscape Architectural Research* explained that: "It is normal in most social science research to provide a written introduction to the person being questioned explaining the purpose of the research, how the findings will be used and disseminated, and what provisions have been made in terms of confidentiality" (Deming & Swaffield, 2011, p.157). For instance, after compiling all information and responses, social researchers are required to ensure that all the information remains anonymous, that it is kept in a safe place, and that it is coded to be used easily in analyses and reports. Typically, the researcher will provide information about their research to the participants and obtain their consent, and make sure that the respondent's identity is only known by the interviewer and is protected from the public (ibdi). Some locations also require written permission for an interview to take place there. This varies from one place to another, so in this regard, the researcher was considering potential issues that might occur and preparing for them before starting the fieldwork. Ethical issues should also be considered during the interview process in order to protect participants and avoid any harm.

This research investigation has a number of methodological limitations, which are listed below:

First, in both public and private environments, segregation of women and men is required by Islam, unless they are related by marriage or blood. Due to this, the researcher faced some difficulties conducting interviews with women.

Second, since the majority of participants had never been questioned before, the researcher had to explain the study and go through the questions in a simple way for each interview, especially with the elderly and interviewees without a background in the subject. It took around half an hour during each interview to go through the list of questions.

Third, the researcher encountered some concerns with different parties such as the Holy Makkah Municipality and the Development of Makkah Regional Authority in regard to access to original and historical information about the city, including maps and numbers. The work culture in the government departments led to substantial difficulties in gathering information and statistics, which was time-consuming.

Fourth, the unavailability of planners, designers, and professionals from relevant authorities involved in city planning was another issue. Unfortunately, even with scheduled meetings, some of them did not show up and there was no opportunity to meet, and so some important materials and information could not be accessed without them. However, regardless of this, there was some useful information that was available from some departments, although this required dealing with other processes and permissions, which was also time-consuming.

Fifth, another limitation was the language barrier between the researcher and some pilgrims. As the focal point of the religion, central Makkah hosts millions of pilgrims coming from different countries and speaking languages other than Arabic and English, which was an obstacle for the researcher to interview.

Sixth, regarding the face-to-face questionnaire, it is generally accepted that attempts to conduct fieldwork outdoors with no assistance can only do 200 or fewer interviews per year (Bernard, 2017). This is the basis for the minimum of 30 participants used in this study. It would also allow the gathering of data from each research location per day, considering that this was determined to be adequate for running the SPSS, creating valid data and making the findings reliable (Kremelberg, 2010; Sahu, 2013).

As a result, 417 questionnaires were completed in the five locations that had been selected. There were a total of 400 valid questionnaires or individuals that were successfully interviewed for this study. The remaining 17 forms were from those who asked for some time to read the form before deciding whether to participate or withdraw from the study.

Lastly, the procedure of direct observation and photographing in this context was not simple, particularly owing to the presence of a large number of people in places such as central Makkah, where safety is crucial. The process to apply for permission was long and dealt with different departments, including the police. Actually, obtaining such permission was another challenge, as this process took an unnecessarily long time.

4.9 Conclusion

This chapter presented the research methodology that explored the walkability of central Makkah and its quality. It is the most important chapter, as it guides and directs the research process. In examining walkability and determining why the built environment is not user-friendly, three major keys were recognised as critical to this study. These include pedestrians' experience, pedestrians' behaviours, physical and quality dimensions, and pedestrians' perceptions and needs. Determining these keys was established through the use of a case study method. The method was selected based on the fact that it has been recommended by many scholars as the most suitable technique when dealing with these kinds of studies. The results were produced using the mixed methods employing a mixture of data collection methods. In the achievement of the research objectives, this is crucial in relation to the challenges raised in the research problem, even though not from a physical perspective but from a social and functional point of view.

The analysis of pedestrian behaviour and the space's physical declinations was accomplished using the field observation method. This method is mostly used in built environments and behavioural studies. To determine the association between behaviour and the physical characteristics of the space maps and photo documentation were applied. Photos were used to record information while observing, along with field notes.

In-depth interviews constitute the qualitative techniques used in this exploration. Semi-structured interviews were determined to be the highly effective method of obtaining detailed data from respondents' answers and allowing issues to emerge that may not have been addressed during observation. Through interviews, the respondents could relate their experiences that were relevant to the research from their perspective. Therefore, in this research, face-to-face questionnaires were used to complement the qualitative data.

Questionnaires were used in determining pedestrian needs and evaluating the built environment. In the present study, the sample used in this research was extracted from the Makkah residents and the pilgrims. Due to the fact that the respondents came from a variety of demographic backgrounds, this allowed for the identification of additional information about the similarities and contrasts between the factors that contribute to exploring walkability in central Makkah from users' different perspectives. The findings from this data supports and strengthens outcomes from interviews and observations.

The data from two datasets were triangulated to discover the convergence of the results. Each approach has its own strengths and weaknesses, and triangulation was employed to complement each method in the research findings. By using this technique, the data is more comprehensive, with understanding and explanation of the research problems from multiple aspects and perspectives.

Chapter 5. Introduction to the Case Study

5.1 Introduction

This chapter introduces the study area. The purpose of this chapter is to detail the background and history of the study area and its demographic information. This chapter is divided into four sections following the introduction. The first section provides the geographical location of the Central Makkah area. The second section provides general background about the city. The third section describes the history of the city's transformation from the past to the present followed by the conclusion of the chapter. The fifth section describes the climate parameters of the study area.

5.2 Geographical location

Before introducing the study area, it is important to describe Makkah, the sacred city, where the Grand Mosque is located. Makkah Al-Mukarramah is situated in the west of the Kingdom of Saudi Arabia, about 75 km away the Red Sea; it occupies an area of 138,941 km^2, and is located in the Ibrahim valley in the surrounded by the Sarwat hills at 700 m above sea level (Ascoura, 2013; Geomatika, n.d.). The geographic coordinates of Makkah are: latitude: 21^{o}42'25"N, longitude: 39^{o}82'61"E (see Figure 5.1). The study area – the area surrounding the Grand Mosque – is located within the core of Central Makkah. Makkah city is a hill between two large basins: the northern Fatimah valley and the southern Noaman valley. The valleys off this hill, then, do not run within it, but go around it from the north, east and south. There are several valleys in Makkah, four of which are within the Makkah Haram area's boundaries: from north to south they are Zaher, Ibrahim, Mahasser and Lahijah. Each valley consists of several minor basins that form a network of water drainage, plus smaller minor basins such as Al-Husainiah (south), Ash-Shuaraa (east) and Shemeisi (west) (Geomatika, n.d.) (see Figure 5.2).

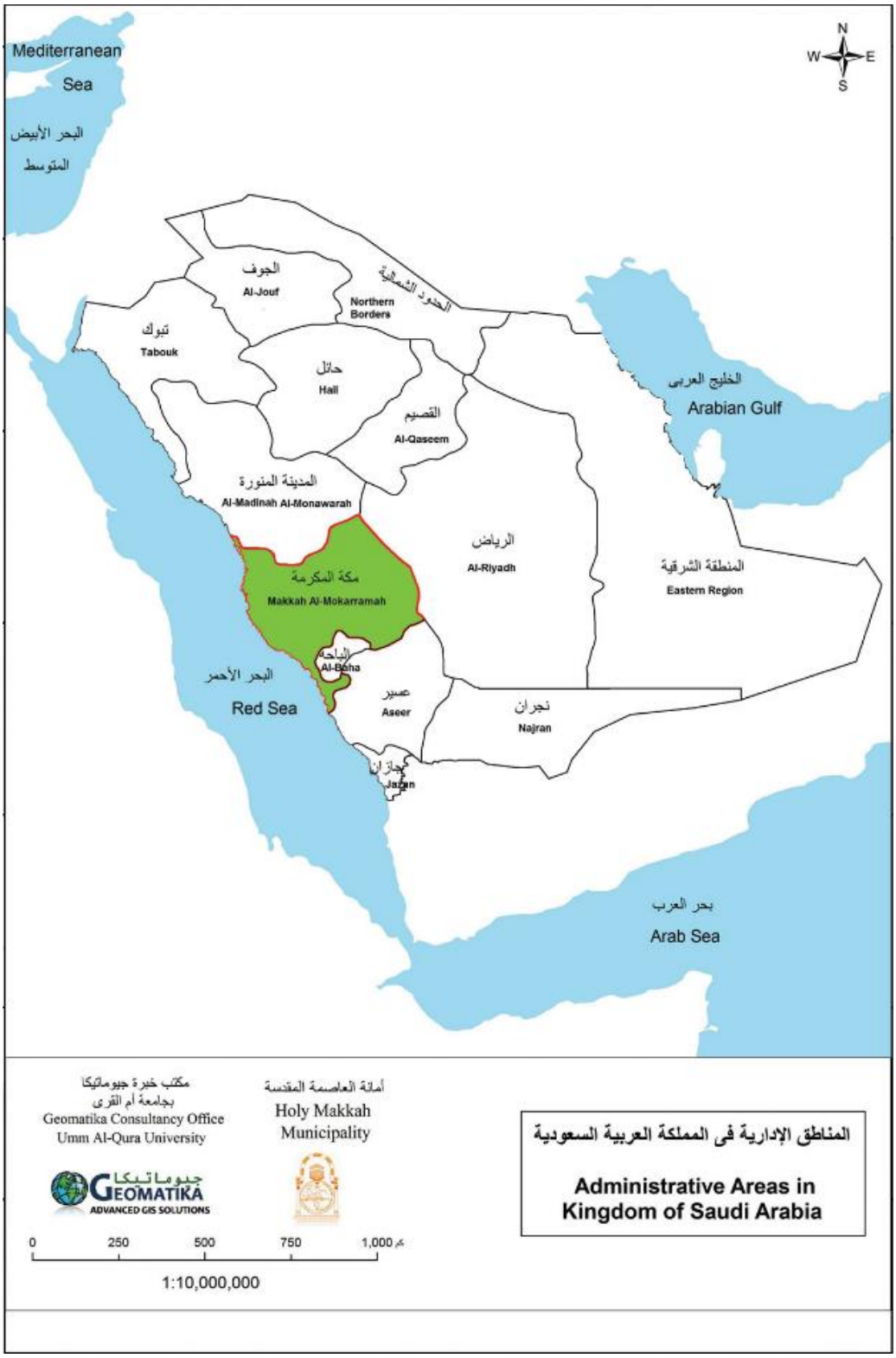

Figure 5.1 Location of the city of Makkah within Saudi Arabia. Source: Geomatika Consultancy Office, Umm Al-Qura University.

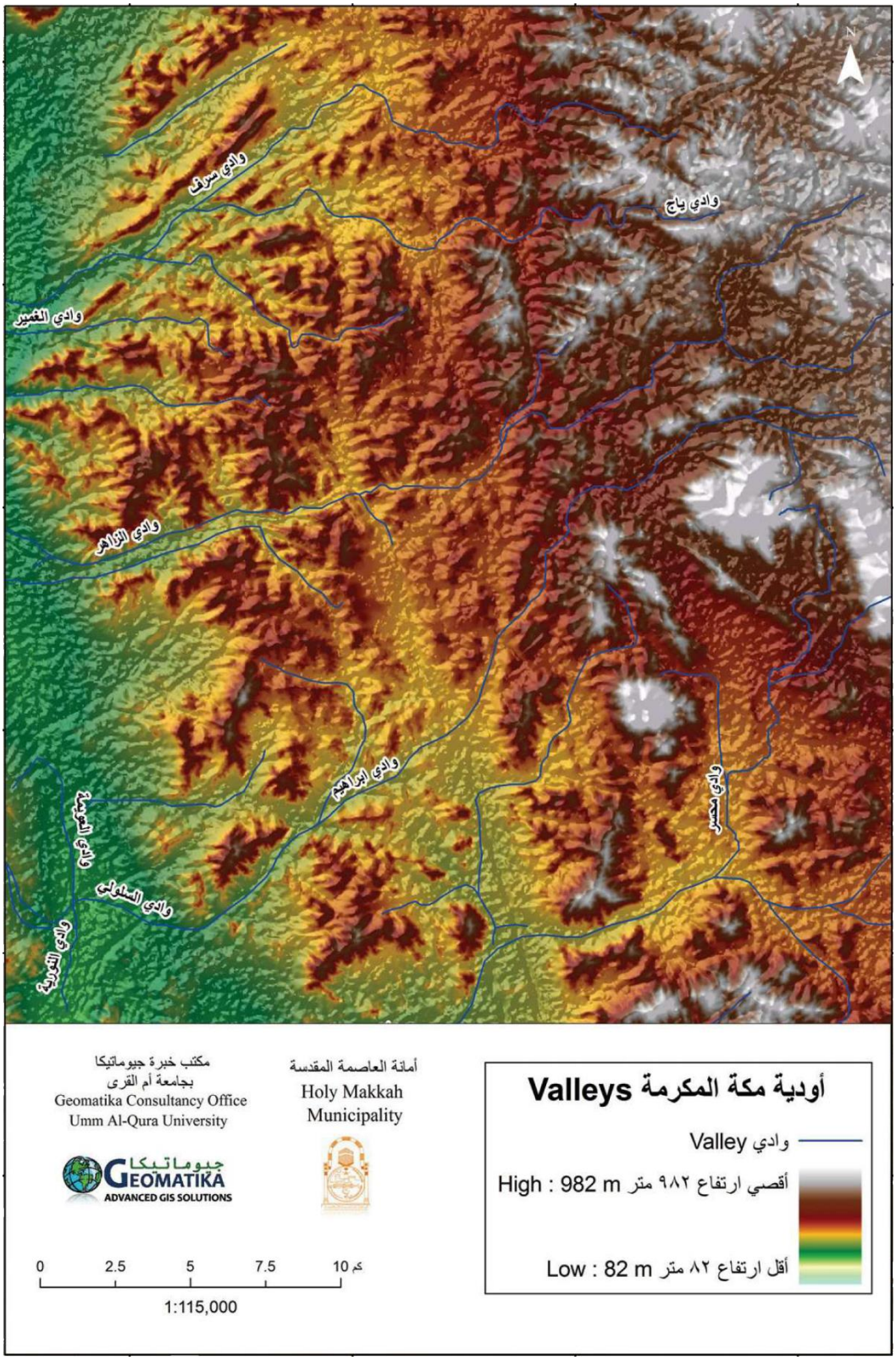

Figure 5.2 Valleys surrounding the city of Makkah. Source: Geomatika Consultancy Office, Umm Al-Qura University.

5.3 General background

5.3.1 ***Historical significance***

According to Muslim beliefs, the significance of Makkah dates back to ancient history. Allah chose this lonely, if isolated, location amidst the desolate foothills of the Arabian Peninsula as a home for the family of prophet Abraham, his wife Hagar, and his son Ishmael, peace be upon him. This turned the place into the centre of the Islamic faith for all Muslim states worldwide. History books show that Makkah became a city for Islamic travellers ahead of Islam; this agrees with Abdullah Ibn Al-Zubair, the Prophet Mohammad's companion: “Seven hundred thousand of the children of Israel performed Hajj at this House. They took off their shoes at Tane’m and after that entered.”

These ideals are not credited uniquely to the building of the Grand Mosque itself, but at the same time are presented about all sites inside the boundary of the Haram land. As described by Atta’a when he stated: “while Ibn Al-Zubair was giving his speech, he stated: Prophet Mohammed said: ‘A prayer at my mosque is better than 1,000 prayers anywhere aside from the Grand Mosque and a prayer at the Grand Mosque is a hundred times better.’ Atta’a said: ‘In the event that it is 100,000 times better, I asked: “Oh, Mohammed’s father, is this virtue just for the Grand Mosque or for everywhere on the Haram of Makkah?”’ He – Ibn Al-Zubair – replied: ‘No, it is for everywhere on the Haram of Makkah.’”

Makkah is not like other cities in the region, as mentioned by Abdullah Ibn Abbas, Prophet Muhammad’s companion, who cited the Prophet, “Allah has made Makkah a sanctuary and it was a sanctuary before me and will be so after me. It was made legal for me for a couple of hours of the day. No-one is permitted to evacuate its prickly bushes, or to cut its trees, or to chase its diversions, or to pick up its fallen things except for an individual who declares it publicly.”

5.3.2 ***Religious significance***

Makkah is considered the holiest place in the Muslim world, being the birthplace of the Prophet Muhammad, and the site of his first revelation of the Quran. A Muslim is obliged to perform pilgrimage to Makkah once in his or her life, a ritual known as *Hajj*, which is one of the five pillars of Islam. Whereas the people of every other country practise many religions, Islam is the

exclusive religion in Makkah and Al-Madinah. Each Muslim, regardless of their location on the world, must pray facing Makkah. Additionally, Muslims consider that one prayer said in Makkah's Grand Mosque is equal to 100,000 prayers offered in any other mosque. Individuals doing Hajj or Umrah must enter the mosque in *Ihram*[2], and the ceremonial showers are required. Since before the advent of Islam, Makkah has been a privileged and safe location. In the Holy Quran, Allah, the almighty, declared that:

"For the protection of Quraish. Their security during winter and summer journeys. Let them worship the Lord of this House. Who has fed them against hunger, and has secured them against fear." [106:1–4]

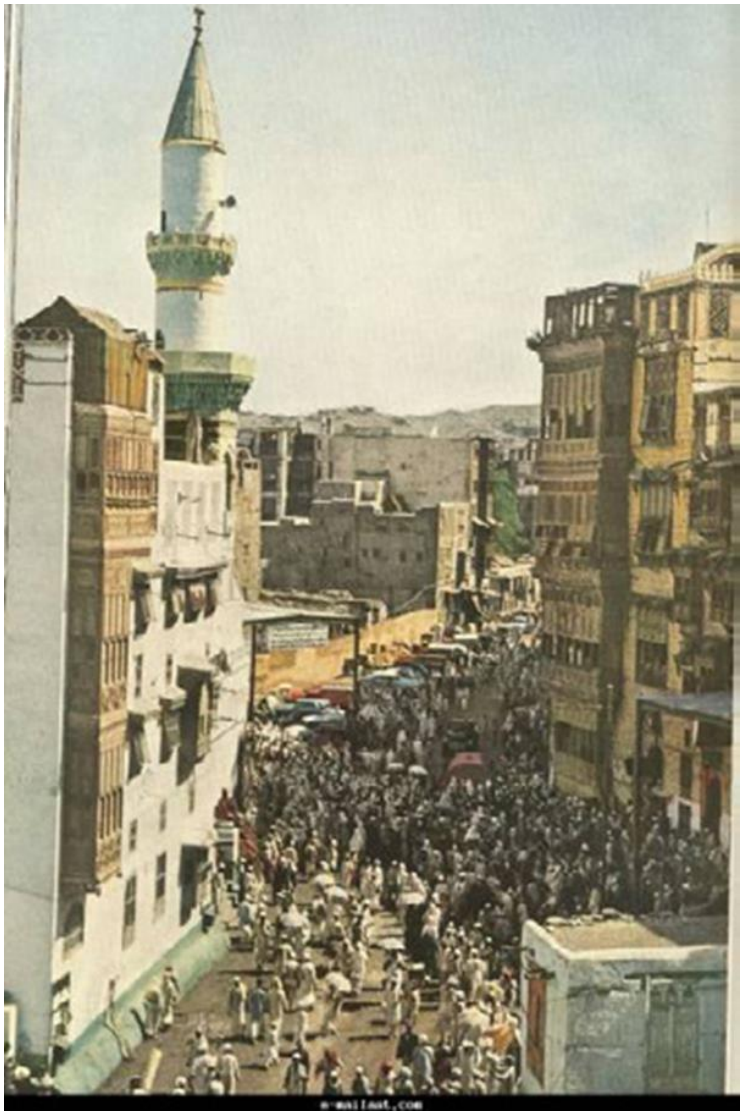

Figure 5.3 Makkah street in 1953. Source: (Mirzā, 2005)

[2] Ihram: "the dress worn by male Muslims on their pilgrimage to Mecca, consisting of two white cotton cloths, one worn round the waist, the other over the left shoulder2. dictionary.com

5.3.3 ***Journey to Makkah***

Makkah‘s most important landmark, the Grand Mosque, is sited inside the central district, alongside most of the business activities (hotels, retail shopping centres, etc.). The three other consecrated sites, Mina, Muzdalifah and Arafat, referred to collectively as Al Mashaer, are situated on the south-eastern side of the central district. Figure 5.4 demonstrates the holy places of Makkah where the pilgrimage rituals occur in the following manner, as explained by Al-Ageel (2011):

1- Al-Masjid Al-Haram, the Grand Mosque, which contains the Holy Ka'aba and performs *Tawaf* rituals. Between the two hills of Al-Safa and Al-Marwa, pilgrims must complete seven circumambulations and the Sa'ee ceremony (see Figure 5.5).

2- Mina is a valley situated around seven kilometres south-east of the Grand Mosque, where on the eastern end of the valley, the roadway connects to Arafat. On the Hajj’s eighth day, pilgrims go to Mina, their first destination and stay there for one night in preparation for the journey.

3- The location of Arafat is to the south-east of Makkah. It is at a distance of around 22 kilometres from the Grand Mosque and occupies a 20-square-kilometre region. This is where pilgrims spend the eneture 9th day of the Hajj, from dawn to night, practising the *Alwqfa* (stay) rite on Arafat, worshipping God and doing the abbreviated Asr and Dhohor prayers in Masjid *Namerah* (mosque). They then return to Muzdalifah as soon as the sun sets.

4- The next stop is Muzdalifah, after Arafat and before Mina, when pilgrims say the *Isha and* Maghrib prayers together. Pilgrims spend the night and begin their journey back to Mina before daylight (on the tenth day of Hajj).

1- In Mina, immediately after stoning the large pillar (*Jamratul-aqabah*), pilgrims return to their final destination, the Grand Mosque, to perform *Tawaf* (*Al-Ifadah*), the final ritual without which the Hajj is incomplete.

Hajj occurs during the final month of the Islamic calendar, and includes five stops, starting in Mina, then Arafat, then Muzdalifah and Mina again, then finally the Grand Mosque. This can be performed over five days. *Umrah* is a pilgrimage to Makkah that can be performed by Muslims at any time of the year. Unlike the Hajj, Umrah only requires pilgrims to visit the Grand Mosque (Al Sudairy, 2015). Thus, the area where Hajj takes place does not attract commercial or hospitality services like the Grand Mosque area. In any case, because of the huge number of pilgrims during the Hajj, these destinations go through a yearly transportation upgrade, maintenance and improvement. People have a variety of transportation options to get to Makkah from Jeddah International Airport, such as cars, buses, taxis and the Haramain High Speed Rail, which started operating in 2018.

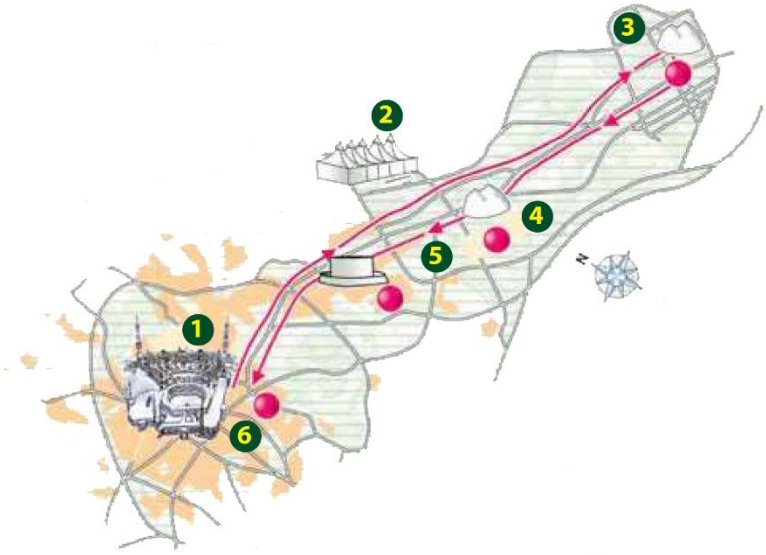

Figure 5.4 Hajj ritual sites. Source: Al-Ageel (2011).

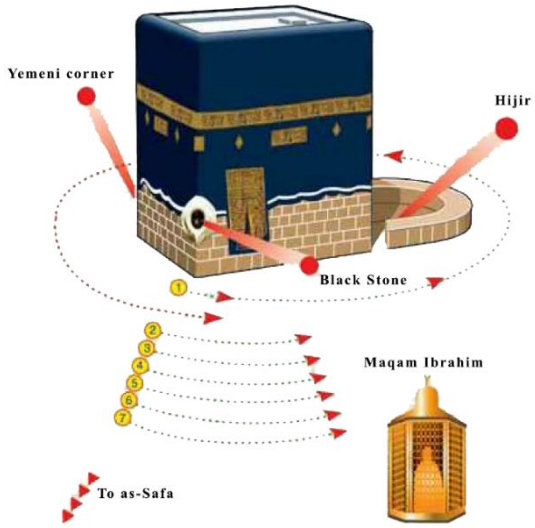

Figure 5.5 *Tawaf* around the Ka'aba. Source: Al-Ageel (2011).

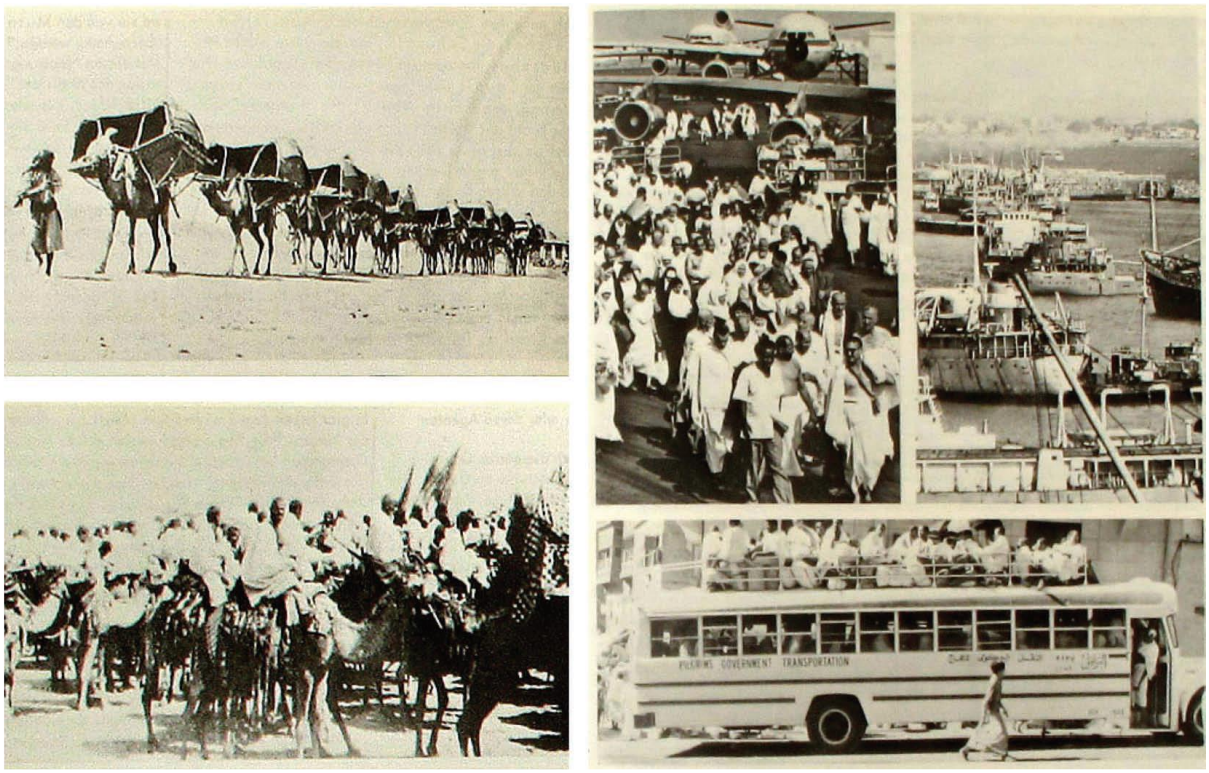

Figure 5.6 The main transportation used in the past to reach the Grand Mosque. Source: (Mirzā, 2005).

5.3.4 ***Topography***

Makkah lies in a hot, sandy valley, hardly has any trees or shrubs, and is surrounded by barren and rocky hills, completely without greenery. The valley's length is approximately 1219.2 meters and the width about 91.44 meters, and it slopes in a southerly direction. In the valley's bed lies the Ka'aba or House of God (Beit Allah). All the streets slope towards it, and it stands as if in the pit of a theatre (Al Sudairy, 2015). The way it stands is as if it was in a theatre pit and all the streets slope towards it.

Hills and valleys dominate the terrain of Makkah, creating a unique and fascinating scenery that differs from the rest of Saudi Arabia in terms of topography. The hills, in particular, are the most prominent characteristics in the area around the city centre, despite the fact that they are a hindrance to its development and expansion (Geomatika, n.d.).

Throughout history, the holy topography in which Al-Masjid Al-Haram is located has been significant in its morphology. The natural physical formation of the rocky hills surrounding the city has given the shape, development and transformation of the mosque fundamental restrictions and directions (Association of Consulting Engineers Pakistan, 1977)

The Makkah landscape, distinct from the rest of Saudi Arabia, makes for unique yet interesting scenery. In fact, the hills shape the most striking features around the city centre, but they are an impediment to its growth and development in a sequence of horizontal directions on the plain or up the lower slopes of the mountains; this form of topography has constrained urban growth.

In the case of Makkah, geography has had an important influence in determining the form of urbanisation that developed in the city. History has shown that urban expansion was restricted between the surrounding mountains and concentrated around the Haram because of its natural location. At the moment, development has spread throughout the highlands, driven on by rising population levels and made possible by improved road networks and modernised modes of transportation. Other factors contributing to expansion include the massive increase of Hajj pilgrims and those performing *Umrah* over the years, which has been a key engine of growth (MMM Group & Moriyama and Teshima, 2011).

Flooding affects most areas of the city, particularly around Al-Haram, because of its position in the lowest part of the valley where there is an overspill of water (Mekki, 1988; Alamoudy, 2017).

It was not until recently that, with the introduction of modern technology, these natural constraints ceased to exist as a major design force. Contemporary technology allowed more improved flood protection, while the rocky hills were excavated due to the dictates of traffic and other phenomena (Association of Consulting Engineers Pakistan, 1977)

5.3.5 ***Population and demographics***

Over a period of a hundred years, Makkah has been transformed from a small valley town of 100,000 inhabitants and 200,000 pilgrims to a city of 1.6 million residents and over nine million pilgrims (three million for Hajj and six million for *Umrah*). The influx of pilgrims at the start of the century during the Hajj season is equal to the flow that the city receives on a weekly basis today. Over the decades, these pilgrims have collectively preserved a rich account of Makkah and its transformation (Al Sudairy, 2015).

Makkah has a religious administrative centre; a significant number of immigrants are naturally attracted to it. Over the years, the population of Makkah has grown significantly. The chart in Figure 5.7 shows the estimated and projected population of Makkah by nationality from 1998 to 2038, when the number will reach 3.63 million. In 2018, the population of Makkah was 2.14

million people, with 46% of these non-Saudi. Moreover, Makkah hosts several million pilgrims during the days of Hajj and *Umrah*, making it the largest gathering in the world. As shown in Figure 5.8, the number of visitors is increasing at an incredible rate and will reach over 14 million by 2040. The visitors coming for *Umrah* from outside the country will reach ten million by 2040 (MMM Group & Moriyama and Teshima, 2011).

The population of the 12 governorates that make up the Makkah Al-Maukarrmah region vary significantly from one another. The city of Jeddah has a population of 3,456,249 people, accounting for about half of the total population of the whole region. Following that is the Governorate of Makkah Al-Mukarrmah, which has a population of 24.2% of the overall population of the region. The city of Makkah has a population of around 1,534,731 people. They are found in a variety of locations across Makkah.

The city of Makkah is distinguished by a significant number of non-Saudi inhabitants, which is a result of the city's distinctive religious status, which serves as a key draw for students and the local labour force. At the contemporary distraction on the outskirts of the city, the number of Saudis has climbed in recent years. However, when they were populated, the traditional historical neighbourhoods close to Al-Haram had a lower population of Saudis than they have now. They have now been included in the most recent enlargement of the Grand Mosque and its surrounding squares (Geomatika, n.d.).

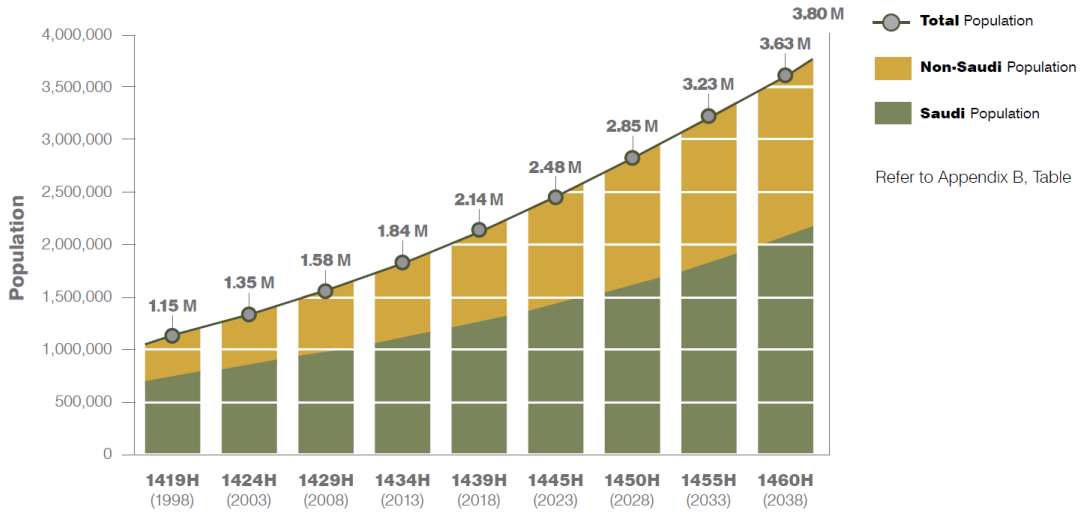

Figure 5.7 Population projection according to nationality. Source: (MMM Group & Moriyama and Teshima, 2011).

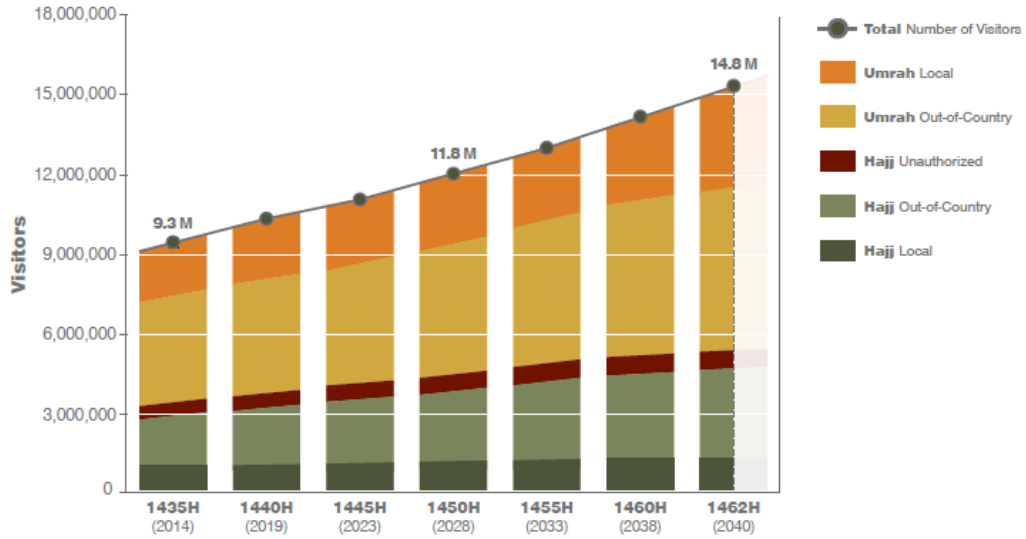

Figure 5.8 Visitors' projections during Hajj and *Umrah* seasons. Source: (MMM Group & Moriyama and Teshima, 2011).

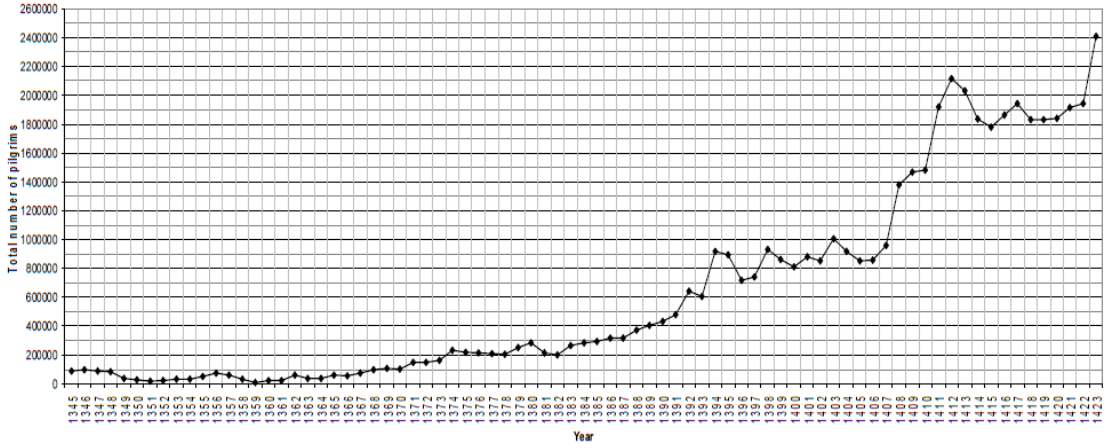

Figure 5.9 Total number of pilgrims 1345–1423 AH (1965–2003 CE). Source: Custodian of the Two Holy Mosques, Institute of Hajj Research.

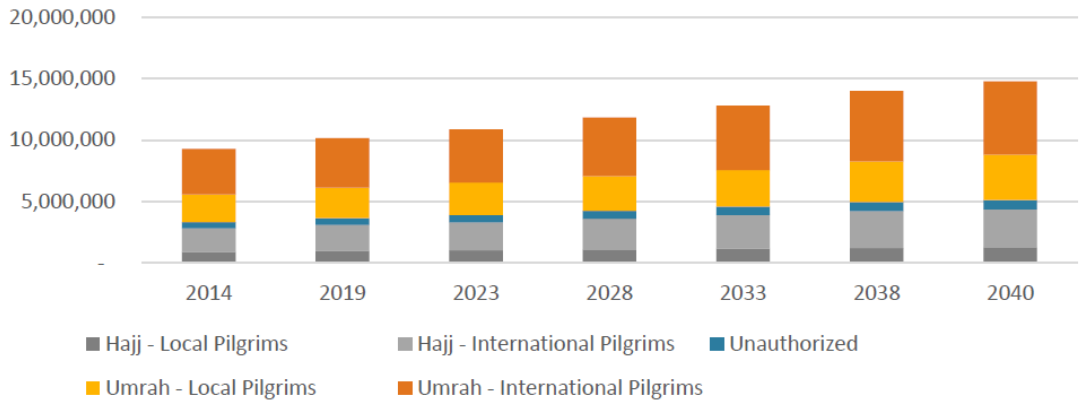

Figure 5.10 Projected growth of religious tourism. Source: DCOMM (2013) (Development & Growth Strategy).

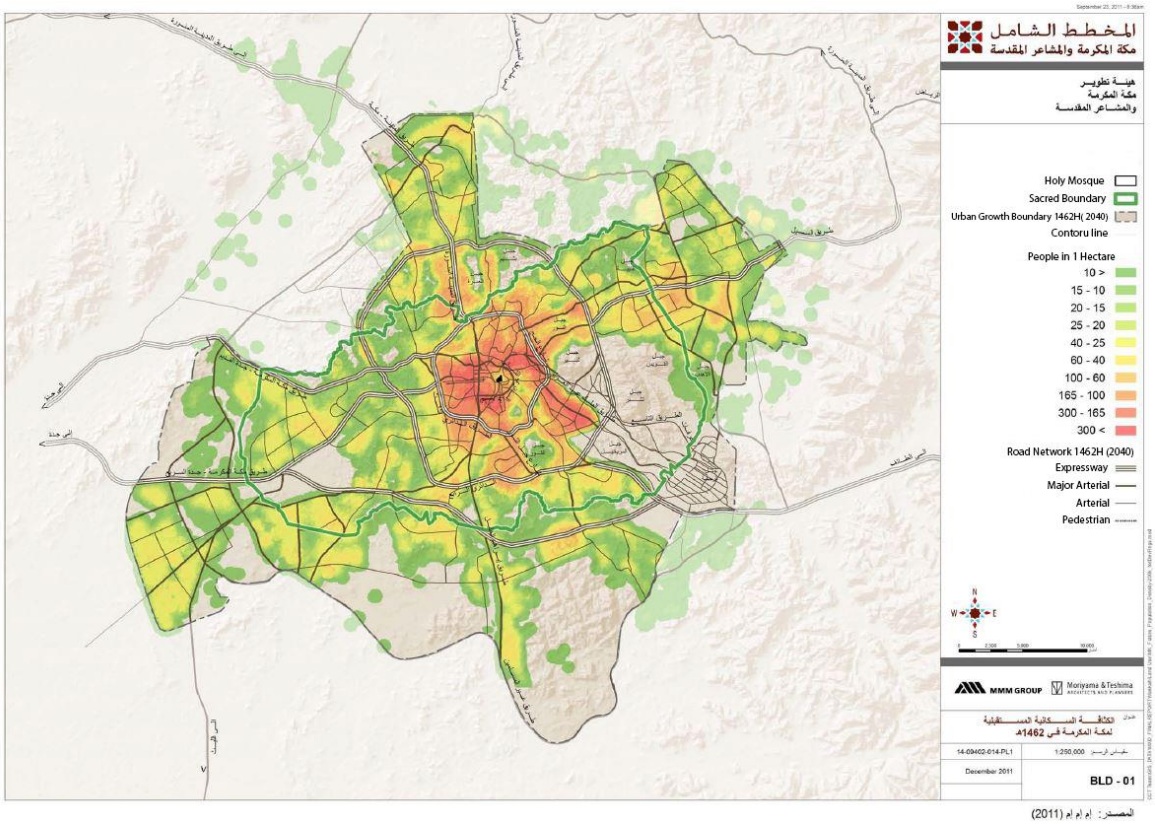

Figure 5.11 Makkah's projected density by 2040. Source: (MMM Group & Moriyama and Teshima, 2011).

5.4 Makkah Urban Growth

Makkah's urban development phase indicates that the location and design of the holy city were based more on religious than secular considerations when it was first established. The construction of the Ka'aba marked the beginning of the city's development as a construction

and civil engineering centre. The legendary Ka'aba was responsible for determining the position of the entire city. The result of a succession of repeated expansions was the extension of the city beyond its original boundaries. The owners of the buildings that were demolished near the Grand Mosque constructed new residences distant from the Al-Masjid Al-Haram area (Geomatika, n.d.)

In fact, the urban growth of Makkah city can be divided into three major distinctive eras: the pre-Islamic era, the Islamic era and the Saudi era, since the most dramatic change occurred during the Saudi era (Figure 5.12). According to Abbas (1995), the first change was carried out by the Quraish [3], and each government before the kingdom of Saudi Arabia was founded tried to take care of the Grand Mosque. King Abdul-Aziz (the first king of Saudi Arabia) and his sons after him made great changes to the Grand Mosque, and since then the mosque has been given the greatest care by the Saudi government. The last expansion took place between 2007 and 2014 by King Abdullah bin Abdul-Aziz.

A number of expansions of the Grand Mosque have taken place during the Saudi period, resulting in a significant increase in the built-up area of the holy city, particularly the first enlargement (1375 AH/1955 CE), and the second extension (1406–1412 AH/1986–1992 CE). The built-up area of the holy city increased by 400% between 1297 and 1366 AH (1880–1947 CE), reaching its zenith during the era 1366–1410 AH (1947–1989 CE), when the city of Makkah's area increased from 5 km^2 to 100 km^2 (Table 5.1). As a result, the yearly pace of urban expansion in the holy city has averaged 8.3% on an annual basis during the previous two decades (Geomatika, n.d.). Additionally, because of the physical setting, as well as the desire of residents and pilgrims alike to be accommodated close to the Haram, the Grand Mosque, there has been extensive development of the adjacent hilly area, which is extremely difficult to service, particularly during pilgrim seasons when the number of visitors is high (Aljohani, 2015).

[3] Quraish: "an Arab people of which Muhammad was a member and which from the 5th century was distinguished by a religious pre-eminence associated with its hereditary provision of the pre-Islamic custodians of the Kaaba at Mecca" (Merriam-Webster Dictionary, n.d.)

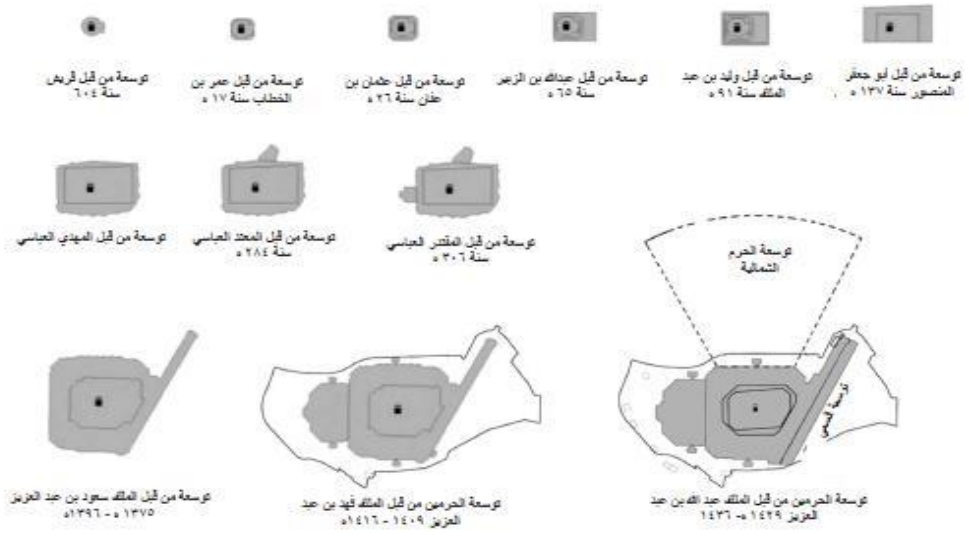

Figure 5.12 Different expansions from 604–1436 AH. Source: (Association of Consulting Engineers Pakistan, 1977)

Era	Year		Amount of increase (m^2)	Expansion %	Area after expansion (m^2)	Holy Mosque capacity (worshippers)
	CE	AH				
Quraysh Era					2,126	3,324
Leader of the Faithful Omar Ibn Al-Khattab	638	17	1,487	70%	3,613	5,650
Leader of the Faithful Othman Ibn Affan	646	26	869	24%	4,482	7,008
Abdullah Ibn Al-Zubair	684	65	2,983	67%	7,465	11,673
Waleed Ibn AbdulMalik	709	91	2,805	38%	10,270	16,059
Abu Ja'far Al-Mansour	754	137	5,221	51%	15,491	24,223
Muhammad Al-Mahdi Al-Abbasi	776–783	160–176	12,512	81%	28,003	43,788
Al-Mu'tamid Billahi AI-Abbasi	897	284	1,340	5%	29,343	45,882

Al-Mugtadir Billahi Al-Abbasi	918–919	306-307	715	2%	30,058	47,008
King Saud and King Faisal: Saudi expansion (I)	1955	1375	13,104	436%	161,099	313,000
King Fahd: Saudi expansion (II)	1986–1992	1406–1412	206,000	128%	366,168	560,720

Table 5.1 History of the expansion of the Grand Mosque. Source: adjusted from Abbas (1995).

5.4.1 ***City structure***

The city, which is expanding radially, is separated into four districts by ring roads, with the maximum density occurring in the central district (300 people per hectare) and progressively decreasing as one approaches the city's periphery. As a result, the built-up area of the city stretches from the centre to a few kilometres beyond the 3rd Ring Road district, which accounts for less than 30% of the overall area of the city.

The Grand Mosque, Makkah's most prominent landmark, is located inside the central district, as are the majority of the city's economic activities (hotels, serviced apartments, shopping malls and other establishments). On the south-eastern side of the central district, there are the three additional sacred sites of Mina, Muzdalifah and Arafat, which are collectively known as the Al Mashaer compound. Despite the fact that the Al Mashaer sites account for about 2% of the city's built-up area, the area is totally unoccupied for the majority of the year. Al Mashaer is only open for a few days each year during the Hajj pilgrimage, and all lodgings for Hajj pilgrims are supplied by the city, either on Al Mashaer premises or in the surrounding area. As a result, unlike the Grand Mosque, this area does not attract hospitality or commercial services. In spite of this, these locations receive a yearly transportation upgrade, maintenance and development as a result of the large number of pilgrims that visit during the annual Hajj pilgrimage. Outside the central district, business and retail uses may be found along main highways. Because of the high concentration of schools and mosques in residential neighbourhoods, public amenities and institutions are more spread out than in other parts of the city. There are few parks, public areas, or industrial and agricultural properties, and most of these are situated on the edges of the central area of the city (Al Sudairy, 2015).

The holy city's historic core, centred around Haram, is created by the old town and the area surrounding it. In the last few decades, the area has been developed to play a unique role providing residential and allied service areas for those residing close to the Haram. Settlements in the vicinity of Al-Haram have tended to use all the land available for residential and commercial purposes. Due to the search for building sites, paths, squares and other spaces have disappeared. Apart from the retail centres near areas of residence around the Haran, pilgrims can access financial services from some banking services. This area is characterised by business areas, seasonal housing, and dense housing complexes. With the city's expansion, the areas adjacent to the Haran developed in the same way, as far as was permitted by the topography. Starting from the city centre, commercial operations and shopping followed the main road, declining in their significance based on how far and accessible they are to the Haram.

The categorisation of communities based on the country of origin of the *Hadjis* (pilgrims), who in the past consented to stay and reside in the holy city, is a crucial element of the city layout. In an area to the west of Makkah, for example, many Africans gathered and remain in the city. This growth has, however, led to an increase in low-quality housing in many neighbourhoods due to people's low incomes (Mekki, 1989).

Due to constant population growth and the presence of new transport infrastructure, the demand for additional residential areas has caused the existing pattern of development to be broken. The Haram has now emerged from new residential areas, which have the supply facilities required. Traffic demand has culminated in the need to build new streets in the area.

The mountainous landscape prevents the building of a new airport close to Makkah. So, both Jeddah and Makkah are served by the existing airport. The city layout and the design and distribution of key uses of land have traditionally evolved to serve the dominant role of the holy city as the spiritual centre of the Muslim world, and to attract hundreds of thousands of pilgrims every year, as well as people who frequently come for *Umrah* and to visit the Grand Mosque during the year (Mekki, 1989).

Nowadays Makkah is a very large city, and the architecture represents the new technology and design. Today's overall view of Makkah may be defined as a mixture of building styles representing the various identities of the city's residents. The picture of the city that appears from any point of entry is one of unorganised and unexpected houses and small buildings

covering large mountain areas in which most foreigners reside, and a mixture of buildings containing houses and other buildings. The horizon is covered by modern high-rise towers, often used by pilgrims and tourists in the Hajj and other seasons.

5.4.2 ***Land use***

The usage of land varies throughout the city of Makkah, but the mountainous parts dominate the city, taking up almost half of the overall land area of the holy capital. Open spaces account for half of the total land area in the city's built-up region, followed by residential areas, which account for 18%. The holy places (Mina, Musdalifah and Arafat) occupy around 15% of the total (Ascoura, 2013). Land use is influenced by the geography of a region as well as the population density (Figure 5.13). Although there is no special strain on land in certain areas, it is critical from the perspective of public transportation that emerging towns do not become overly reliant on private automobiles.

Because isolated districts have grown at a distance from the city centre as a result of Makkah's spatial growth, people have been encouraged to use private transportation to get about. For example, the Al-Awaly district, located east of Al-Haram, and the Al-Sharaiia district, located north of Al-Haram, are 18 and 22 kilometres from the city centre, respectively. Because of the distance between these areas and the heart of Makkah and the limited number of people who would be served, the setting up of public transportation between these districts and the centre of Makkah would be prohibitively expensive (Ascoura, 2013).

An update has been completed by Makkah Regional Development Authority to the land use map for conditions existing in 2010; existing and planned residential uses occupied around 35,152 hectares. The proposed land use will provide homogeneity analysis of the neighbourhoods' components by mixing uses with different densities (Figure 5.14).

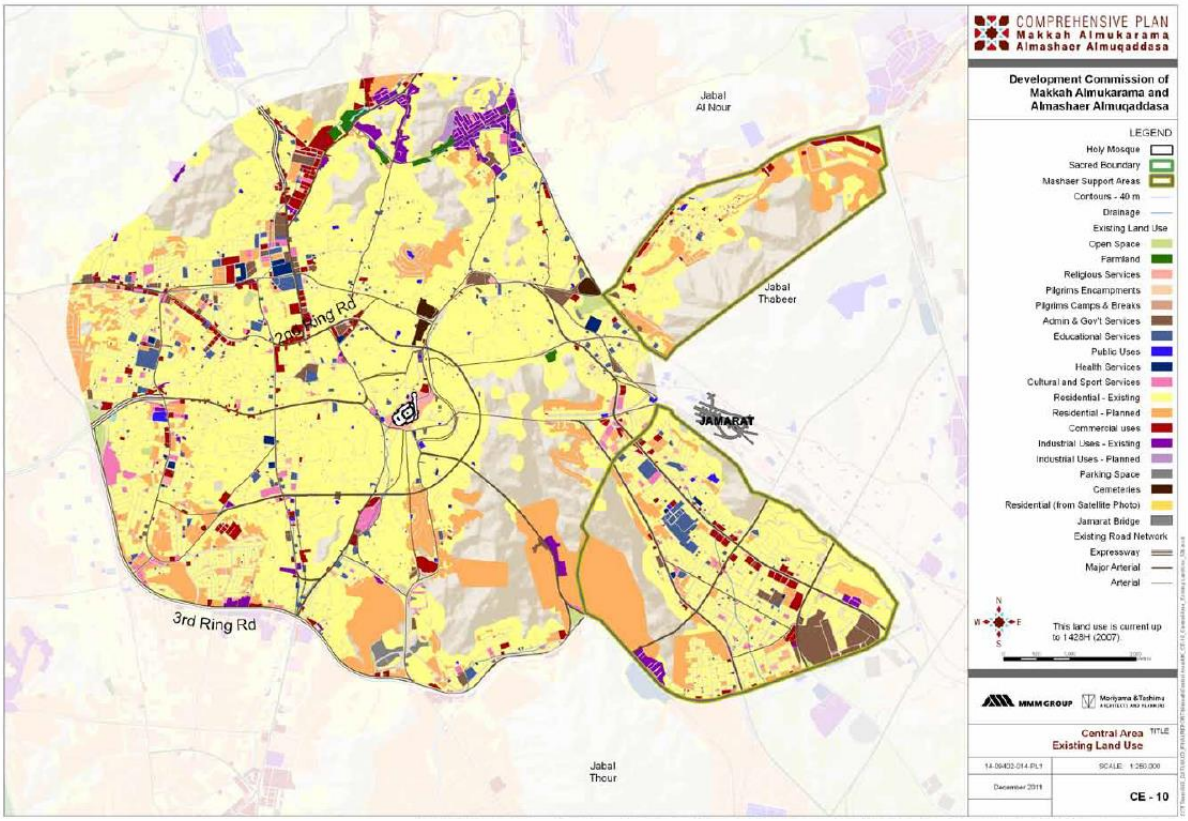

Figure 5.13 Existing land use of the city of Makkah. Source: (MMM Group & Moriyama and Teshima, 2011).

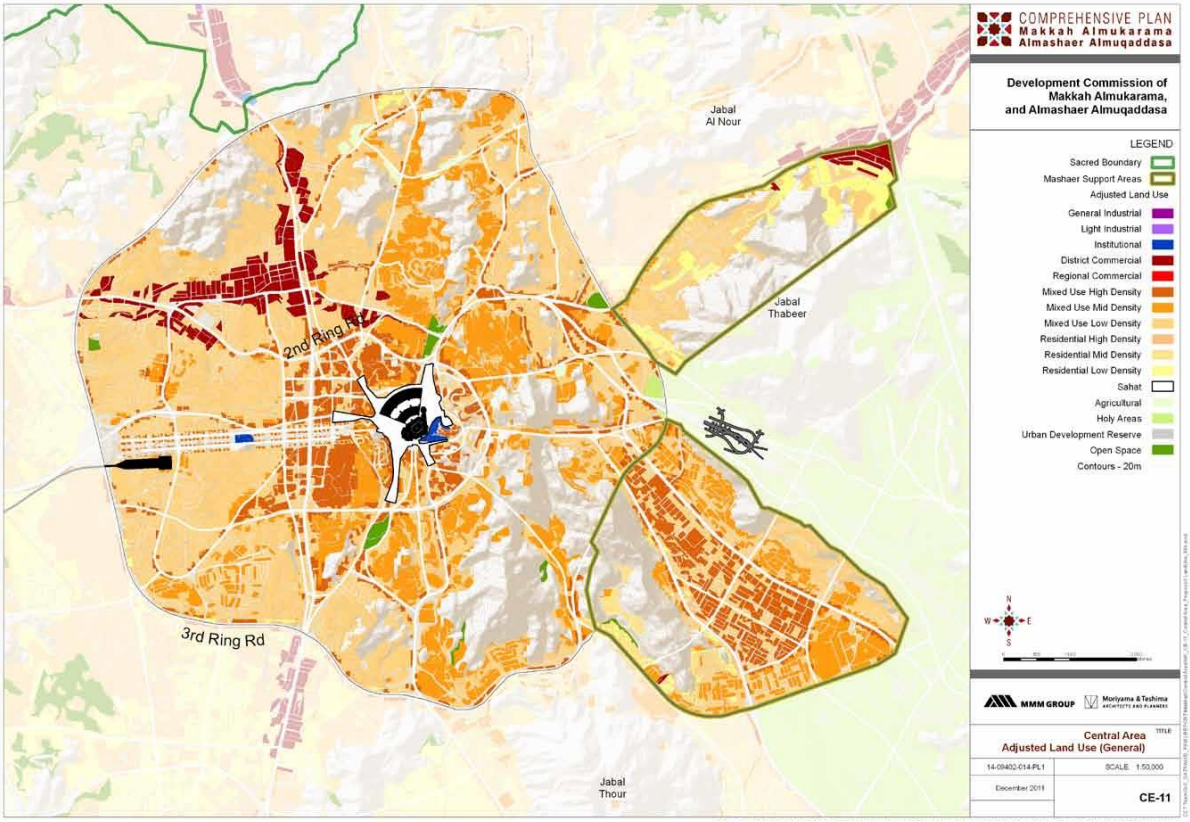

Figure 5.14 Proposed land use of central area. Source: (MMM Group & Moriyama and Teshima, 2011).

5.4.3 ***New development in Makkah***

A total of 25 projects surrounding the Grand Mosque are planned for development, according to the Comprehensive Plan for Makkah and Mashaer. It was decided to give priority to the first six projects, which are located in the vicinity of the Grand Mosque and consist primarily of commercial and residential schemes, with the exception of the King Abdul-Aziz project, which facilitates pedestrian movement from the Haramain station to the Grand Mosque (see Figure 5.15).

A significant portion of the growth in Makkah may be ascribed to the construction of hotels and apartments, which has resulted in a unique pace of hotel development in general, with the majority of four-star, five-star and luxury choices dominating the market. As a side note, 3.3 million housing units are expected to be required by the country during the next decade, according to the Ministry of Housing (Amoudy, 2014).

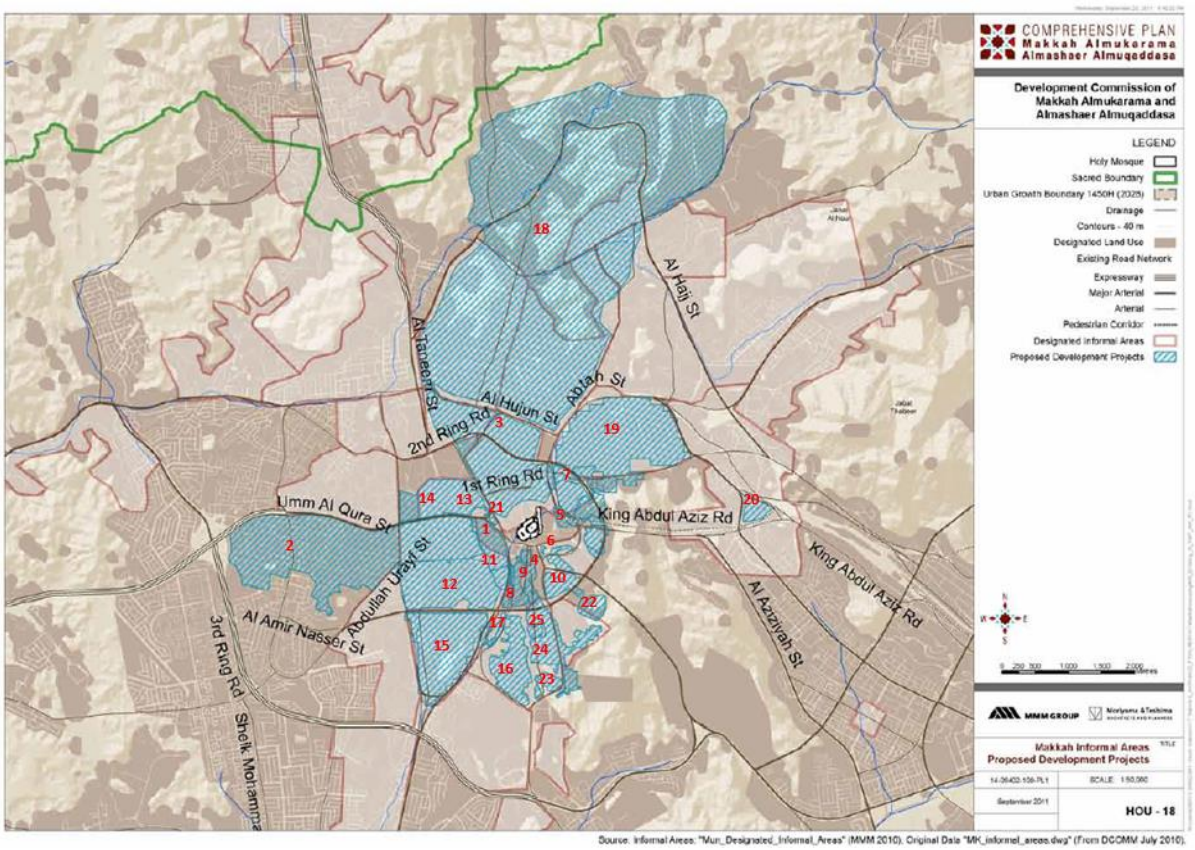

Figure 5.15 Proposed development areas. Source: (MMM Group & Moriyama and Teshima, 2011).

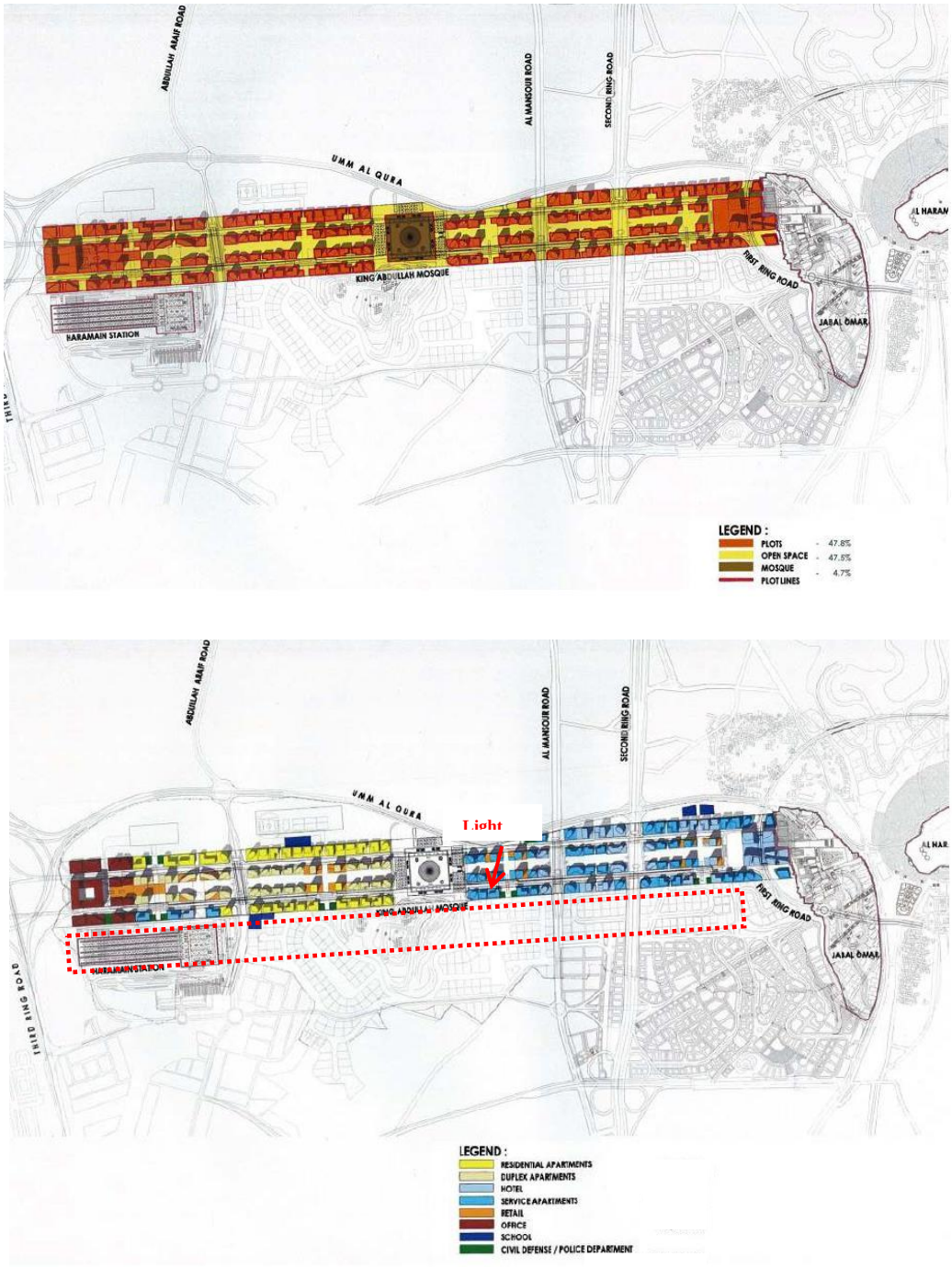

Figure 5.16 Proposed King Abdul-Aziz Road project.

Figure 5.17 Proposed King Abdul-Aziz Road project.

5.4.4 ***Public transportation projects***

Regarding transport needs, a significant improvement is to be introduced with the help of a four-line and 88-station subway system, and a network of fast bus services. The underground lines will focus on releasing the tension around the Grand Mosque, while other lines are to run on suspended bridges (MMM Group & Moriyama and Teshima, 2011).

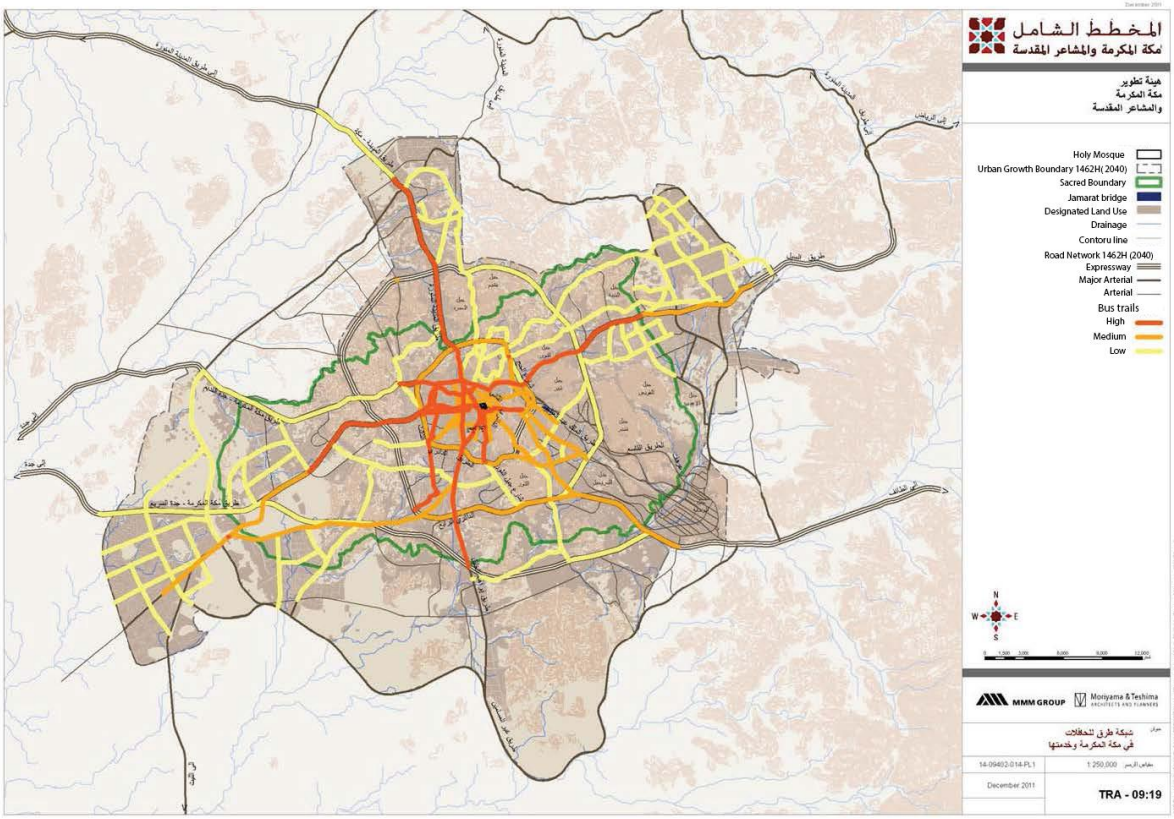

Figure 5.18 Proposed bus network. Source: (MMM Group & Moriyama and Teshima, 2011).

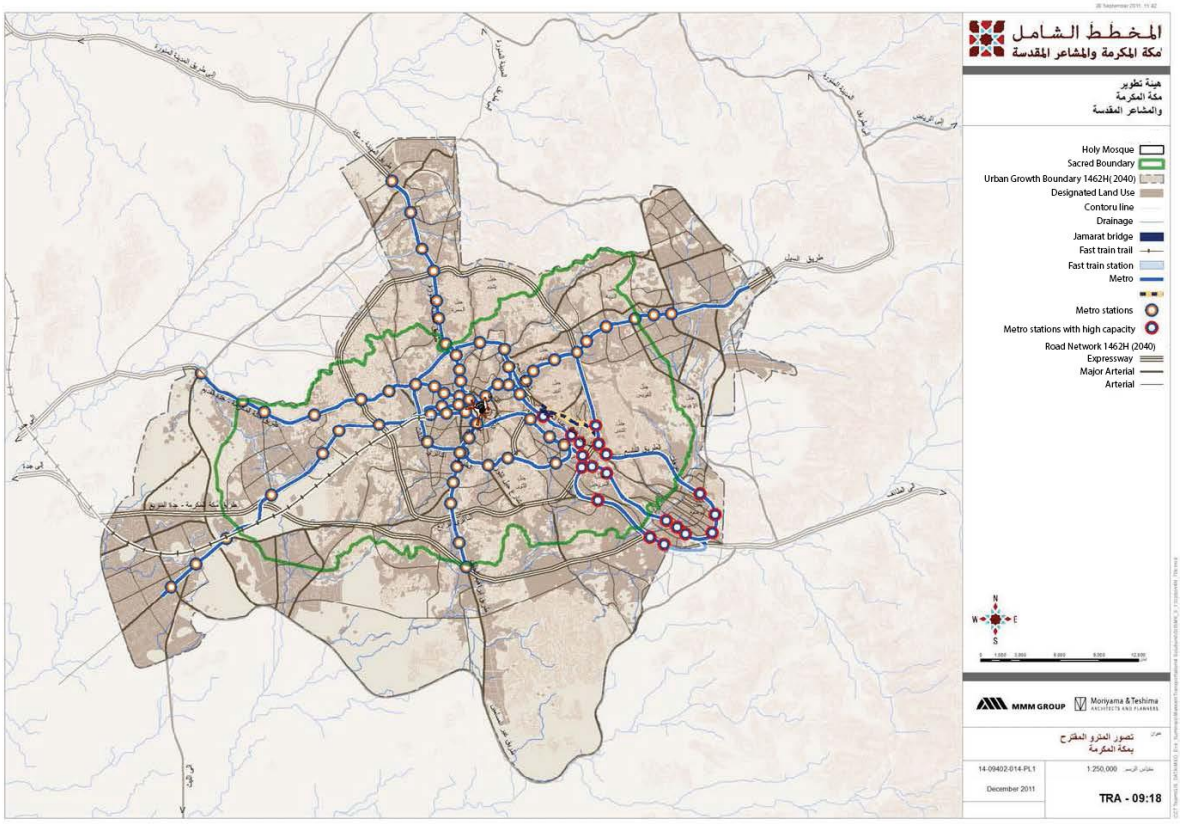

Figure 5.19 Proposed metro network. Source: (MMM Group & Moriyama and Teshima, 2011).

5.4.5 ***Proposed plan***

When the Comprehensive Plan for Makkah and Mashaer was launched, guidelines were advocated for the adoption of guiding principles, which will function as a foundation for the creation of an environment for high-quality places to worship, live and work, among other things. These ideas of urban design will be included in all future developments. The design guidelines envisage and regulate excellent urban design and planning across Makkah, articulating the "public domain" both on-site and in built form.

All development within the limits of the following components – Makkah City Centre, Hima and Mina Support Areas, and Boulevards – is subject to these guidelines. A review board will evaluate all development applications and determine whether or not they are in compliance with these design guidelines. The development standards for each of these three components will differ in order to identify each area properly. Furthermore, these differences allow for a smooth transition in terms of use, density, building type and height, while also ensuring that a comprehensive approach to city building is taken.

According to Alamoudy (2017), the main challenge Makkah faces is managing the number of visitors, which has resulted in some financial issues due to the failure to capitalise on *Umrah* and Hajj as a global event by attracting business and media attention. Alamoudy also points to a lack of cooperation between authorities and some sectors, as well as a lack of communication between the general public and decision-makers. It was proposed in the Comprehensive Plan for Makkah Almukarama (2011) to improve streetscape aesthetics by constructing continuous and wide walkways, offering street furniture and landmarks, landscape, lighting and signs; and to create a pedestrian environment by reducing traffic congestion.

Despite the fact that pedestrian movements are extremely important during the Hajj, the city of Makkah and Mashaer does not have a comprehensive network of pedestrian amenities that is specifically intended for this purpose. The implementation of pedestrian–vehicle separation and the provision of more pedestrian space to handle the growing pilgrim and resident populations have been attempted in the past, but these plans have only been partially realised. As a result,

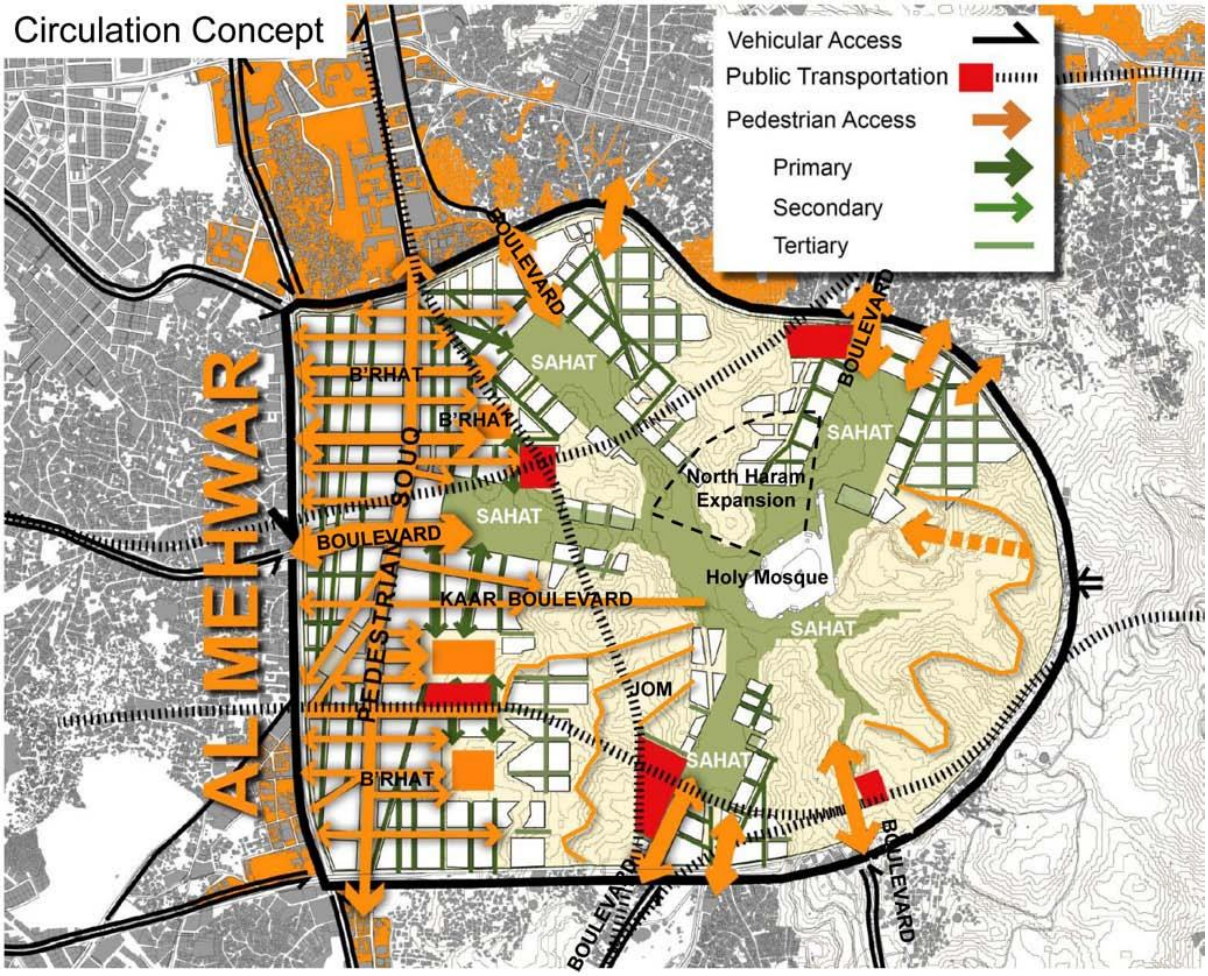

Figure 5.20 Proposed plan (Axis) for central Makkah. Source: (MMM Group & Moriyama and Teshima, 2011).

the city is still plagued by areas of severe conflict between pedestrians and vehicles, as well as unsafe congestion of pedestrian routes and spaces.

5.5 Climate

Makkah is located in a hot tropical zone. Summers are hot and dry, while winters are mild. In 2009 the lowest temperatures occurred December (12.4°C) and January (10.4°C). That year's June and July recorded the greatest temperatures. Recording a peak of 48° C, the highest temperatures in that year were between June and July. Makkah's intense heat is caused partly by the nearby hills, creating a windbreak. The annual average temperature is about 32°C. The climate of Makkah is also further affected by the area's closeness to the Red Sea and the adjacent Hijaz escarpment, making relative humidity low. In Makkah humidity ranges between 45% and 53% and its relationship with the temperature is inversely proportional. Summer does, however,

include brief periods of increased humidity. Rainfall is sparse, occurring primarily during the winter months and averaging less than 100 mm per year. Flooding is a frequent outcome of rainfall, particularly in low-lying sandy plains. Additionally, runoff is considerable and may be rather spectacular inside the valley; however, the majority of the water percolates below ground. Makkah is located in a valley surrounded by mountains, with the main winds coming from the north and northwest.

For example, floods, heat, and humidity all have a substantial effect on the pilgrims' conditions and experience at the Holy Mosque area, which may affect their behaviour in the crowd. Because the Islamic lunar calendar governs the pilgrimage's schedule, it takes place in different times from one year to the other, with the Hajj happening in the summer in specific years and the winter in others.

Following the Köppen-Geiger climate classification, the climate of Saudi Arabia is typically classed as [BWh], which indicates that it is influenced by hot and dry conditions and is thus classified as a desert climate (Peel et al., 2007) (Figure 5.21). Countries situated inside this zone are mostly classed as deserts, and their climate is characterised by severely high temperatures, large diurnal temperature fluctuations, low humidity, rapid evaporation, and little precipitation, among other characteristics. However, due to the Kingdom's huge geographical size, the climatic characteristics of the City of Makkah vary slightly from those of the rest of the country, with high levels of heat experienced as a result of its geographical location and topographical qualities.

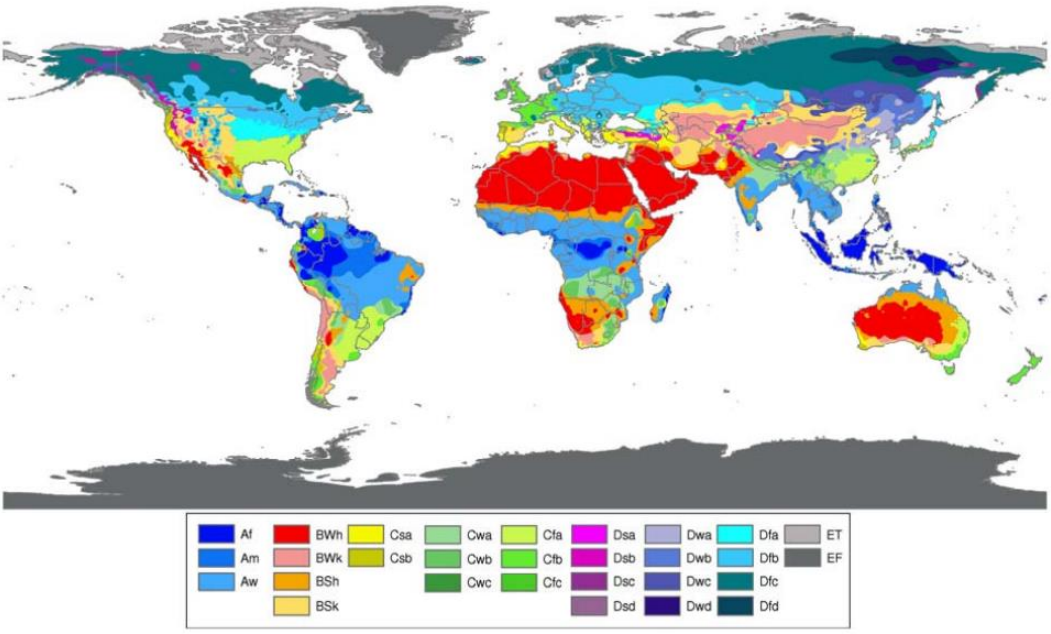

Figure 5.21 Köppen-Geiger climate classification map. Source : Peel et al. (2007).

5.5.1 ***Air temperature***

In general, the temperature in Makkah Almukarmah is hot and dry. As seen in Figure 5.22, there is a smooth movement in the annual temperature across the months, with the highest recorded in August and the lowest in January. Between January and August, there is a greater movement of 14°C at the lowest temperatures only, with the average daily temperatures remaining the same. In both January and May, the minimum and maximum diurnal air temperature values indicate a broad variation, ranging between 17°C and 30°C, as the lowest and highest values (Presidency of Meteorology and Environment, 2019). This occurs because of the high level of sun exposures.

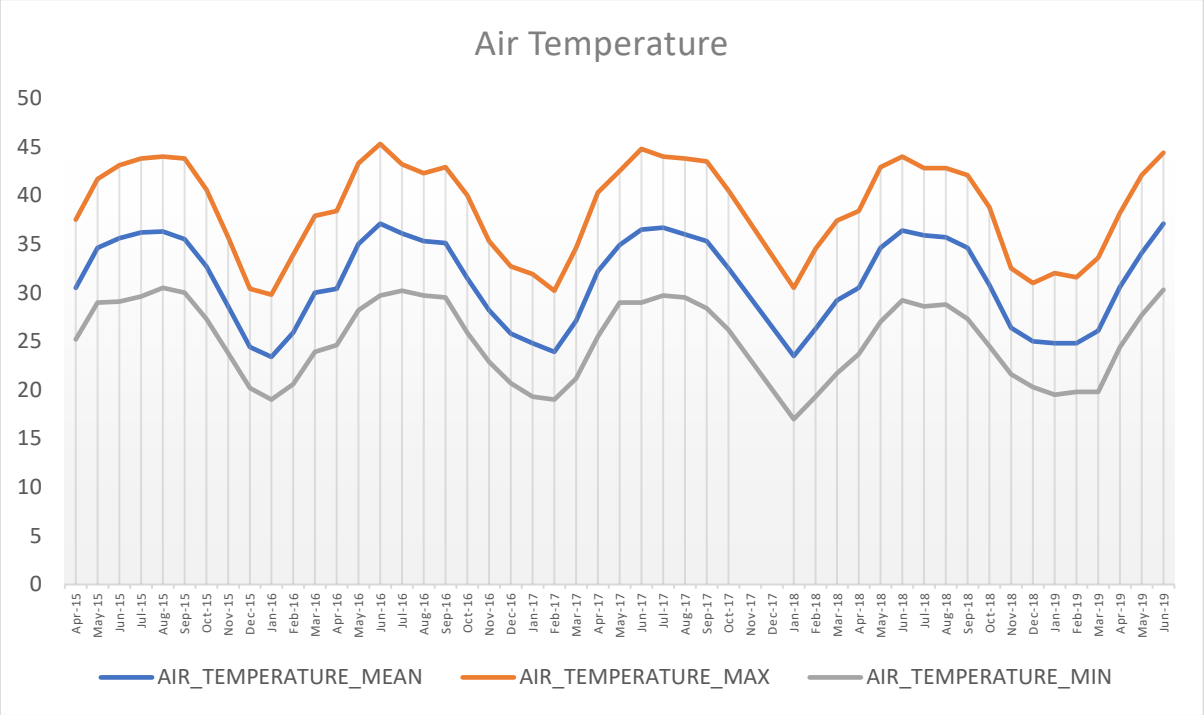

Figure 5.22 Average monthly air temperatures (mean, maximum, minimum). Source: Presidency of Meteorology and Environment (2019).

Mean air temperature

The average air temperatures for the years 2015–2019 are examined in Figure 5.23. It is seen that the highest maximum average mean air temperature was recorded in 2015 and the highest minimum average mean air temperature in 2019. It may be further concluded that the variation in air temperature is increasing with each year.

It may be further observed that the mean average air temperature is greater than 32.7 units for 2015 and has decreased with each year. The mean average air temperature for 2019 is 29.5 units.

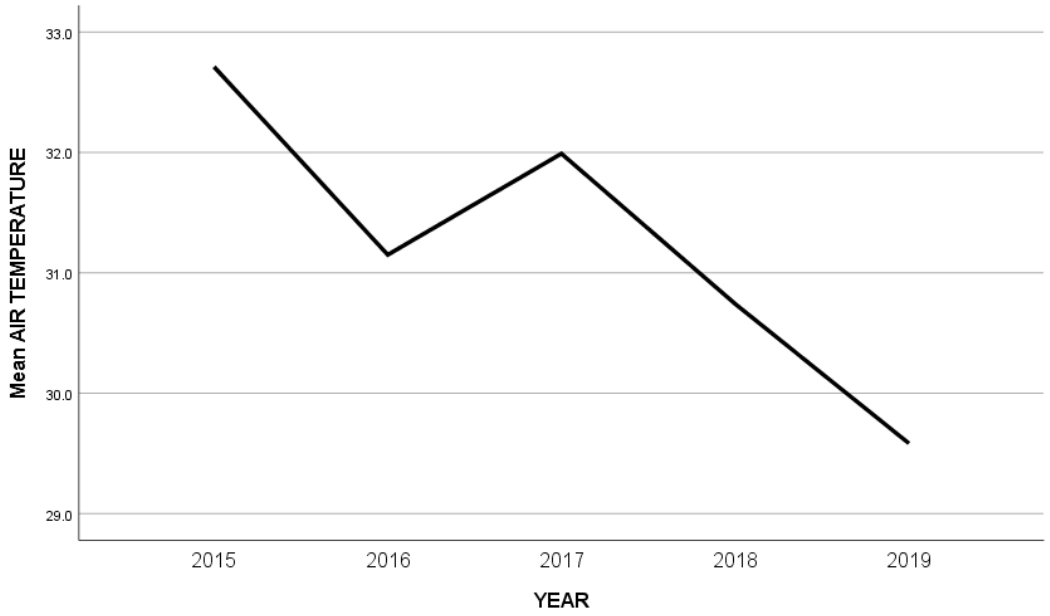

Figure 5.23 Mean air temperature for Central Makkah during the period 2015–2019. Source: Presidency of Meteorology and Environment (2019).

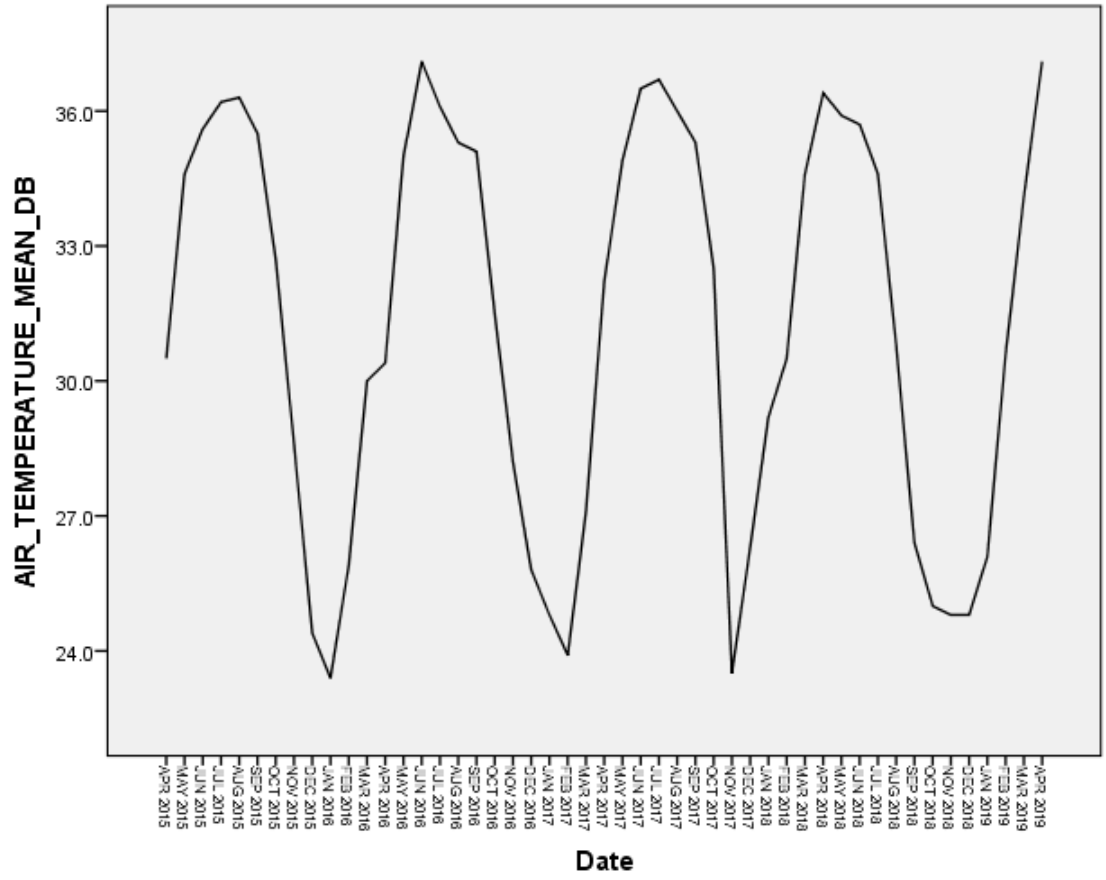

Figure 5.24 Mean air temperature for Central Makkah during the period 2015–2019 by month. Source: Presidency of Meteorology and Environment (2019).

Maximum air temperature

The maximum air temperatures for the years 2015–2019 are given in Figure 5.25. It may be seen that the highest average air temperature was recorded in 2015. It may be further concluded that in all five years, the maximum air temperature fluctuated between 20 and 45 units.

It may be further observed that the maximum air temperature was at its highest in 2015 with 40.1 units, and has decreased with each year, but in 2017, there was a slight increase in maximum temperature. The lowest maximum air temperature was recorded in 2019 with 36.9 units.

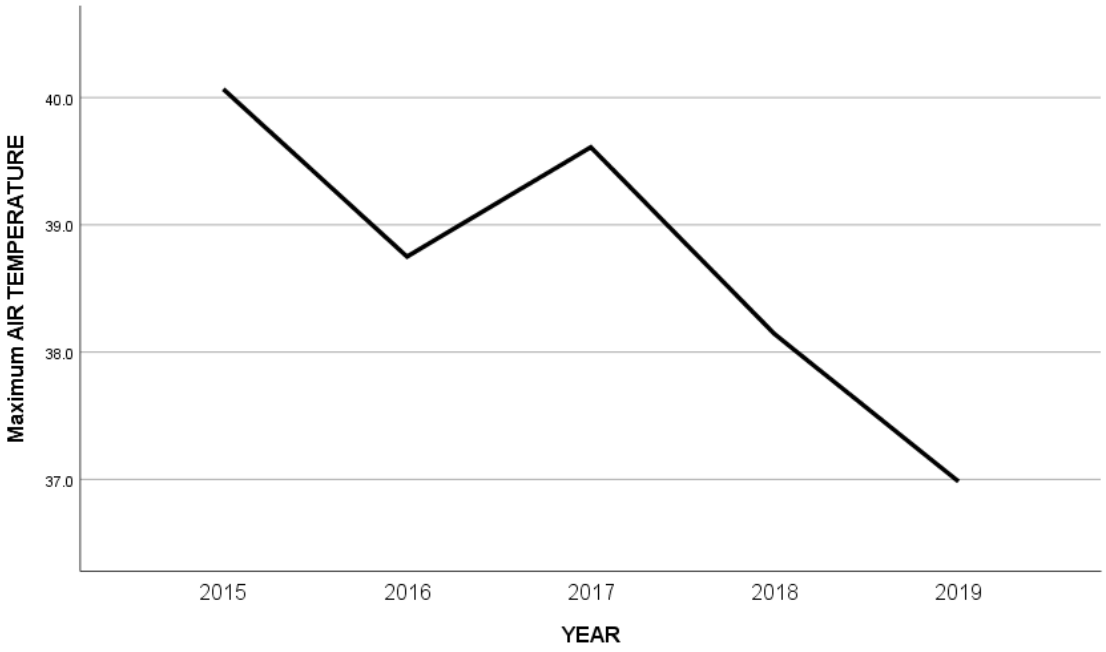

Figure 5.25 Maximum air temperature for Central Makkah during 2015–2019. Source: Presidency of Meteorology and Environment (2019).

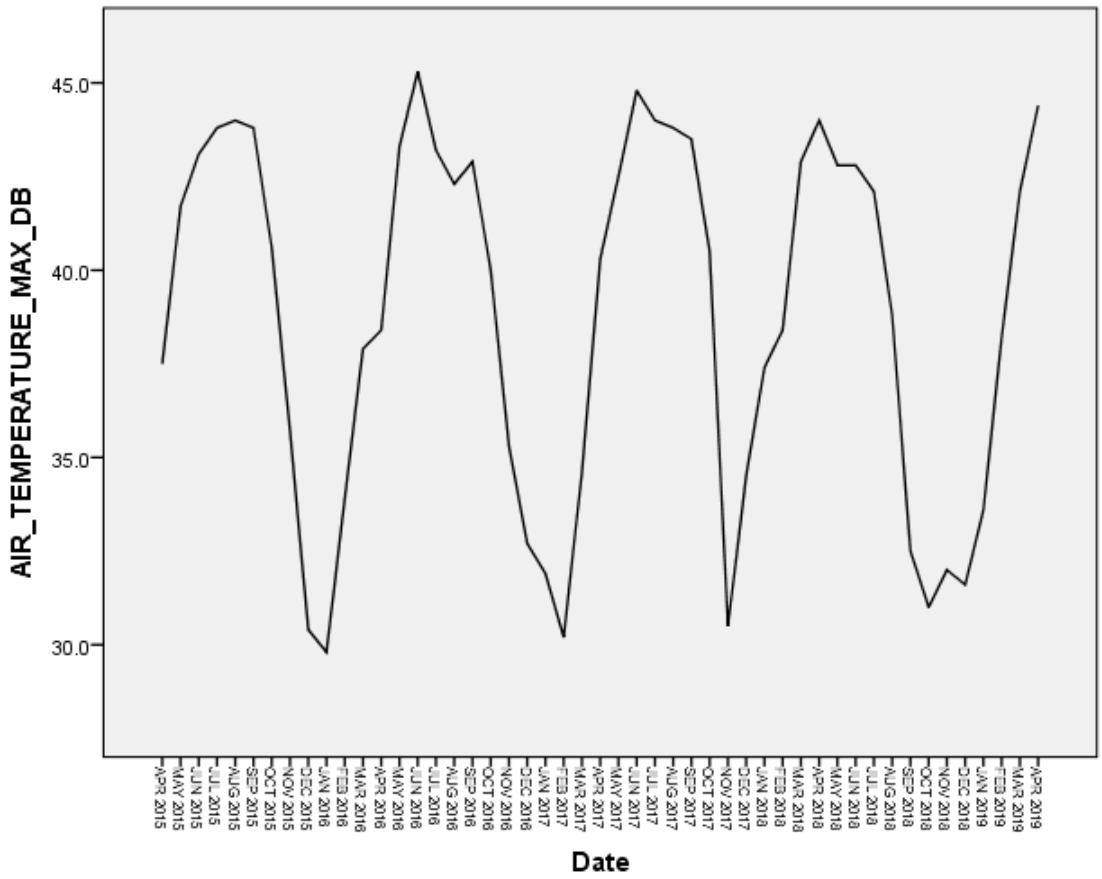

Figure 5.26 Maximum air temperature for Central Makkah during the period 2015–2019 by month. Source: Presidency of Meteorology and Environment (2019).

Minimum air temperature

The minimum air temperatures for the years 2015–2019 are given in Figure 5.27. It may be seen that the highest minimum air temperature was recorded in 2015. It may also be seen that for 2018 and 2019, the minimum air temperature range is relatively higher than in the other years.

It may be further observed that the minimum air temperature was at its highest in 2015 with 27.2 units and it has decreased with each year. The lowest maximum air temperature was recorded in 2019 with 23.6 units.

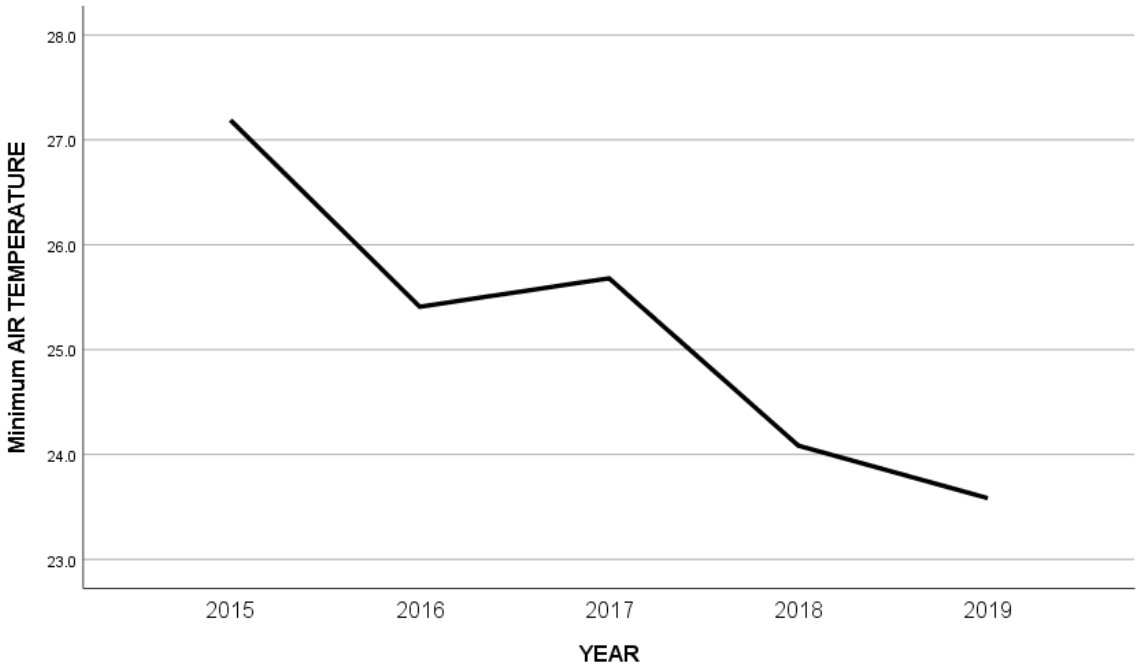

Figure 5.27 Minimum air temperature for Central Makkah during 2015–2019. Source: Presidency of Meteorology and Environment (2019).

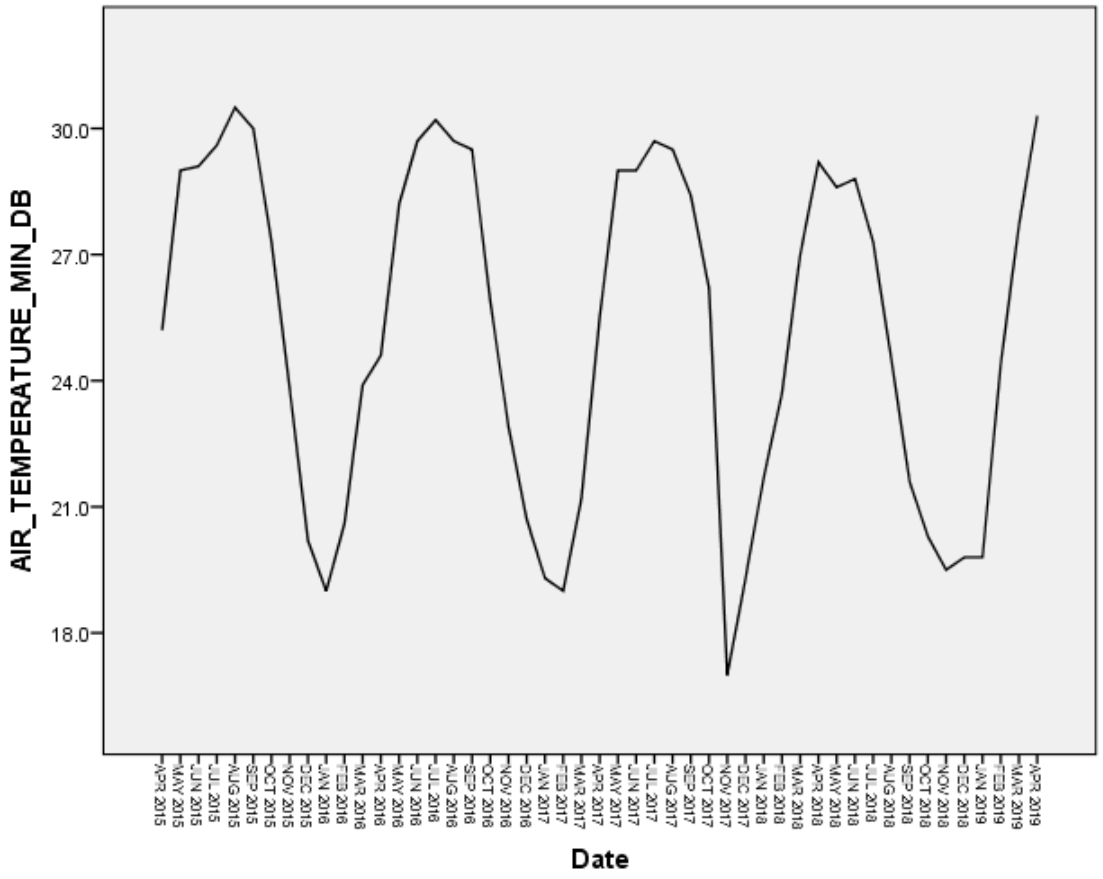

Figure 5.28 Minimum air temperature for Central Makkah during the period 2015–2019 by month. Source: Presidency of Meteorology and Environment (2019).

5.5.2 ***Sunlight***

Makkah's geographical coordinates are latitude: 21°25′36″ N; longitude: 39°49′33″ E, with an elevation of 273 m, indicating that the city receives a lot of solar radiation. Based on data from the Climate Data Organization (2019), it is estimated that June has the greatest average number of daily hours of sunlight, with an average of 11.96 hours of sunshine every day, and an overall total of 370.66 hours of sunshine during the month. With an average of 8.81 hours of sunshine per day and a total of 273.11 hours of sunshine for the month, January has the lowest totals when it comes to the number of daily hours of sunshine recorded (figure 5.29). During the course of the year, Makkah receives around 3859.55 hours of sunlight. In a typical month, there are 126.84 hours of sunlight on average.

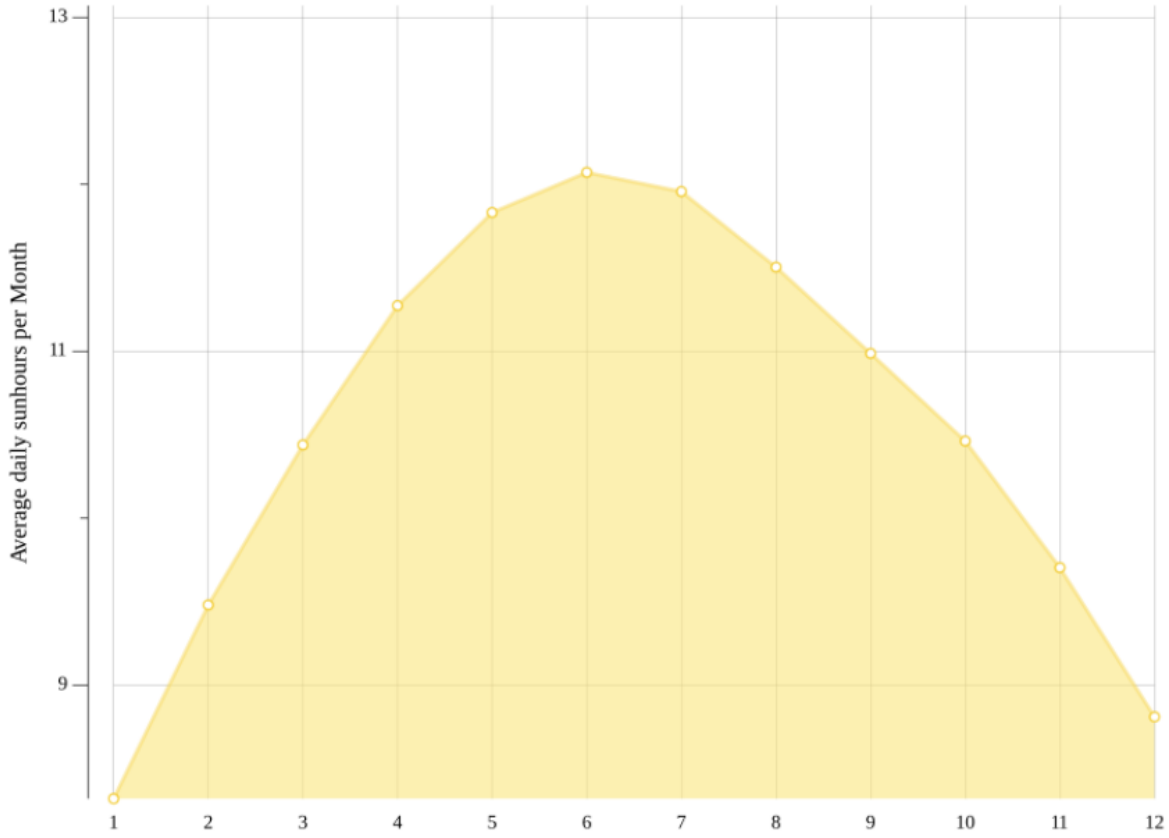

Figure 5.29 Average daily hours of sunshine per month in Makkah. Source: Climate Data Organization (2019).

The location of Makkah is north of the equator, so the sun directly faces south during most of the year. The heat has an effect on people's health and movement. A study by Fatani et al. (2000) found that "skin diseases are common during the Hajj season and are most likely related

to the hot weather and overcrowding of the pilgrims. Most of the diseases can be easily identified, treated, and prevented".

There have been a few studies focused on how pedestrian movement is impacted by the weather. Among the few studies that have focused on this area, the conclusions have been inconsistent. Certain studies have shown that winter increases the walking speed of pedestrians, and others have found the reverse to be true. Muraleetharan et al. (2005) observed that walking speeds rise throughout the winter months, due to individuals choosing to walk rather than cycle during the colder months. Other studies observed that weather fluctuations affected pedestrian route selection, with the amount of cycling rising in good weather and decreasing in poor weather. It was discovered by Lam and Cheung (2000) that high temperatures in Hong Kong led pedestrians to walk faster. Another study, on the other hand, found that 40% of pedestrians lowered their speed when it was raining or snowing (Clifton & Livi, 2005).

Weather conditions influence pilgrims in different ways depending on the time they are performing pilgrimage. The Saudi Presidency of Meteorology and Environment (PME, 2019) provided long-term hourly measurements (1985–2011) of Makkah weather data, which are displayed in Figure 5.29 and indicate substantial changes in weather conditions. Recent evidence reveals that between 2015 and 2019, there was a high incidence of sunstroke and heat exhaustion during pilgrimages as shown in Figure 5.30. As predicted, the number of years in which the pilgrimage is undertaken during summer, the number of these incidents have increased significantly (Statistics of the Saudi Ministry of Health, 2019).

These changes have a substantial influence on pilgrims' health and movement. A connection has been found between the rate of incidence of sunstroke and heat exhaustion among pilgrims and the weather conditions, according to the Saudi Ministry of Health data (2019). According to Figure 6.10, the number of incidents has increased significantly in connection with the Hajj seasons, with the vast majority of these accidents occurring during days of high temperatures. During the summer months, the temperature variation in Makkah is a key factor influencing the movement of pilgrims. It should be considered in conjunction with the other factors that contribute to tiredness and fatigue, many pilgrims are unaccustomed to hot temperatures, stress from walking for many kilometres, especially during the day, traffic congestion and carbon emissions from public transportation, and a lack of air circulation (Aljohani, 2015).

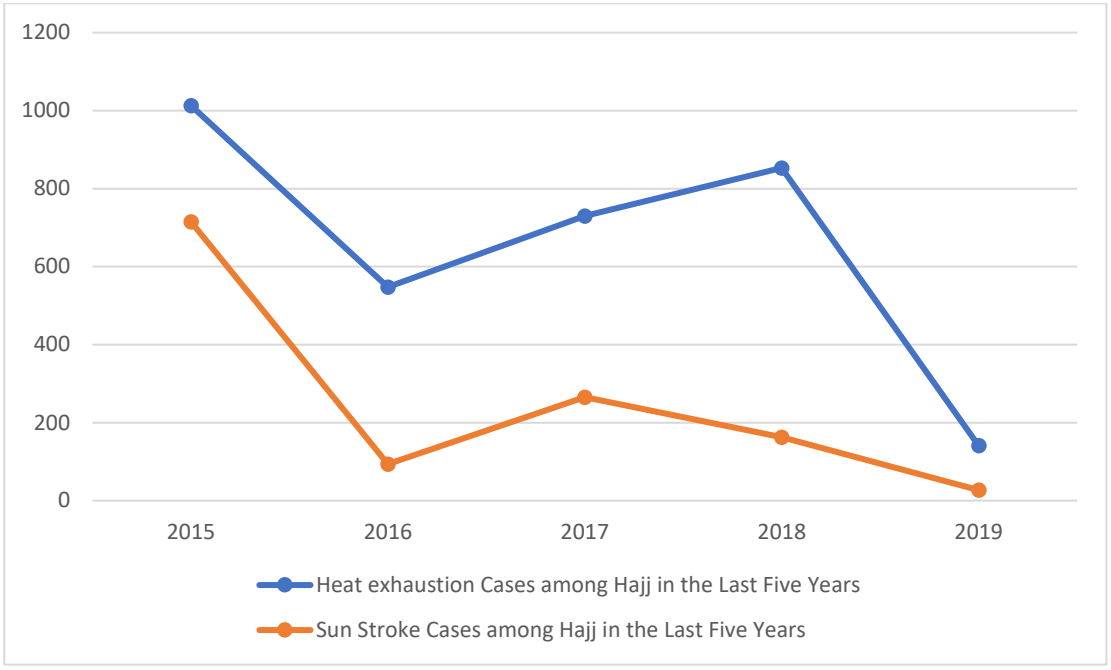

Figure 5.30 Sunstroke and heat exhaustion incidents during the Hajj (2015–2019). Source: Health Statistical Yearbook (2019).

5.5.3 ***Humidity***

The amount of water vapour present in the air indicates the relative humidity. In addition, the water vapour particles have an effect on the irradiance levels of sunlight, which in turn have an effect on the amount of heat trapped in the air, leading to a rise in mean radiant temperature. The relative humidity of the air is defined as the ratio between the water quantity held in the air and the quantity of water that the air might hold at the same temperature. In conjunction with the variations in temperature that occur throughout the course of the day, the relative humidity varies significantly as well, even though the water content stays constant.

The humidity in Makkah ranges between 45 percent and 53 percent. The relationship between humidity and temperature is inverse. The low relative humidity in the area is attributed to the fact that it is adjacent to the Hijaz escarpment and the Red Sea. The presence of additional water vapour particles in the environment also results in increased diffraction. Wind speed, on the other hand, has the opposite influence on relative humidity, which in turn has an effect on the received irradiance.

The average relative humidity for the years 2015–2019 is examined in Figure 5.31. It is seen that the highest average mean relative humidity was recorded in 2018 and the lowest in 2015. It may also be seen that the standard deviation of the relative humidity is between 10 and 12 units for all the years under consideration.

It may be further observed that the mean average relative humidity is 41.1 units in 2015, which increased to 45.7 units in 2016. Then in 2017, it decreased to 43.5 units, and for 2019, the average relative humidity was 43.7 units.

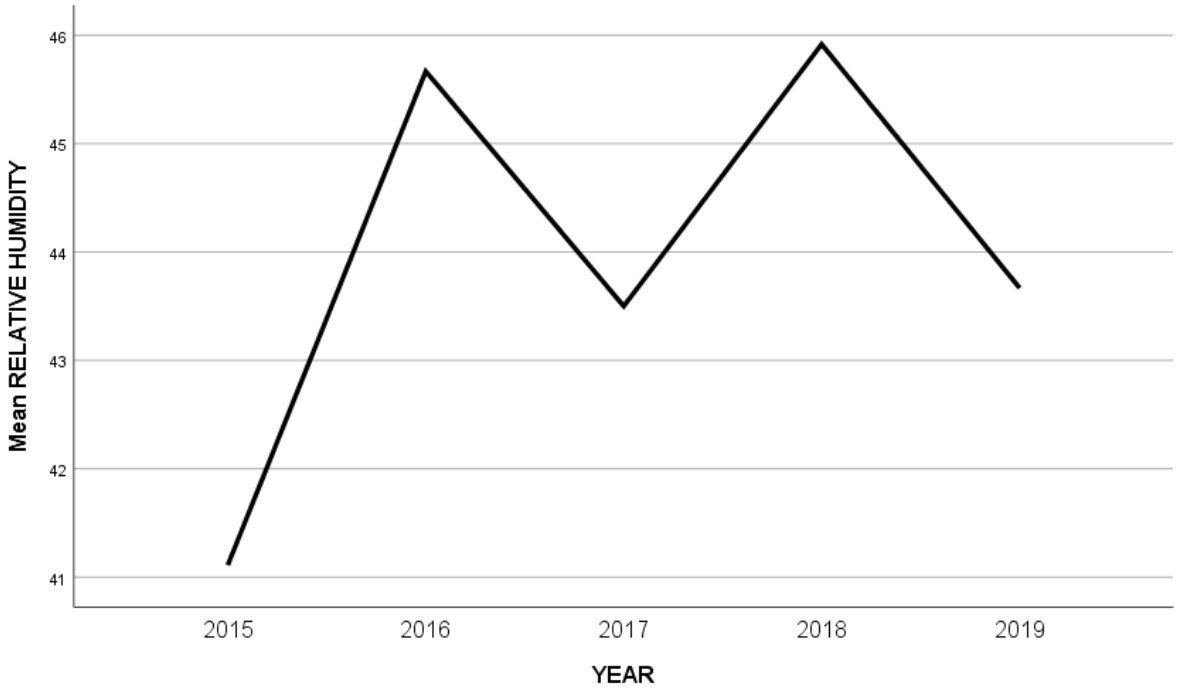

Figure 5.31 Mean humidity in central Makkah during 2015–2019. Source: Presidency of Meteorology and Environment (2019).

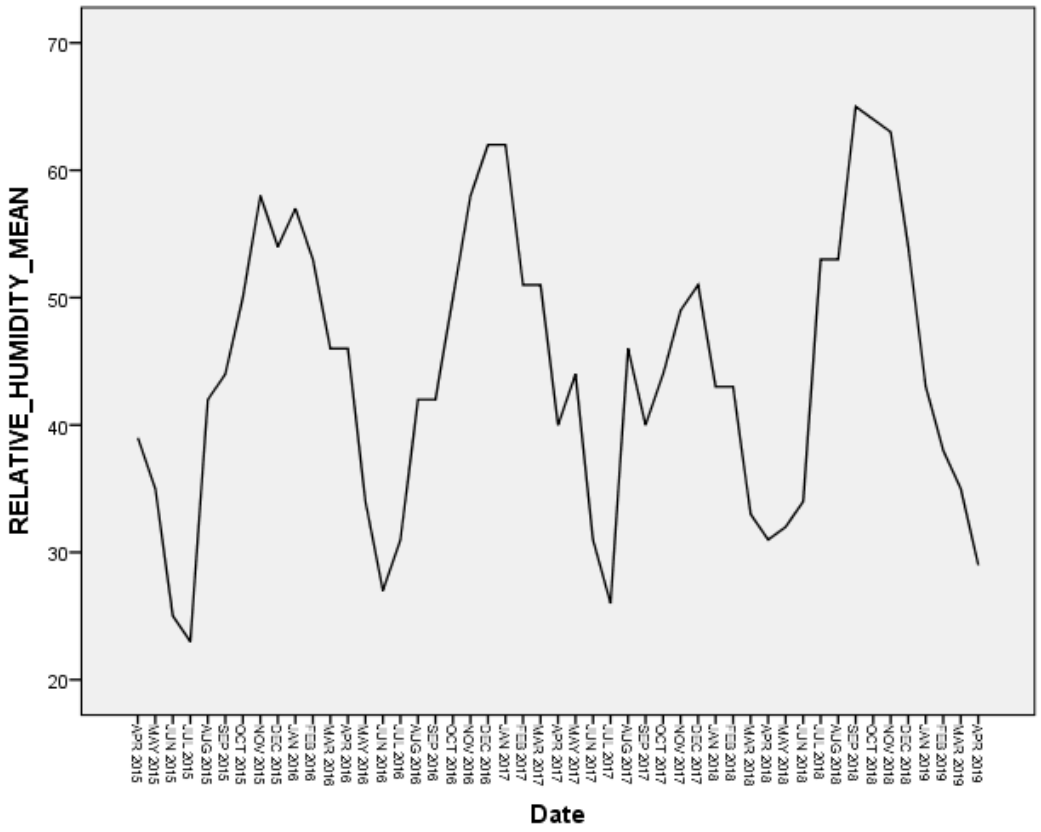

Figure 5.32 Humidity in Central Makkah during the period 2015–2019 by month. Source: Presidency of Meteorology and Environment (2019).

5.5.4 ***Wind speed***

The Makkah area is located in a valley surrounded by mountains and hills, which can create a wind-free zone in the city centre. People use umbrellas for protection from the burning sun, but they are useless when the wind is blowing. Recent observation by Farahat et al. (2021) shows that, during the months of July and August 2019, the dominant winds in Makkah were northerly and westerly, with a slight component of southerly winds in August 2019 (Figure 5.33). The predominant wind direction in June 2020 was north-westerly to westerly and in July 2020 was westerly with a southerly part. Within August 2020, there was a north-westerly to westerly wind pattern; a similar wind pattern was recorded in both corresponding months in 2019.

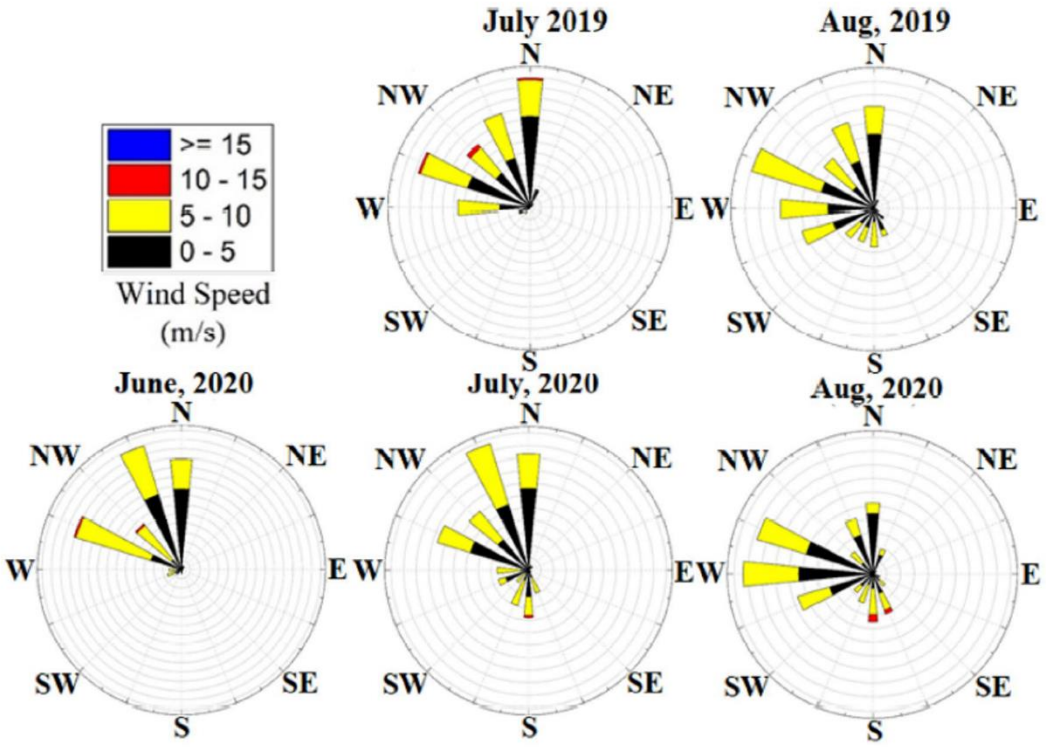

Figure 5.33 Wind rose diagrams for Makkah. Source: Farahat et al. (2021).

Average wind speeds for the years 2015–2019 are compared in Figure 5.34. It may be seen that the lowest average mean wind speed was recorded in 2015. It may be further concluded that the average wind speed varied between 2 and 3 units for 2015, 2016, and 2017, whereas, for 2018 and 2019, average wind speed varied between 3 and 4 units. It may be further observed that mean average wind speed was less than 2.7 in 2015 to 2017 but increased to 3.5 in 2018 and 2019.

As seen in Figure 5.35, the wind speed increases substantially in January, February, and March, and decreases significantly in August (the hottest month), respectively. Wind speeds are often greater in the summer months, when temperatures rise; however, the wind may be exploited to increase the thermal comfort of pedestrians. During the remaining months, the wind speed values are similar to those shown above.

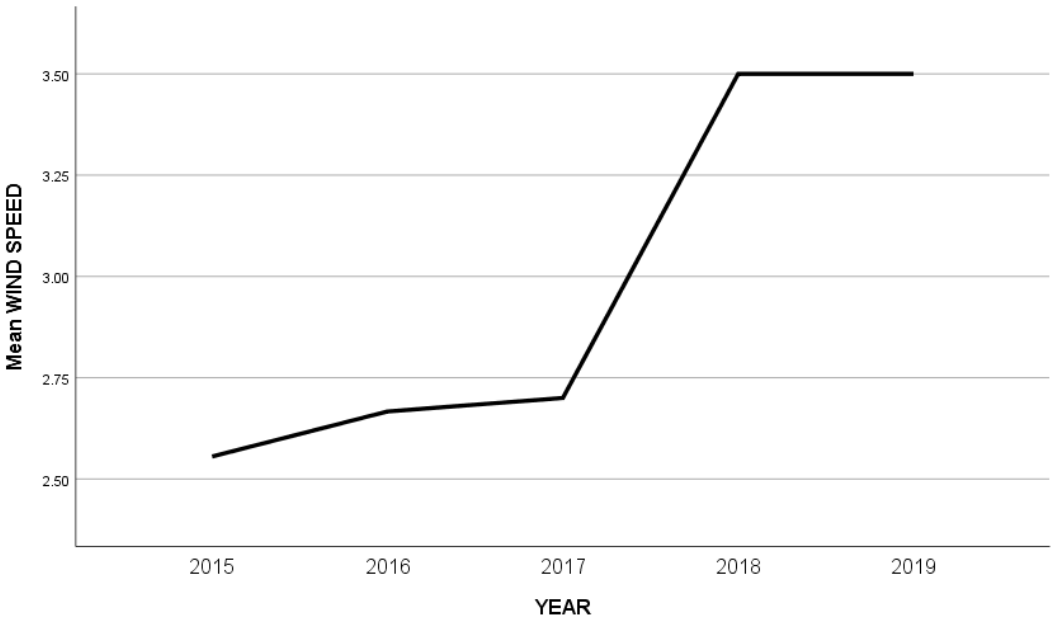

Figure 5.34 Mean wind speed in Central Makkah during 2015–2019. Source: Presidency of Meteorology and Environment (2019).

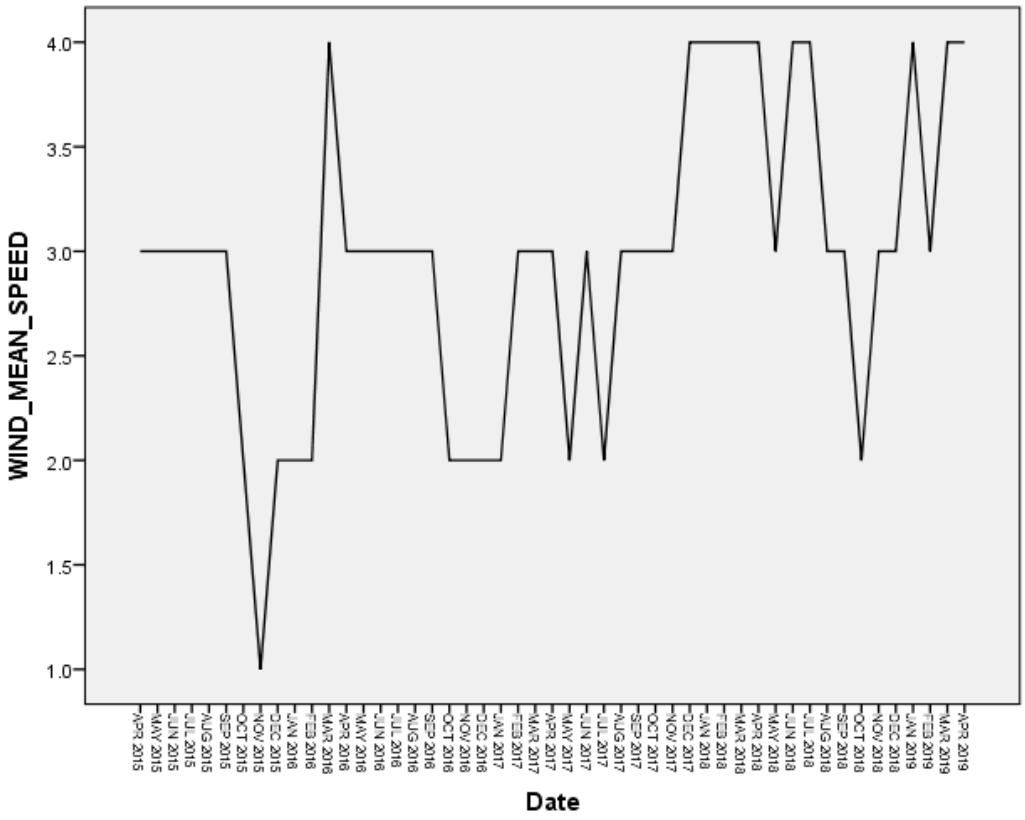

Figure 5.35 Mean wind speed in Central Makkah during the period 2015–2019 by month. Source: Presidency of Meteorology and Environment (2019).

5.5.5 ***Rainfall***

Rainfall is limited, falling mostly during the winter months and averaging less than 100 mm per year. Flooding is a typical occurrence, especially on the sandy plains that lie low. The valley is also characterised by high runoff, which is sometimes spectacular, but most of the water percolates beneath. The rain changes are highest in the winter, mainly in February and March, depending on location. Short, abrupt bursts of rain characterise the winter rains, which, if they fall in the surrounding mountains, flow down quickly into the city. During the summer, thunderstorms with a localised impact are not uncommon (Presidency of Meteorology and Environment, 2019). As a result, there have been several overcast days, resulting in lower solar gains in March and April. For further planning, it is also necessary to carry out weatherproofing measures, such as providing rain ruts on footpaths and buildings to protect pedestrians, which may preserve walkability throughout these two months.

Average total rainfall for the years 2015–2019 is shown in Figure 5.36 and it may be seen that the highest total rainfall was recorded in 2018 and the lowest in 2015. Considering the range and deviation of the total rainfall, it may also be seen that the range of total rainfall is significantly higher for 2018 when compared with other years.

It may be further observed that the mean total rainfall was 9.322 for 2015, which is the lowest for the years under consideration. It increased to 70.43 units in 2016 and then to 161.2 units in 2017, increasing further to 214.2 units in 2018. Then in 2019, the average total rainfall decreased to 143.8 units.

It may also be seen that there are outlying observations with very high total rainfall values in the years 2016, 2017, 2018 and 2019.

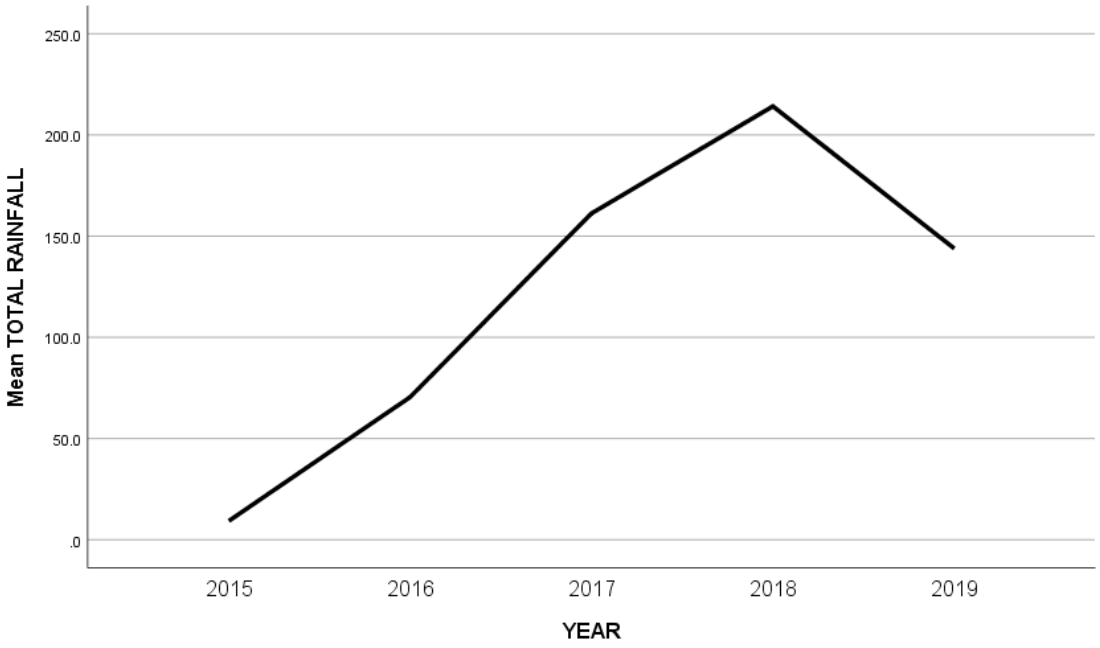

Figure 5.36 Mean rainfall in central Makkah during 2015-2019. Source: Presidency of Meteorology and Environment (2019).

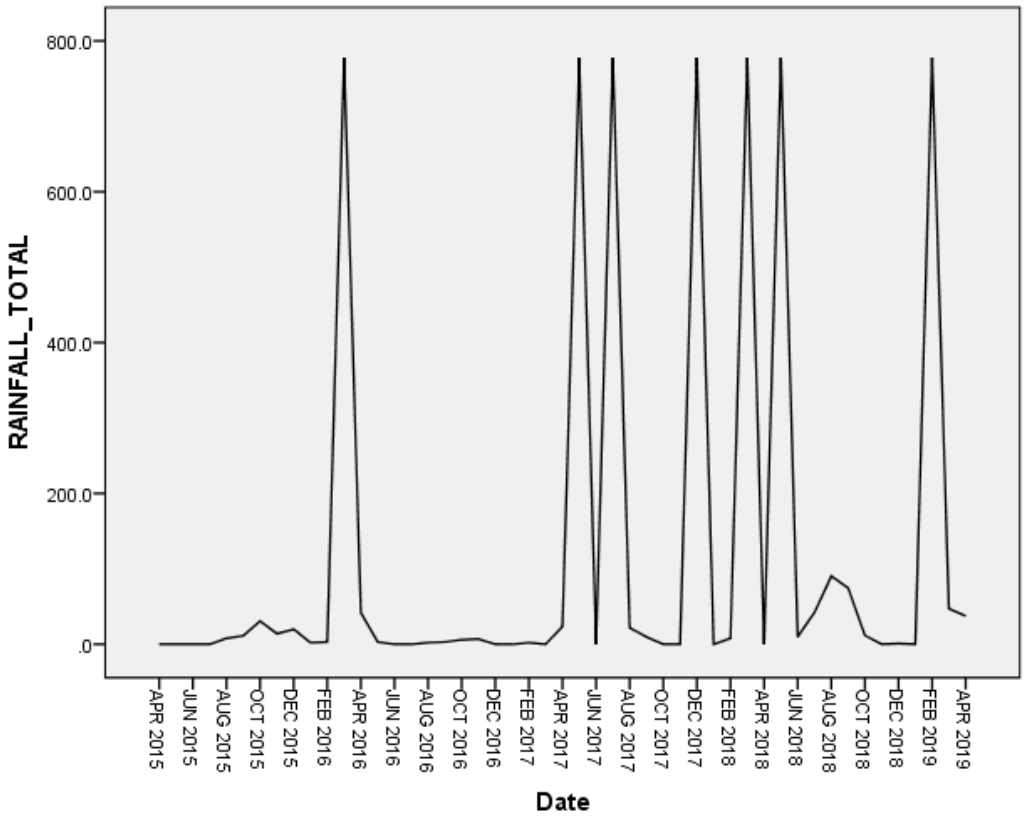

Figure 5.37 Mean rainfall in Central Makkah during 2015–2019 by month. Source: Presidency of Meteorology and Environment (2019).

5.6 Conclusion

As an introduction to the study area, this chapter provides a historical overview of Central Makkah, focusing on changes from the past to the future. It is certain that the nature of Central Makkah's streets reflects that of a city centre, and that it is significant as the primary gathering point for pilgrims for religious and commercial activities. The information gathered from this case study on the physical characteristics and features will be utilised to support the next approach that will be employed in this research. From general observation and climatic studies, it may be concluded that the following factors contribute to Makkah's supposedly severe climate: an initial six months period characterised by little humidity and high temperatures starting in May and ending in October and another six months during which the weather is acceptable for two months and pleasant for four. In this case, the possibility to increase walkability through the use of appropriate and effective sun protection and ventilation techniques is highlighted. Aspects of design of urban communities in Central Makkah that improve microclimatic conditions while also offering flexibility to meet seasonal climatic changes must be considered. Despite the fact that not enough has been studied about the effect of climatic conditions, this study seeks to explore and examine the walkability of Central Makkah based on the experience, behaviour, and evaluation of pedestrians. The climate is being examined to determine whether it is relevant to encouraging walkability in the area. As a result, walkability would be enhanced, and the time period during which locals of Central Makkah and pilgrims may enjoy the outdoors would be extended.

Chapter 6. Environmental Factors Influencing Walkability in Central Makkah

6.1 Introduction

This chapter presents the findings from analysis of data associated with the first and second objectives of the research, which is to examine the extent to which walkability may be relevant in a hot arid climate; specifically, Central Makkah. Also, to examine in detail pedestrian behaviour and obtain people's perceptions of comfort levels while walking in public spaces and explore the relationship between physical characteristics and cultural, psychological issues that influence people's decision-making with specific reference to Makkah and the Umrah/Hajj pilgrimage. The findings are the results of the analysis of both qualitative and quantitative data. This study aims to explore and examine the walkability of Central Makkah from the experience and behaviour and the evaluation of pedestrians. The current conditions are examined through the analysis of observations, interviews, and face-to-face questionnaires of pedestrian behaviour and experiences of pedestrians walking in the study area.

The main set of data was from observation and interviews and was analysed using the thematic analysis method. As outlined in Chapter 4, thematic analysis was used as a method to support the research to present the findings in a systematic manner according to the issues raised from the data. Interviews and observations were used to understand and examine how pedestrians behave and feel walking in such an area and weather conditions, and also examine the physical setting or urban environment in the study area of Central Makkah.

6.2 Limiting factors to walking in Central Makkah

Comfort was shown to be a significant factor in motivating individuals to walk on the street in this research. Within reviewing the literature, it was discovered that weather is one of the environmental factors associated with walking for active travel (Humpel et al., 2004; Delclòs-Alió et al., 2020; Miranda-Moreno & Lahti, 2013). People of all ages are motivated by how exciting or boring each route is, since they often do not choose the most direct route to their destination (Gehl, 2000). This is also developed by Carmona et al. (2010), who stated the importance of comfort in a city environment in which the temperature is one of the factors that have an effect on people's experience. The survey of street users in Central Makkah streets

shows the most limiting factors that discourage people from walking; respondents are based on user types. It is observed that the majority of the respondents believe that temperature, besides traffic congestion, are the most limiting factors to walking within the Central Makkah area. What this indicates is that the area does not encourage or at least does not limit the use of streets (see Figure 6.1).

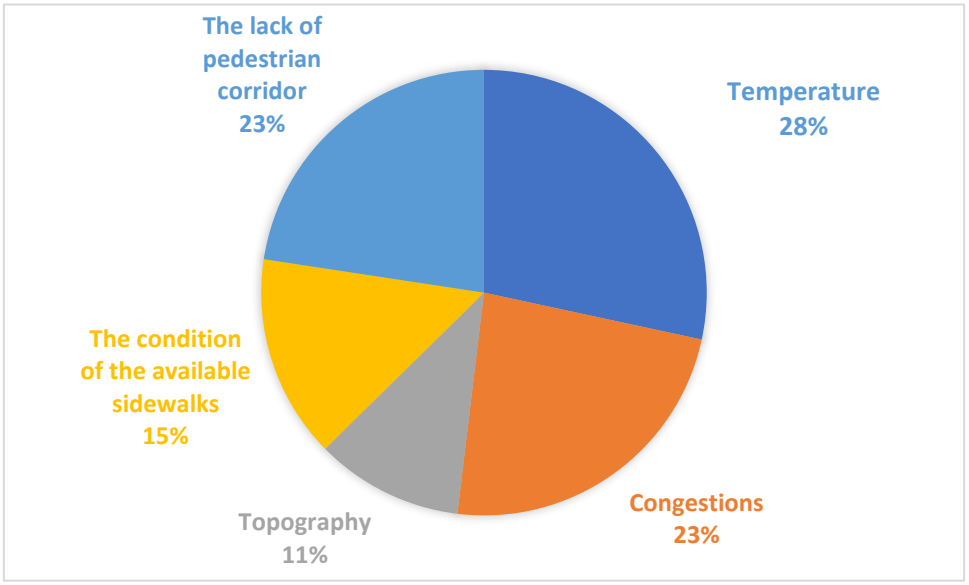

Figure 6.1 Limiting Factors for walking

Based on the survey, the most limiting factor on walking within Central Makkah area was the temperature (28%), followed by the congestion of people and vehicles and the lack of pedestrianised streets (23%); 15% said it was because of the condition of the available sidewalks, while 11% said it was because of the topography. Out of 400 respondents, 275 respondents agreed that the climate/weather was the most limiting factor preventing them from walking, and 228 respondents agreed there was too much traffic congestion. So, most of the respondents believe that the weather limits their walking during their visit, so that the reason that some would not walk at certain times might be because of that. This shows that people's walking is restricted and their walking depends on the weather/temperature and congestion.

Variations between different socio-demographic backgrounds concerning how the environmental limiting factors determine their walking

To study the ability to walk freely, be self-sufficient, and see clearly is critical in every human's life time, and this will evolve across time (Bridge, 2010). In the next subsection, the variations of how people use urban environments, depending on the type of user, age group, gender, or nationality, will be identified.

6.2.1 ***Temperature***

Based on Table 6.1, it may be concluded that since the p values are higher than 0.05 here, the factors concerning temperature do not depend on any socio-demographic types except nationality. The results in the table show the socio-demographic information of the respondents who expressed the importance of shade and indicate that all the respondents are concerned and perceived this issue to be negative, as seen in the result proven earlier in Figure 6.1.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Type of user	Between Groups	.511	1	.511	2.710	.100
	Within Groups	74.922	397	.189		
	Total	75.434	398			
Age	Between Groups	.314	1	.314	.281	.597
	Within Groups	444.834	397	1.120		
	Total	445.148	398			
Gender	Between Groups	.203	1	.203	1.109	.293
	Within Groups	72.699	397	.183		
	Total	72.902	398			
Nationality	Between Groups	.915	1	.915	4.258	.040
	Within Groups	85.296	397	.215		
	Total	86.211	398			

Table 6.1 Degree of limiting factors attributes (temperature) based on mean value, which only shows significant association in nationality.

Variation according to nationality

In respect of ethnic background, whose categorisation was limited to Saudis and non-Saudis, while the respondents were mainly non-Saudi, according to the questionnaire results it can be seen that the p value is smaller than 0.05, from which it may be concluded that these two variables have a strong relationship (see Table 6.1). So, the perception of temperature depends on the respondents' nationality. Most of the non-Saudis agreed that the temperature was a limiting factor for walking. This supported the findings from the qualitative data, which revealed that most of the non-Saudis were mostly people from Arab countries such as Egypt, Tunisia, Algeria, Iraq, and Morocco, and were not familiar with the Saudi climatic zone, which might cause discomfort while walking or might contribute to the decision to walk or not (even though their home countries have relatively hot climates).

6.2.2 ***Topography***

Topography is one of the major obstacles for pedestrians, especially for the elderly, children, and people with disabilities. Topography, such as hills and slopes, has various effects on different individuals. A few respondents identified uneven terrain as making walking a tiring experience and that it increased the amount of time required to reach their destination.

> *"I can walk for an hour – an hour and a half and I'm tired with this topography … the topography is making walking more difficult in some areas to go up and down."* – P3[4]

Based on Table 6.2, since the p values are higher than 0.05 here, it may be concluded that the factors concerning topography do not depend on any of the socio-demographic types except for age group. The results in the table show the socio-demographic information of the respondents who expressed difficulties with walking in such an environment, which indicates that all the respondents were concerned and perceived this issue to be negative, as seen in the result proven earlier in Figure 6.1.

[4] P refers to public participants followed by the number in the list.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Type of user	Between Groups	.396	1	.396	2.085	.150
	Within Groups	75.594	398	.190		
	Total	75.990	399			
Age	Between Groups	8.542	1	8.542	7.745	.006
	Within Groups	438.968	398	1.103		
	Total	447.510	399			
Gender	Between Groups	.000	1	.000	.000	.992
	Within Groups	72.960	398	.183		
	Total	72.960	399			
Nationality	Between Groups	.431	1	.431	1.998	.158
	Within Groups	85.879	398	.216		
	Total	86.310	399			

Table 6.2 Degree of limiting factor attributes (topography) based on mean value, which shows significant association only for age.

Variation according to age

According to Figure 6.2, age does show significant association with topography as a limiting factor; since the p values are higher than 0.05 here, it may be concluded that the topography as a limiting factor for walking does depend on age group, so there is a significant relationship between them. Based on the survey results, in the age group 20–30 more than 13 people chose topography as a limiting factor and the reason may be that the young generation are used to travelling by car. It was shown that the age groups 31–40 and 41–50 were more numerous than the elderly, which refers to those above 50 years old, and that the lowest number of participants from this age group took part in the survey. On the other hand, based on observation, people aged above 50 years old seem to have more difficulties walking in areas that have hills or steep slopes, while the opposite is true for other age groups. Hills and slopes have varying effects on different individuals, such as the old or handicapped, who have a hard time tolerating areas with so many activities (Carr et al., 1992; Rapoport, 1990). For more details see Appendix F.

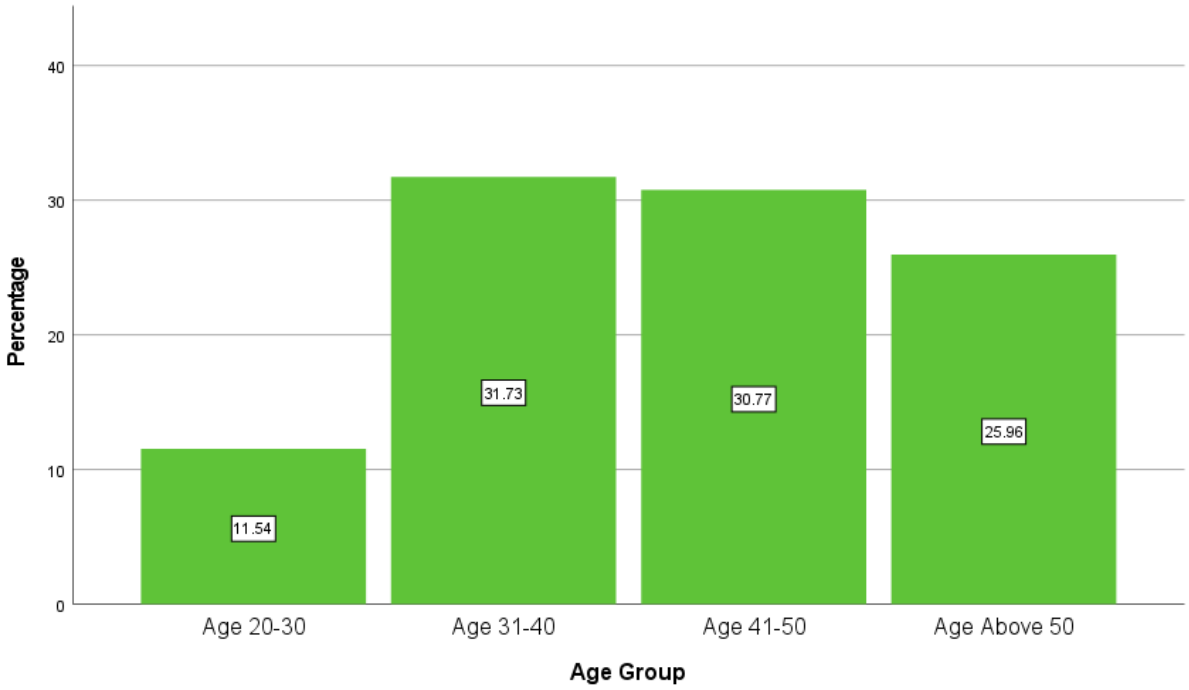

Figure 6.2 The significant relationship between topography as a limiting factor and the ages of the respondents.

6.3 Comfort and convenience

6.3.1 ***Comfort attributes and characteristics that contribute to walkable streets***

Comfort is a basic physiological need for people. As mentioned by Carmona et al. (2010), social and psychological comfort is linked more to the street's nature and atmosphere. In respect of the attributes, the findings indicated comparable patterns of relevance that contribute to pedestrians' comfort, which might attract more people to walk and use the street more. It indicates that on the basis of user's perceptions in relation to their degree of enjoyment and comfort attributes, which show that shade and covered pathways to protect them from the elements, public facilities for seating and relaxation availability, and signage for pedestrians are the most crucial criteria making walking on the street more comfortable.

The attribute scale indicates the factors of comfort that matter to the respondents. The majority of the most important features, according to users' perceptions, were more strongly related to the climate. Surprisingly, as supported by the average response, sidewalk width and fountains were the least significant criteria in comparison with others (see Figure 6.19). Streets with appropriate infrastructure and utilities are comfortable, welcoming and pedestrian-friendly (Burton & Mitchell, 2006).

Masjid Al-Haram is a destination for millions of Muslim people and can be described as a dream for most of them, so being in such a place does not cause each individual to question this feeling. However, most people felt that comfort issues such as thermal stress, pedestrian volume, and narrow sidewalks made walking an unpleasant experience.

The culture of a place where many people of different nationalities walk along the streets creates peace and a feeling of unity, with some seeing this as a culturally unique experience. This supports the claim by Fattah (2005), who said that Makkah's distinctive character is formed in part by the fact that it is populated by people of different races and ethnicities, making it one of the most diverse cities in the Islamic world, with more than 100 ethnic groups represented. Despite this, very few respondents perceived the area to be friendly to walking:

> *"Access to Al-Haram is easy and there are no problems. People can walk to all the prayer times."* – P12
>
> *"The situation is comfortable with this number of pilgrims; we need shade to encourage people to walk comfortably"* – P4

Some authorities are aware of the current problems but have not reacted or obtained visitors' experiences and perceptions about the current issues they face during their visit to Central Makkah. Based on an interview with a member of one of the authorities, it was acknowledged that the sidewalks were not comfortable for walking. They lacked shade and water elements to shield pedestrians from the hot daytime temperatures; poor air quality discouraged walking for fear of health-related problems, and the use of pedestrian paths had also been affected by ongoing construction, forcing people to use public transport.

> *"... in the central area, problems such as roads, old buildings, and new projects that are under construction affect the existence of pedestrian routes and [they] still depend on the type of transportation, only small cars or buses."* – P7

That shading could minimise heat was proven by previous research, which revealed that air temperature and solar radiation played important roles in comfort, explaining why a strong correlation exists between microclimatic and comfortable environments (Nikolopoulos et al., 2006; Eliassaon et al., 2007).

From observing a man walking comfortably in the absence of the sun (Figure 6.3), it seems as though he enjoyed the walk, even with disconnected sidewalks and unsafe crossings, as is

clearly seen by his facial expression, where in many cases the physiological response of sweating is the first sign to thermal stress that pedestrians feel.

The man was walking out of the mosque alone, with light clothes and a bottle of water. He was walking comfortably and enjoying the clouds and was walking alongside the street without being separated from the cars. He used the street to walk where some people were on the right and turned his head before crossing to the other side where there were no sidewalks, which put him in danger. He met his friends who were waiting for him, after which they continued walking and crossed to the other side without paying attention to the oncoming cars. They then walked towards the sidewalk, which was covered by canopies and protected by safety barriers, and had a conversation with each other. While walking they turned their heads towards what merchants were selling, and finally crossed the street to their residences.

Figure 6.3 Observing pedestrians by tracking them from Masjid Al-Haram to their residences. Source: Field observation, 2019.

Covered Path and shade and other shelter from the sun

In places where the climate is hot and arid, sun protection is essential for creating a positive outdoor experience. The existence of covered paths providing shade and protection from the sun is crucial for pedestrians to walk on the streets comfortably, as shown by the findings. Based on the survey, the temperature and the heat of the sun have been mentioned before as one of the factors limiting walking, where 75% of all respondents agree that they need shade as protection

from the heat of the sun; prolonged exposure to the sun may affect people's health (Figure 6.4). As well as this, 74% of respondents were uncomfortable, indicating the importance and the need for trees as protection from the sun (Figure 6.19).

According to studies extracted from the literature reviews, three main strategies of protecting against hot sunlight and rain include building design, orientation, and spacing between building (Lang, 1994; Carmona et al., 2010), planting trees, the space between the trees and buildings, and the provision of pathways with cover (ibid). On the street, building orientation also has a significant influence in decreasing street sunlight. According to on-site observation, the spaces getting shade from the buildings attract people and activities, particularly those of a social of optimal nature (see figure 6.4). Additionally, because of the high-rise buildings on the streets, some areas of Central Makkah have good shadow casting. In addition to covered arcades, retail malls include building overhangs that offer shade for pedestrians. However, high-rise buildings do not necessarily include open space provision, and as a consequence, they may destroy the townscape and social life. Some research also suggests a link to increased criminal activity, and impairment of the quality of light, air, and views in the urban environment as a result of this (Alexander, 1977). Spatial quality is associated with the unit's scale, defined as the height to width ratio as measured along a section line (Oktay, 1990). In the next chapter, further discussion takes place from different perspectives.

Figure 6.4 High-rise buildings create comfortable environments for pedestrians to walk and socialise. Source: Field observation, 2019.

The pedestrian walkways are split into two categories. In the case of Central Makkah, there are only a few covered walkways along two streets: Jabal Bakkah Street and Masid Al-Haram Street. The second style refers to trees and palm trees, which are few, limited to two places, and cannot offer enough protection from the sun, rain, and strong wind. More spaces for walking, described as uncovered walkways, are explained in section 7.2.1.

Figure 6.5 Pedestrians use the shade from the palm trees and awnings to get away from the sun. Source: Field observation, 2021.

The interviews revealed that the existence of trees or green spaces has a desirable environmental influence, like changing the microclimate effect, making shade available along routes and also playing the role of dividing the pedestrian walkways from the traffic flow. This is a view bolstered by observations in Central Makkah, where palm trees have only been planted in those areas. It was found that there are more activities in the places that have shaded palm trees planted or are covered.

It was found in the survey that trees and shade along pedestrian routes influence the usage of the street. There is intense direct sunlight every day in Central Makkah, so planting trees is one of the methods of providing shade, which may create a comfortable environment for people to walk, socialise, and have conversations. People come from climatic regions that are different from Central Makkah, which is described as having hot, dry weather. For this reason, some people's decisions not to walk may be affected because of the weather of the area, as explained in the section on suitable temperatures below. Figure 6.6 shows that open spaces occupy a huge amount of the built environment in Central Makkah, which makes the exposure to the sun much greater than if shade was provided.

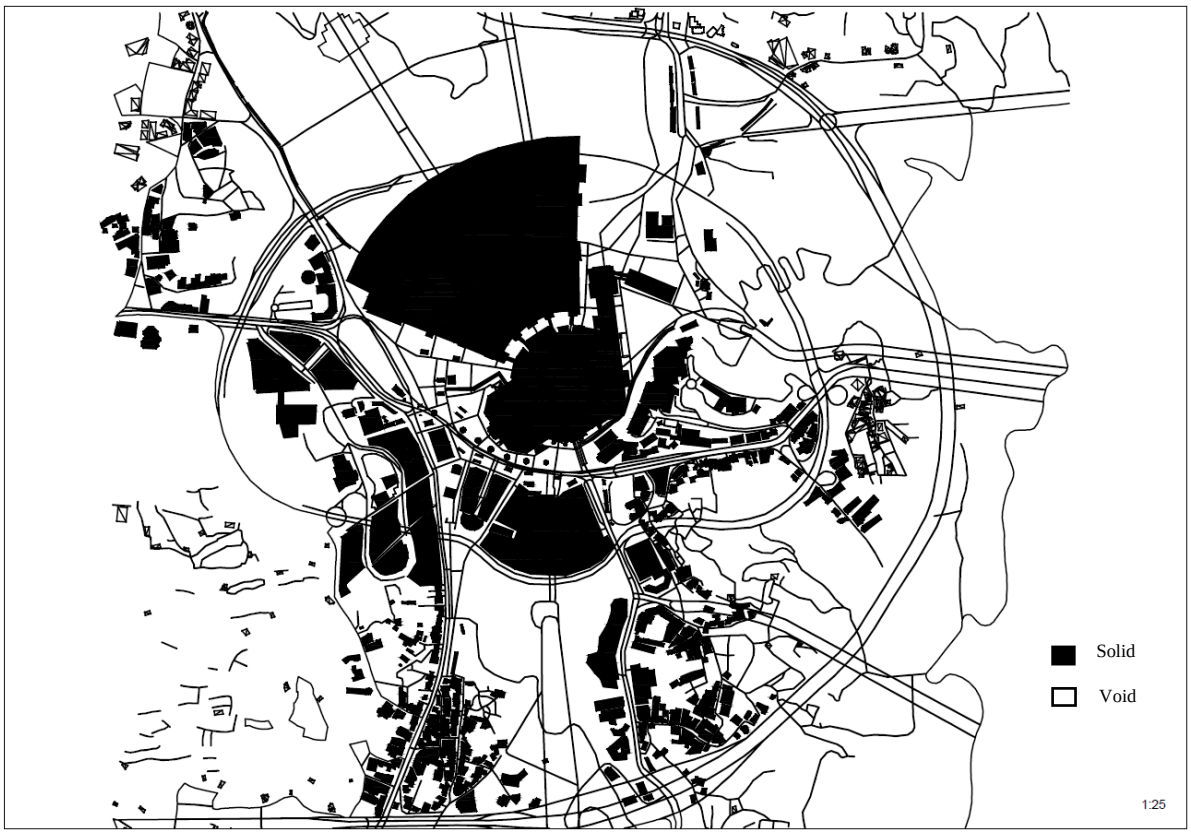

Figure 6.6 A figure-ground map for Central area of Makkah. Source: author.

In the case of Central Makkah, it was also shown that the areas lack shade based on respondents' perceptions; the majority of responses disagree that there is enough shade and trees. In comparison with some Western and European countries where the penetration of sunlight in areas is low, protection from sunlight is a key factor in Central Makkah in order to provide a walking environment that makes people feel more comfortable and happy while using the street, helping to create a more enjoyable area for users (Carmona et al., 2010). The findings of the survey on pedestrians' needs show that it is important to include covered walkways, trees, and greenery, which are relevant to sun safety as well as being cooling elements (see Figure 6.7). This is in line with Lynch's (1981) assertion that shaded streets possess an environment for events that can bring people together.

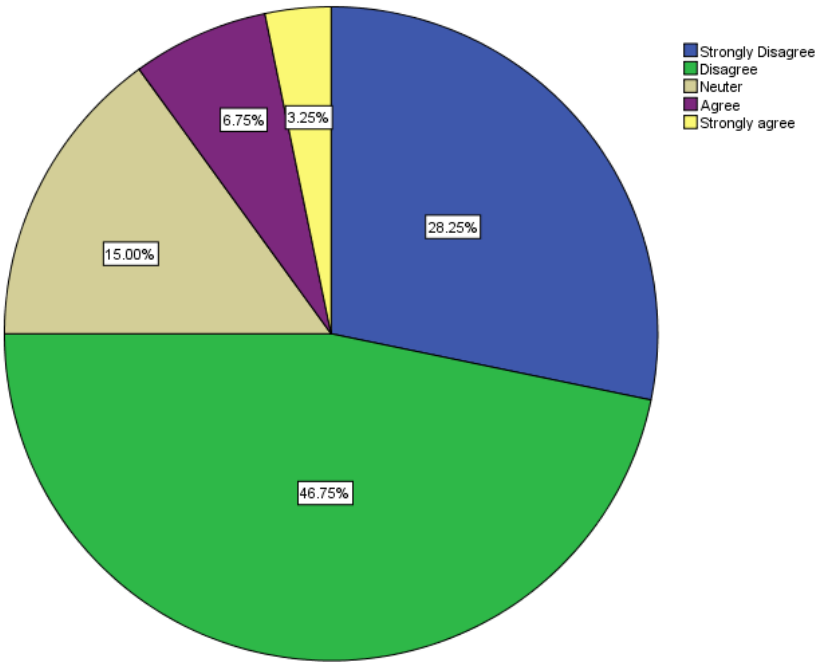

Figure 6.7 Users' perceptions on the degree of satisfaction about available shade along Central Makkah streets.

Variations in perception between different socio-demographic backgrounds concerning availability of shade

Based on Table 6.3, since the p values are higher than 0.05, it may be concluded that factors concerning the availability of shade along Central Makkah streets do not depend on any of the socio-demographic categories. The results in the table show the socio-demographic information of the respondents expressing the importance of shade, which indicates that all the respondents were concerned and perceived this issue to be negative, as proven earlier in Figure 6.7.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Type of user	Between Groups	1.280	4	.320	1.692	.151
	Within Groups	74.710	395	.189		
	Total	75.990	399			
Age	Between Groups	7.009	4	1.752	1.571	.181
	Within Groups	440.501	395	1.115		
	Total	447.510	399			
Gender	Between Groups	1.353	4	.338	1.866	.116
	Within Groups	71.607	395	.181		
	Total	72.960	399			

Nationality	Between Groups	1.150	4	.288	1.334	.257
	Within Groups	85.160	395	.216		
	Total	86.310	399			

Table 6.3 Degree of comfort attributes (covered walkways and shade and other protection from the sun) based on mean value, which shows no significant difference across all variables.

Trees and Suitable temperature

In Chapter 7, it is found by observation that the central area also lacked trees, which affected the use of the street as there is intense sun exposure that pedestrians experience during the day. The presence of trees or shade in certain areas was also perceived to have a strong influence on the walking environment, as evidenced by the interviews, for instance managing the effect of the microclimate, offering protection from the sun, and serving as a barrier between the pedestrian path and traffic movement. Other studies also suggest that street trees and landscaping not only act as a barrier for pedestrians and traffic, but also provide a friendly walking experience by providing visual stimulation and shelter from the elements (Jacobs, 1996; Giles-Corti et al., 2009). This is supported by observations in Central Makkah streets, where a few palm trees that have been planted provide little shelter/shade when the sun is directly overhead, particularly in the afternoon.

Previous studies have established that sun protection is a critical aspect to consider, since it has been shown to influence the microclimate in urban areas (Whyte, 1980; Carr et al., 1992). Protection from effects of sunlight is an essential element in making people feel pleasant and comfortable when walking in Saudi Arabia streets, in contrast to many Western countries (for example, in Northern Europe) where sunlight penetration into places helps create a reas that are more pleasant for users (Carmona et al., 2010). The results of the questionnaire, considering the improvements that are necessary in Central Makkah, reveal that the provision of trees and greenery that provide protection from the sunlight and rain, as well as a cooling aspect, are all required (Figure 6.8). The statement of Lynch (1981) that shady streets create an environment for activities and can attract people together is in line with this finding.

Figure 6.8 Street users enjoying the shade from the high-rise buildings where the palm trees do not provide enough shade. Source: field observation 2019.

Based on the survey, the availability of trees along Central Makkah streets was found to be a negative factor, as most of the respondents perceived that there were not enough of them (Figure 6.9). Most of the respondents (75%) did not agree with the statement ‘There are enough trees along sidewalks’, which may affect comfort and discourage usage of the space, limiting it to times where the sun and temperatures are low. As was proven, the volume of pedestrians increases and decreases as a result of temperature and sun exposure, which will be discussed in more detail in the next section.

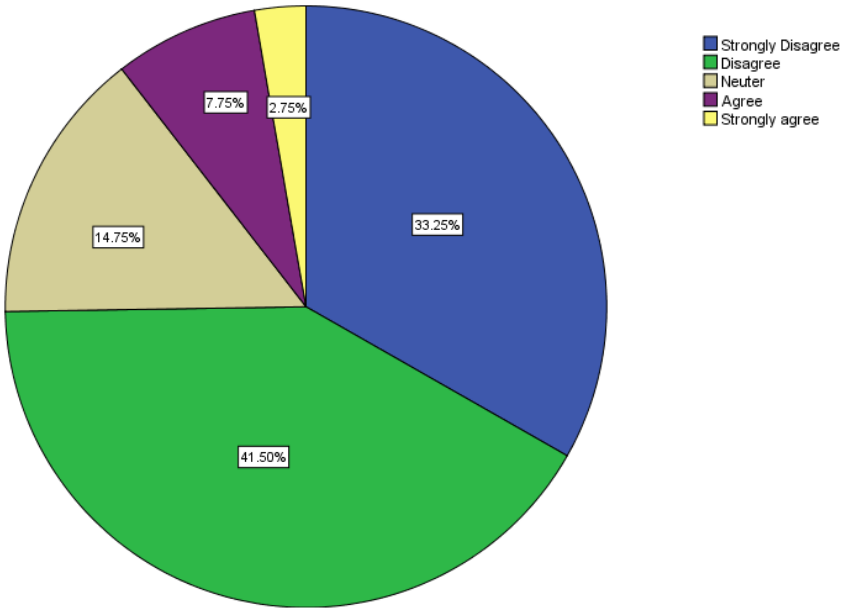

Figure 6.9 Users' perceptions on the degree of satisfaction concerning the availability of trees in Central Makkah.

Variations in perception between different socio-demographic backgrounds concerning availability of trees along Central Makkah streets.

Since the p values are higher than 0.05 here, it may be concluded that the socio-demographics of the respondents are not connected to their responses in regards to the availability of trees along Central Makkah streets, which indicates that the findings above that demonstrated a negative perception about the availability of trees was one of the factors that would contribute to the comfort of the place and encourage people to use the space more. This was proved by Jaber (2013), who revealed that in the hot climate of Arab cities, trees have been shown to change the microclimate of urban streets, lower air temperatures, and provide a psychological cooling effect.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Gender	Between Groups	1.637	4	.409	2.267	.061
	Within Groups	71.323	395	.181		
	Total	72.960	399			
Nationality	Between Groups	.722	4	.181	.834	.504
	Within Groups	85.588	395	.217		
	Total	86.310	399			
Age	Between Groups	1.878	4	.469	.416	.797
	Within Groups	445.632	395	1.128		
	Total	447.510	399			
Type of user	Between Groups	.550	4	.137	.720	.579

	Within Groups	75.440	395	.191		
	Total	75.990	399			

Table 6.4 Degree of comfort attributes (availability of trees along Central Makkah streets) based on mean value, which shows no significant difference in all variables.

Based on field observations that showed the pedestrian numbers and recorded temperature for different times of the day (Aljawabra & Nikolopoulou, 2010), Figure 6.10 clearly shows that the early morning between 6 and 9 am had a greater number of pedestrians than at noon. Only 1334 pedestrians passed by from 10am to 3pm, when the temperature was above 40°C. The afternoon temperature is usually high and may be the reason behind the decreasing number of pedestrians, whereas there are more numbers of pedestrians close to sunset. More than 8000 people were recorded walking when the temperature was below 40°C, as it is usually cooler nearer to sunset, attracting more pedestrians than other times of the day. From this, it is evident that the temperature plays a significant role in influencing people to walk. During normal hours, the respondents were able to walk comfortably along the sidewalks; however, pedestrian volume increased significantly in the moments before and after prayers. This led to congestion and difficulties in walking. This scenario is supported by Nikolopoulou and Lykoudis (2007), who found there is a solid link between microclimate conditions and space use. They also determined that the air temperature and wind speed are two important elements in space use, which supported their findings.

The presence of trees and shade along the route contributes to the local climate. This is corroborated by the survey findings, which show that one of the elements that requires the most improvement on Central Makkah streets, according to the respondents, is to provide trees along the streets (see Figure 6.19). The existence of trees in a city will not just give shade, but may add to the cooling of the temperature of that area (Gill et al., 2007). Thus, planting trees along the streets may help to reduce high local temperatures in Central Makkah, which would create a comfortable environment for people to walk.

Exposure to direct sunlight and hot daytime temperatures made it very tiring and difficult for the respondents to walk. Based on observations, in daytime and where the area was exposed to sunlight, the number of people decreased, with some people still walking to Masjid Al-Haram but covering their head with a rag or handbag as protection from the sun (see Figure 6.11).

Based on interviews, some of the respondents opted to limit their walking time to when temperatures fell, that is, in the late afternoon and early morning:

> *"My arrival to Al-Haram is difficult depending on the weather and the weather gets better before sunset and after dawn…"* – P14

The other coping mechanism is that they chose a more convenient means of transport:

> *"Walking is closer but with this sun and heat [it] is almost harder; I drive from 5–10 minutes, but the temperatures force me to drive the car."* – P2

Some respondents also chose to walk along shaded paths:

> *"I chose this path because there is a large shadow along [it] to stay away from the sun's rays and heat."* – P2

Other traffic plans included developing climatic solutions to protect pedestrians from harsh climates. Such initiatives revolved around planting trees and installing umbrellas along sidewalks to prevent exposure from direct sunlight and providing water sprinklers or fountains.

> *"… climate solutions for heat are very important, both natural shading like trees or mechanical shading because it is more environmentally friendly, also the use of water sprays …"* – E2[5].

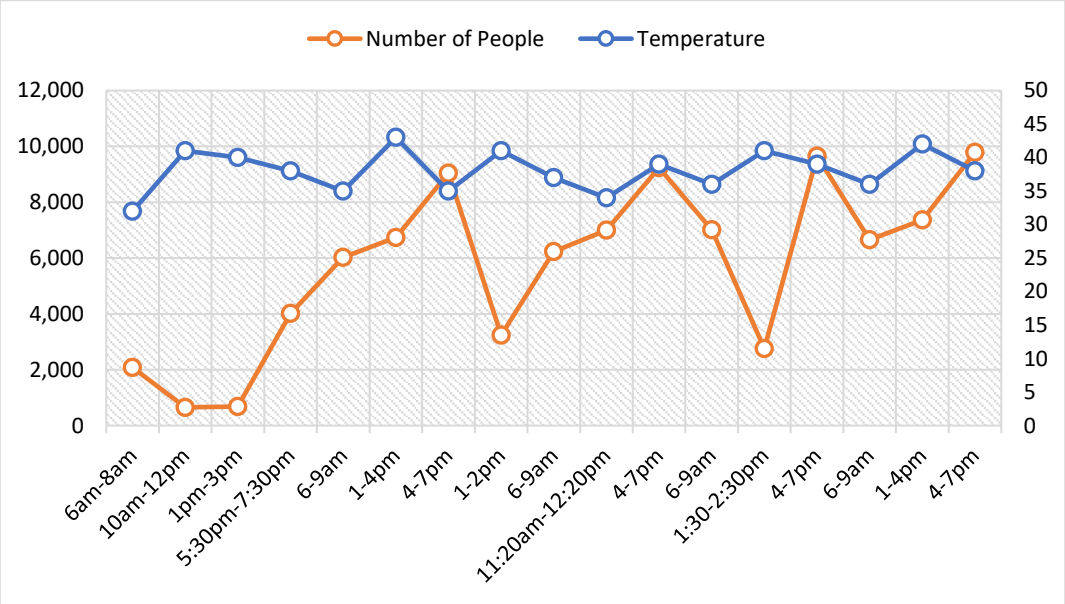

Figure 6.10 The relationship between the number of pedestrians and the temperature. Source: Observations, 2019.

[5] E refers to elite participants followed by the number in the list.

Figure 6.11 Pedestrians protect themselves from the burning sun by using their belongings. Source: Field observation, 2019.

The effect of the climate on the purpose of visit

The motivation to visit the central area of Makkah city is mainly for religious purposes such as praying and performing Hajj or *Umrah*. The temperatures have limited visits to these two categories, which are the main purposes, but do not support others (shopping, socialising, and working), as shown in Table 6.5, which concluded that the visitors who came to Central Makkah with the purpose of praying and performing Hajj answered that there was a hot climate. This is possible, since people from all around the world come to pray and perform Hajj, and the climate may be significantly different compared with their countries. This supports the findings from the interviews where most of the participants prefer to carry out other activities at night in the central area because of the temperature:

> *"[I] usually shop at night because it is hot during the day."* – P8

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Purpose of your visit (praying)	Between Groups	.971	1	.971	3.960	.047
	Within Groups	97.082	396	.245		
	Total	98.053	397			

Purpose of your visit (perform Hajj or Umrah)	Between Groups	6.886	1	6.886	9.581	.002
	Within Groups	284.612	396	.719		
	Total	291.497	397			
Purpose of your visit (shopping)	Between Groups	.356	1	.356	.372	.542
	Within Groups	379.543	396	.958		
	Total	379.899	397			
Purpose of your visit to (Socialising)	Between Groups	.144	1	.144	.109	.742
	Within Groups	523.756	396	1.323		
	Total	523.899	397			
Purpose of your visit to (working)	Between Groups	3.583	1	3.583	2.874	.091
	Within Groups	493.716	396	1.247		
	Total	497.299	397			

Table 6.5 Significance of variation concerning the purpose of the visit attributes based on mean value, which demonstrates no difference in association across all variables.

Time preference to the visit the Central Makkah area

Based on the findings from the interviews, most of the participants prefer to visit the central area either in the early morning or after sunset: the latter is preferred more than the former. This is corroborated by the survey's results, which reveal that most of respondents, almost 52%, agree that after sunset is the best time to visit, while the early morning comes second with 21.50% (see Figure 6.12) (Appendix F). They mainly used the street during cooler times of less sunshine such as in the mornings and evenings, which is also the time when the walking experience and atmosphere is more pleasant. This explains why the majority of respondents use the street during these times, which explains the effect of the temperature, which may discourage walking at certain times of the day. The significance of urban air temperatures for encouraging the use of urban spaces has been emphasised by scholars (Jacobs, 1996; Carmona et al., 2010; Nikolopoulou & Lykoudis, 2007).

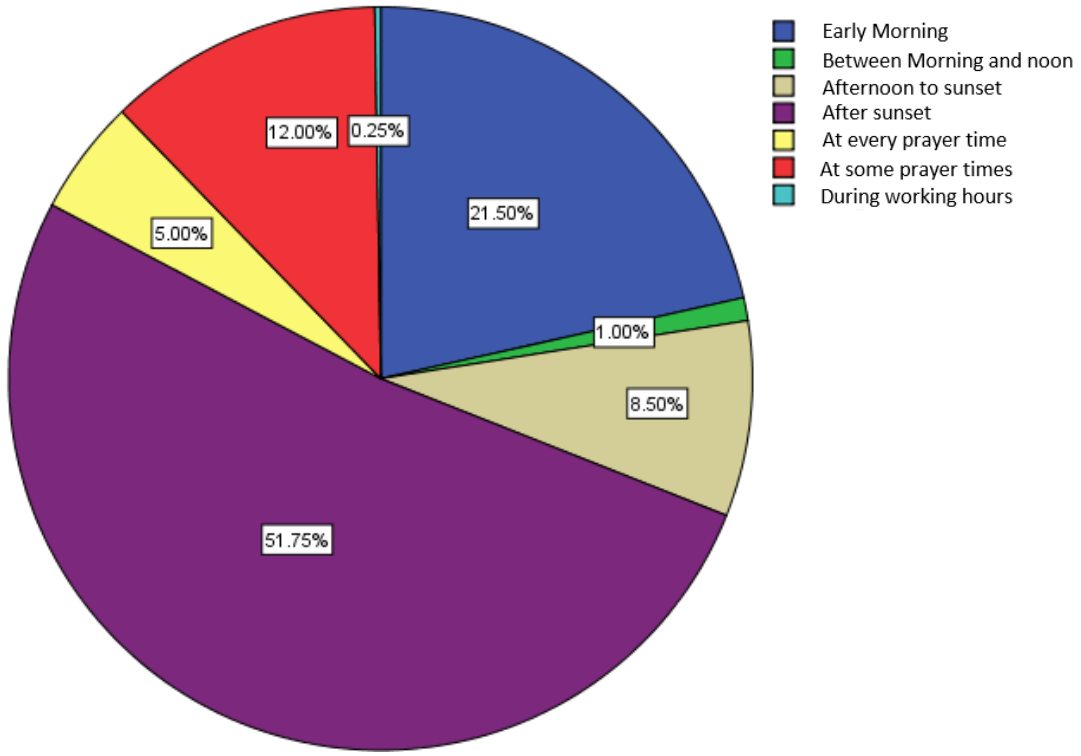

Figure 6.12 Time preferences of visiting Central Makkah.

Variations between different socio-demographic backgrounds concerning the time preference to visit Central Makkah

Based on Table 6.6, since the p values are less than 0.05 here, it may be concluded that factors concerning preferences of the time of visiting Central Makkah depend on socio-demographics, except for age and nationality. The results in the table show the socio-demographic information of the respondents expressing a time preference, indicating that all the respondents were concerned and perceived the situation differently, and there are variations in some variables.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Type of user	Between Groups	4.450	6	.742	4.074	.001
	Within Groups	71.540	393	.182		
	Total	75.990	399			
Age	Between Groups	9.790	6	1.632	1.465	.189
	Within Groups	437.720	393	1.114		
	Total	447.510	399			
Gender	Between Groups	3.285	6	.547	3.088	.006

	Within Groups	69.675	393	.177		
	Total	72.960	399			
Nationality	Between Groups	2.533	6	.422	1.980	.067
	Within Groups	83.777	393	.213		
	Total	86.310	399			

Table 6.6 Degree of comfort attributes (time preferences for visiting Central Makkah) based on mean value, which shows no significant difference in the type of users and gender.

Variation according to user type

In terms of the time of visits to the Grand Mosque (Al-Haram), this varies between the residents and visitors, who are mostly pilgrims. It may be seen that the time of visits differs dramatically between residents and visitors (see Figure 6.13). We can use cross tabs and a bar chart to study these two variables.

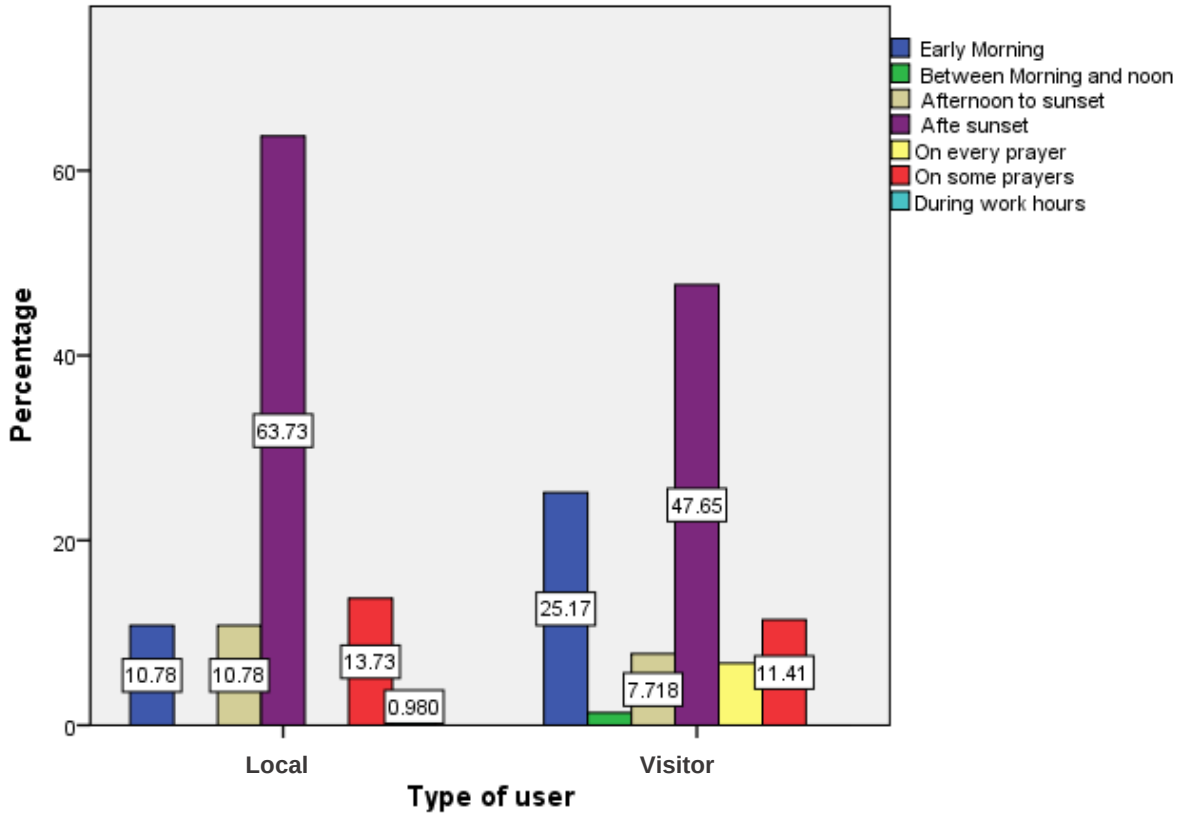

Figure 6.13 Time preferences of visiting Central Makkah based on the type of user.

To summarise the findings, a chi-square test was applied.

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	23.423a	6	.001

Likelihood Ratio	30.063	6	.000
Linear-by-Linear Association	5.993	1	.014
N of Valid Cases	400		
a. 4 cells (28.6%) have expected count less than 5. The minimum expected count is .26.			

Table 6.7 Chi-square test for the time preferences of visiting Central Makkah according to the type of user

It can be seen that the p value is smaller than 0.05, so we may conclude that these two variables have a strong relationship. Most of the residents visit Al-Haram after sunset, whereas visitors do so at some prayer times, and some visitors visit at every prayer time. The majority of the people who attend the morning prayer are visitors. This shows that people avoid walking or visiting Al-Haram during the time when the weather is hot and decide to walk when the temperature cools down and is more comfortable for walking. Therefore, this demonstrates that the climate has an effect on people's decision to walk at certain times of the day.

Variation according to age

According to Figure 6.14, the age factor does not show significant association with the time of the visit; since the p values are higher than 0.05, it may be concluded that the time of visit does not depend on age group, so there is no significant relationship between these. Based on observation, people aged 40–50 and those aged above 50 years old seem to prefer to visiting during the day, especially in the morning, while people of other ages vary in their preference. This supports the finding that the responses of participants of diverse ages differ greatly, so different age groups have different physical conditions, as well as differing viewpoints on open space (Sisiopiku & Akin, 2003; Forsyth, 2003).

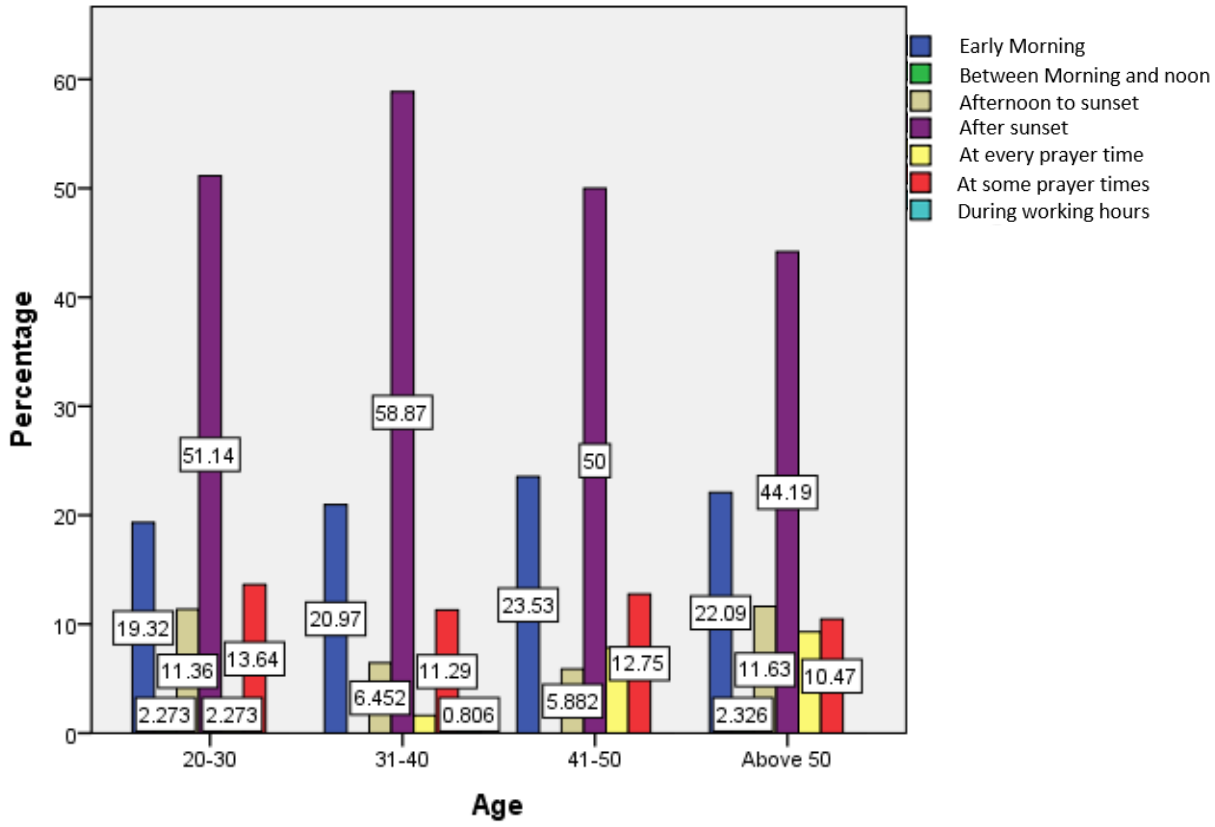

Figure 6.14 The significance of the relationship between the time of visits and the age of the respondents.

Variation according to gender

The Chi-square test indicates a statistically significant difference between gender groups in terms of the time preference to visit the Central Makkah area (see figure 6.15). The two groups perceived that the preferred times to visit were early morning and after sunset. The small difference in the perception between the gender groups which is that females have a stronger negative response to some prayers and the time from afternoon to sunset, which seems to be positive for the male group, so that might be because it causes them discomfort as the temperature is still high. Another reason might be that the women feel safer going out during the morning, when presumably the light is brighter even if the heat is yet to really increase, rather than the evening when the light is fading.

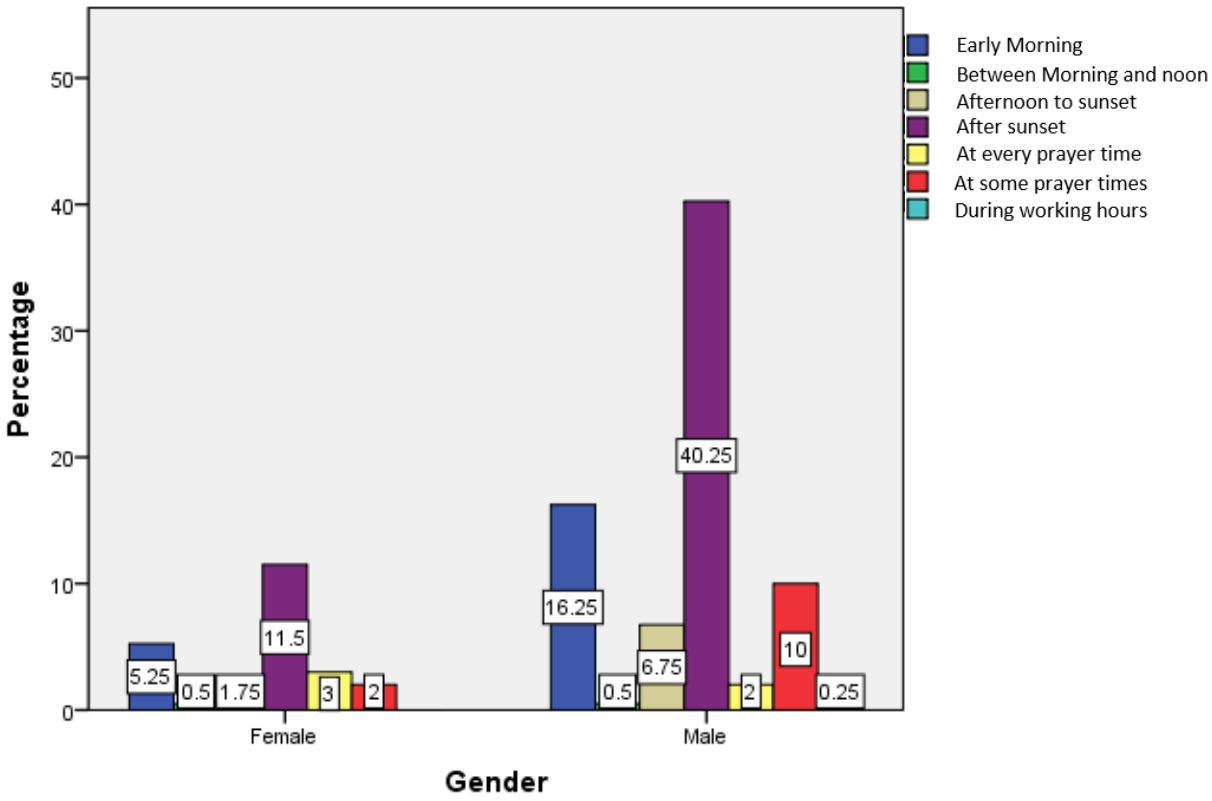

Figure 6.15 Variation in perception of the time of visit according to gender.

Variation according to nationality

The chi-square test indicates there is no considerable difference between these two groups in terms of the time of their visits to the central area. The slight difference in perception between the two groups is that the Saudi group has a negative response to visiting at every prayer time, while the other group show more positive responses towards their visits in the early morning and at every prayer time (see Figure 6.16).

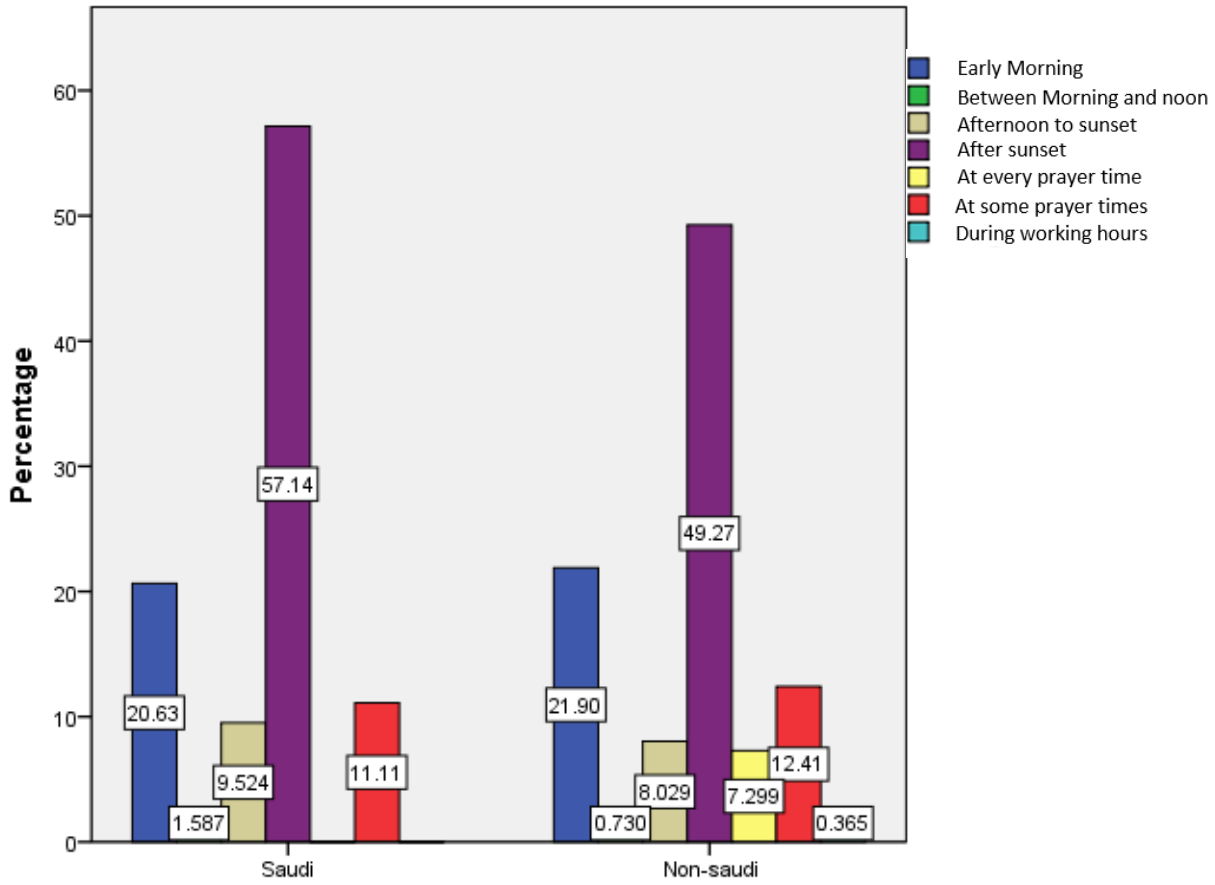

Figure 6.16 Variation in perception of the time of visit between two ethnic groups

Duration of visit

The amount of time spent by individuals in public places is influenced by the perception of comfort and convenience. This view is in line with the perspective of Carmona et al. (2010) who emphasised that comfort is a precondition for a successful public space and has an effect on how long people remain in the area. There is no specific time to visit Makkah to perform *Umrah*, whereas there is for Hajj. Therefore, since the Grand Mosque remains open day and night, trips from various places and between them and the mosque are unlimited and varied. According to the results below concerning visit duration (Figure 6.17), the majority of users spend between one and three hours (62.25%) at this place during their stay. Others spend four to eight hours there (33.50%), less than one hour (2.8%), or 9–12 hours (1.50%).

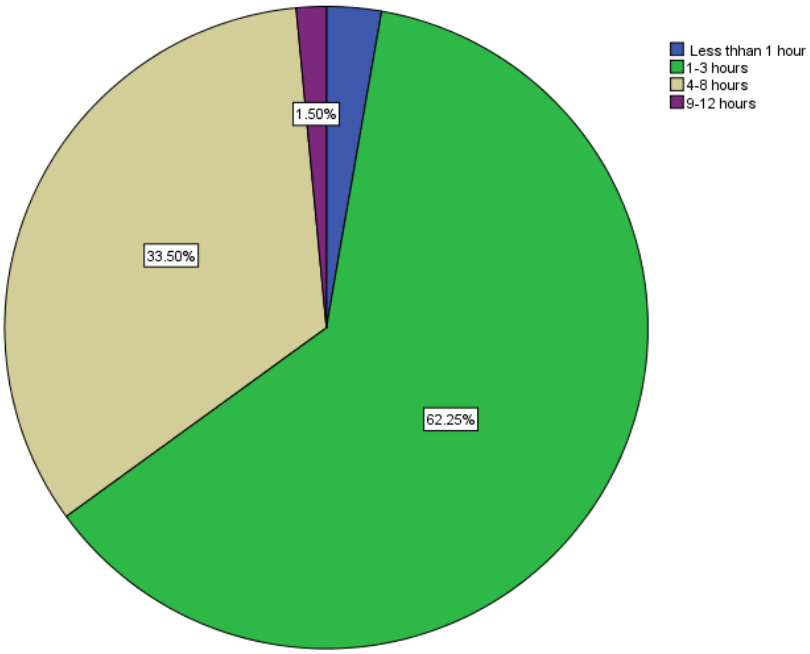

Figure 6.17 Users' perceptions on duration of visit to the Central Makkah.

The relationship between time of visit and duration of the visit

The majority of users spend between 1-3 and 4-8 hours in the morning and evening in the Central area and the reason pedestrians walk on the street more during early mornings and late afternoons is that there is less sunshine, leading to lower temperatures ideal for comfortable walking and use of the street (see figure 6.18). This evidence reveals that pedestrians tend to stay longer when they feel comfortable, so the more comfortable the environment, the longer people will stay in the area.

This explains the reason that the majority of respondents prefer to walk on the street in the early morning and evening. Respondents commented on the importance of the conditions of the environment as follows:

> *"The best time to walk is after sunset and the sun in the daytime is burning."* – P5

And they also made suggestions about what might be done to improve the situation:

> *"The sidewalks that exist, if developed with trees, fountains, and water sprinklers, [would] help and encourage pilgrims and people to walk comfortably"* – P7
> *"It is better to provide comfortable sidewalks for people and [for them to] be shaded and [would] be more helpful for movement"* – P15

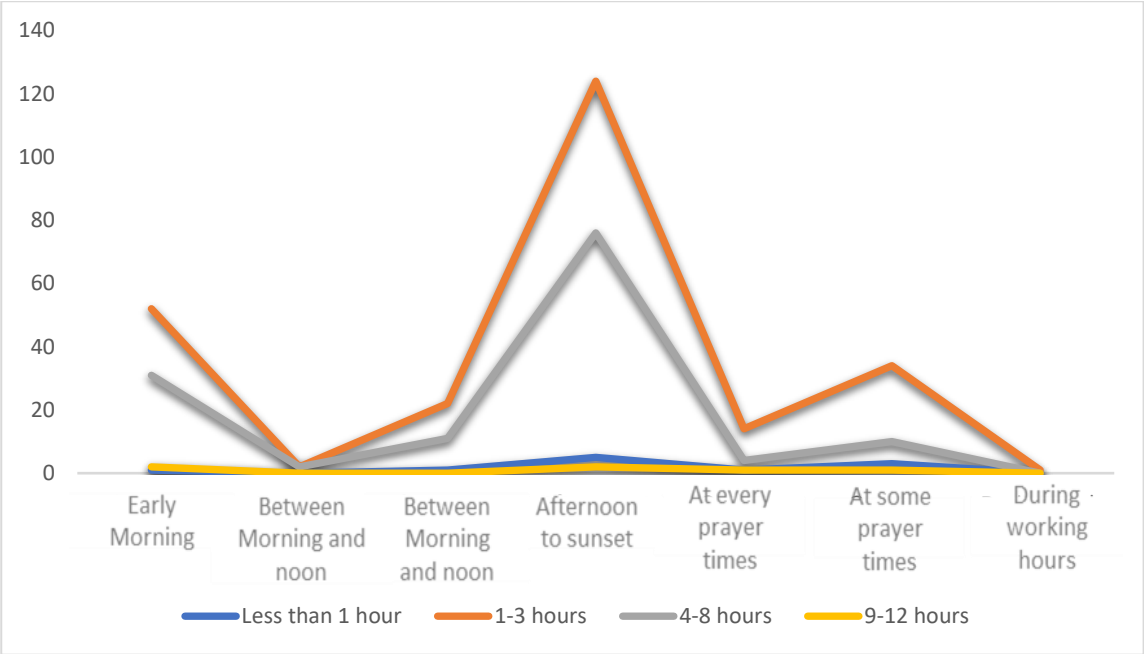

Figure 6.18 The time of visiting Masjid Al-Haram compared with the duration of the visit. Source: Field survey, 2019.

Comfort of walking is related to the weather conditions, specifically the temperature, with most evidence proving that walking behaviour changes based on this. The weather conditions clearly impact the frequency and duration of the use of the streets in Central Makkah, with temperature, overall, having a negative relationship and influence on a pedestrian's decision with regard to walking. Gehl (2010) highlights the relevance of microclimatic conditions as a determining element in the use of outdoor urban spaces for social life and activities, claiming that pleasant weather is one of the most important variables in ensuring the ease of people's movements in cities.

6.4 Pedestrian needs

The results from Figure 6.19 show that most respondents (304) answered that 'trees' (as explained in section 6.3) would make their walking experience more attractive, enjoyable, and comfortable. This shows that shade is necessary to those who walk, as it might affect the way they use the street or sidewalks. Currently, the Central Makkah streets and sidewalks lack trees. 'Canopies' come in second place as items that provide shade as chosen by the respondents (276), with 'places to sit and relax' coming in third place as factors that may affect pedestrians' journey walking on Central Makkah streets where the temperature has an effect on physical activity. 'Sidewalk width' was the fourth factor that would make the pedestrian experience more

attractive, enjoyable, and comfortable, with ‘fountains’ being the item least chosen by respondents.

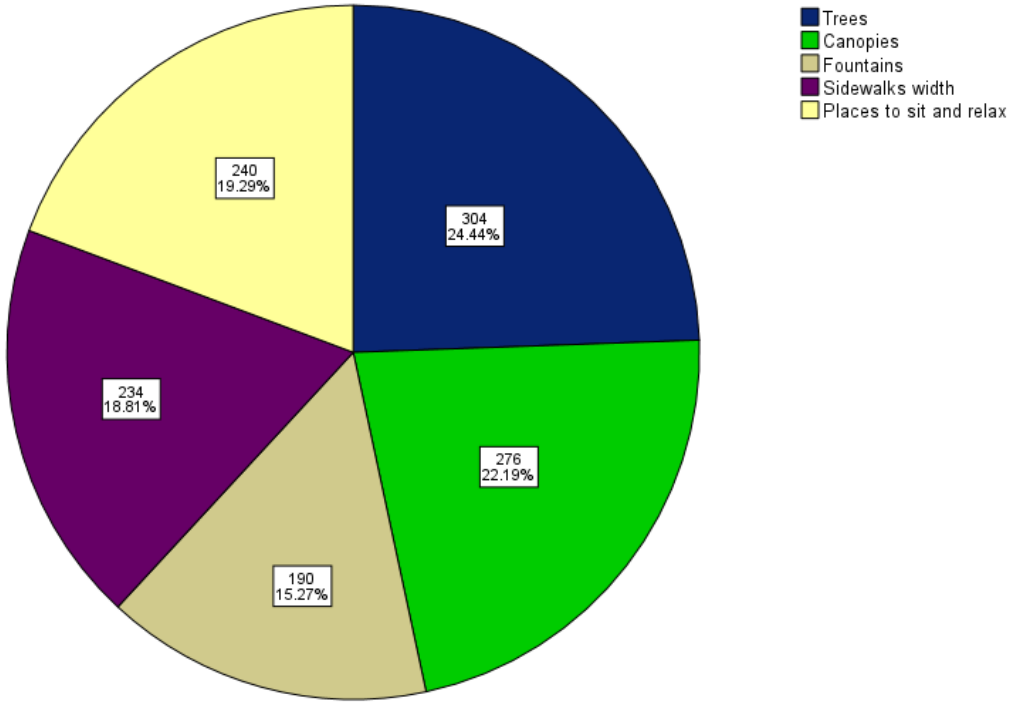

Figure 6.19 Perceptions of users on the degree to which comfort attributes contribute to their walking. Note: the number of respondents is 400, but since they were able to choose more than one response, the total may be higher than 400.

Based on the results presented below, it is clear that the comfort attributes that people requested are important to encourage the use of the space and make it more walkable. According to Francis (2003), users’ needs refer to the experiences and amenities that the public expects while using public open space, and user discontent concerning such space may occur when their demands cannot be granted or when the needs of different user groups conflict. To design and manage streets effectively, one needs to understand the function that such spaces play in the lives of individuals and why they are used or disregarded. There is also a need to determine why particular spaces work for individuals, while it is not the case for others (Whyte, 1980; Carr et aI., 1992). The microclimate of the place is a significant issue that people experience, which is perceived negatively based on what was found from the results, which relates to user needs when walking as commented on by participants:

“I need trees and fountains that will reduce the heat of the sun”. – P7

“Make sidewalks wider, shaded, and put [in] fountains”. – P8

"If there are trees, people [will walk] more and [this] encourages them, because some of them rest between noon and afternoon because of the heat of the sun". – P10

"Trees, places to sit, and the width of the sidewalks are the important things to consider." – P11

"There are no trees, so we need trees as well as separation from cars. Older people need chairs and shade". – P12

"We need trees and more water sparkling to reduce the heat". – P16

Based on the survey results in Table 6.8, it can be concluded that people who responded that the climate is not good stated that trees, canopies, and fountains would make their walking experience more comfortable. This may be quite reasonable, since these people did not like the existing climate, trees, canopies, and fountains that must have made their walk much less comfortable.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
walking experience more comfortable (trees)	Between Groups	1.094	1	1.094	6.080	.014
	Within Groups	71.231	396	.180		
	Total	72.324	397			
walking experience more comfortable in (Canopies)	Between Groups	2.643	1	2.643	12.710	.000
	Within Groups	82.344	396	.208		
	Total	84.987	397			
walking experience more comfortable in (Fountains)	Between Groups	2.214	1	2.214	9.033	.003
	Within Groups	97.082	396	.245		
	Total	99.296	397			
walking experience more comfortable in (sidewalks width)	Between Groups	.189	1	.189	.776	.379
	Within Groups	96.407	396	.243		
	Total	96.595	397			
walking experience more comfortable in (Places to sit and relax)	Between Groups	.721	1	.721	3.021	.083
	Within Groups	94.555	396	.239		
	Total	95.276	397			

Table 6.8 Degree of comfort attributes (pedestrian needs) based on mean value, which shows a significant difference in some variables.

6.5 Conclusion

The aim of this chapter is to ascertain the factors that make people walk on streets more in a comfortable way in such a climate, and their needs on the street in that regard that contribute to a walkable urban environment in Central Makkah. It also determines the variation of people's needs and the pattern between different socio-cultural information concerning participants. This is often used to assess the similarities and disparities in walkability-related perceptions of attributes. The differences in perception between different socio-demographic contexts were studied in order to assess if these variables had any effect on perception.

The results indicate that the variables affecting general user demands for a walkable urban street in Saudi Arabia were comparable to those affecting the needs of people in urban public spaces in other countries. However, the walkable street and prior research differ in terms of the relative importance of the factors. The findings show that comfort attributes influence walking decisions where certain feelings and experiences and behaviour occur in response to the physical environment in the Central Makkah area. This may be linked to a place's culture, climate, and environment, which differs from past studies.

Under environmental factors that influence walkability, factors such as temperature and topography were the most limiting factors. The characteristics that relate to environmental conditions, such as sun protection, were very important attributes that people needed. This also demonstrates how important microclimate and psychological comfort are in a hot, arid country such as Saudi Arabia. Under the variations of perception on the environmental factors, in the temperature attributes, there was a significant association according to nationality, where those who were non-Saudi gave more responses that temperature was a limiting factor. Under topography, the response among ages varied, where older people gave more responses that topography was a limiting factor.

It was discovered that in the case of central Makkah streets It was discovered that in the case of central Makkah streets the attributes involving conditions related to the environment, like protection from the elements, were very important attributes that people need. This also demonstrates that in a hot, arid country such Saudi Arabia, aspects related to psychological and microclimate comfort are crucial.

Regarding variations in perceived levels of comfort and convenience, visitors and locals mostly perceived the physical characteristics of the place more negatively. Both types of users demonstrated similar perceptions towards the most crucial attributes that provide comfort and

convenience of the environment, which are covered paths and shade, other protection from the sun, and suitable temperatures. Where the attributes show a significant difference between groups under the heading of comfort and convenience is the preferred time of visiting. In comparison with other groups, locals have a greater concern about these attributes. Also, females found it more comfortable to walk in the morning than the evening, while the opposite was true for males. It was found that in the case of Central Makkah streets, the greatest need was for covered paths (trees/canopies) to protect people from the sun and make their walking comfortable.

To conclude, the factors contributing to the streets walkability in this study were consistent with past research to a large extent. The factors themselves, on the other hand, changed according to context. The attributes that paly part in a street's comfort in Saudi Arabia may vary from those that do so in other countries, particularly those with a distinct climate and economic status. The following chapter discusses the physical features of the study area that encourage walkability.

Chapter 7. The physical factors influencing walkability in central Makkah

7.1 Introduction

This chapter presents the findings from analysis of data associated with the third objective of the research, which examines the physical characteristics that may encourage/discourage walkability in a hot, arid climate, and specifically in Makkah. The findings are the results of the analysis of both qualitative and quantitative data. This study aims to explore and examine the walkability of Central Makkah from experience, behaviour, and evaluation of pedestrians. The current conditions are examined through the analysis of observations, interviews, and face-to-face questionnaires of pedestrian behaviour and experiences of pedestrians walking in the study area.

7.2 Physical characteristics that encourage/ discourage walkability (influencing factors of walkability)

This section outlines the research's fourth objective, which is to examine the physical characteristics that may encourage – or discourage – walkability in Central Makkah. The variables that contribute to a walkable street may be connected to how pedestrians use the street, what discourages them from using the street, and what can be done to spur them to spend more time in the street. According to the review of the literature, a walkable street has physical, social, and functional factors.

The literature review relating to walkable streets, shows that the level of walkability is influenced by numerous principles (see chapter 2 & 3). These elements, or principles, were adopted in the present study as a guide. As mentioned in the review, to evaluate the walkability of the street, it is essential to examine the physical characteristics which may encourage or discourage walkability in a hot, arid climate. This may help to determine the factors that may contribute to street use, such as how walkable the street is for pedestrians.

7.2.1 ***Path context (street design, visual interest of built environment, landscape (tree))***

Based on observation, many issues such as comfort issues, volume of pedestrians, and narrow sidewalks affect people's walking. It would appear that the street design both enables and limits certain types of behaviour, as examined in the following sections.

Street design

Paths (or streets) are identified as one of the urban elements by Lynch (1960); however, many of the streets in Central Makkah are missing basic requirements (Figure 7.1). There is no parity of design of the streets between pedestrians and vehicles (mainly private cars), and the current design tends to be car-orientated. Experts have participated in this study, which shows their awareness of the current design issues. They expressed the absolute need to define design standards to guide the remodelling of streets and buildings. They felt the need to adhere to international design standards for pedestrianised streets. For instance, population density is grouped into four categories (people per square metre) for pedestrian paths, as proposed by the Transportation Research Board of the National Academies (2010); in the Central Makkah area, the rating was twice the recommended level, as described by an advisor working in Makkah Region Development Authority:

> *"There is a standard population density rating per square metre identified as follows (A, B, C, D); they consider level C as four people per square metre; in Makkah [the density] can reach eight people per square metre during certain hours, which is seriously dangerous."* – E2

The current design was described as a limiting factor by a participant:

> *"Streets in the central area [are] well suited for cars and unprepared for pedestrians."* – P19

As observed, the street design is mostly car orientated, and the sidewalks are a small proportion of the whole area of the street on most of the Central Makkah streets around the Al-Haram (see Figure 7.2). "The ratio of width of street to height of enclosing buildings is critical for good street design" (Moughtin, 2007, p.141). The amount of the streets of central Makkah have changed throughout time. At the turn of the twentieth century, the majority of buildings constructed around the Grand Mosque were one to three stories in height, which put the ratio between distance and height at approximately 2:1. Currently, building height ranges from six stories to more than 20 stories on most streets, which conflicts with a sense of enclosure and human scale as described by Alexander (1977) (see Appendix B).

Therefore, in the instance of Central Makkah streets, the majority of urban streets cannot give the user a sense of enclosure because of the way the building is designed and the fact that automobiles are prioritised over pedestrians. Human scale, according to Montgomery et al. (1998), is commonly recognised as the most significant element determining walkability

(Ewing et al., 2005). Space operates on a variety of scales (Montgomery, 1998), and concerns pertaining to scale may include the following: built scale (a concept denoting the proportion of building heights to street widths, which creates majestic or intimate areas). As a result, a street wall height equal to the width of the street severely restricts the view of the sky and produces a strong sense of enclosure in the community (Carmona et al., 2010). For example, let us assume that the surrounding buildings are higher than the space itself and their width exceeds its height. According to the findings of the debate, buildings' height, street width, and the consistency of buildings on a street are the most important element in creating a feeling of enclosure. In many Western countries, this is regarded as vital in terms of maintaining a friendly street environment. This is consistent with what Frank et al. (2003) describe as the characteristics of streets that are narrow and winding. Most often, these streets form small, compact blocks, allowing for short distances and multiple connections between destinations; however, these characteristics are uncommon in contemporary urban design and are found primarily in older cities.

Figure 7.1 View of a street in Mecca in different periods. The left-hand picture was taken in 1937 (source: Bridgeman Images). The right-hand picture was taken in 2019 during fieldwork.

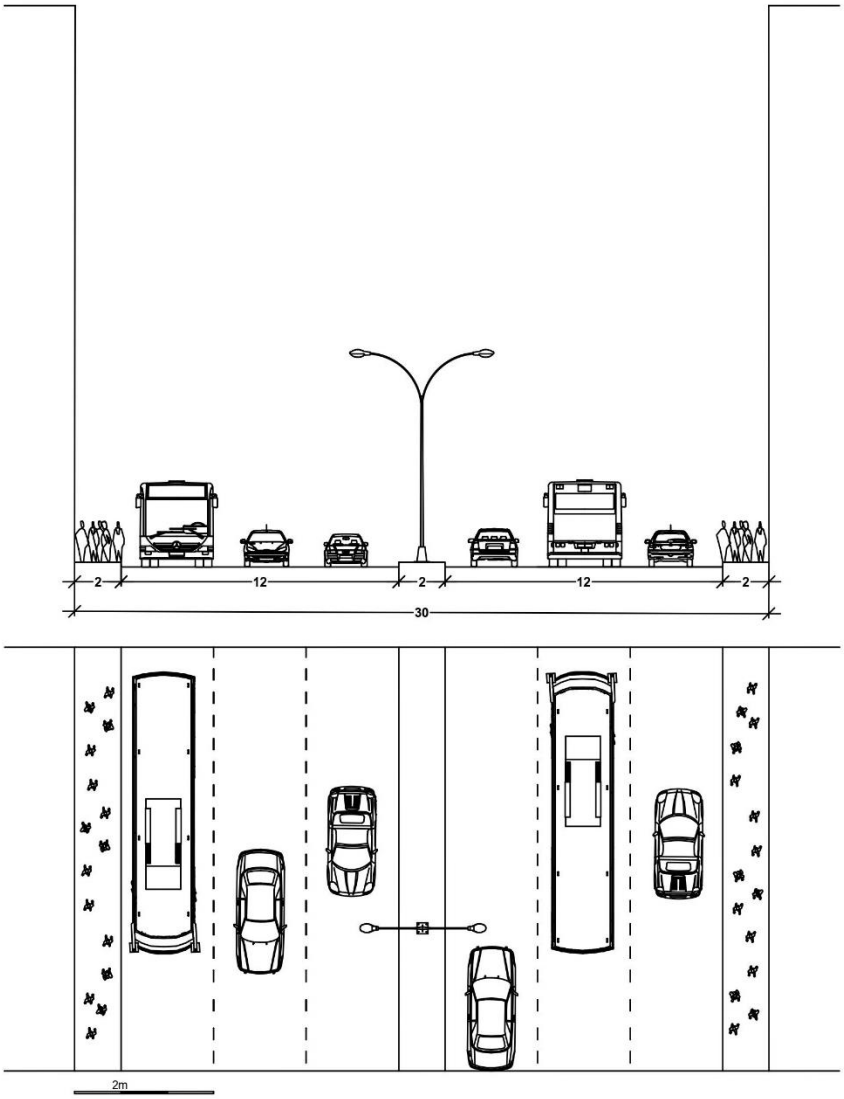

Figure 7.2 Characteristic layout of the street including sidewalks and public transportation. Source: Author.

Sidewalk design (presence of sidewalks)

Central Makkah streets are over-scaled and lack sidewalks in some parts of the area. A walkable area is clearly defined by complete pedestrian infrastructure, such as sidewalks (Forsyth & Southworth, 2008). Some Central Makkah streets have no sidewalks at all, but people still walk along these streets to the Masjid Al-Haram (see Figure 7.3). The sidewalk design varies from one street to another, but there are basic requirements that need to be considered.

Based on observation, it seems the sidewalk design may have forced particular behaviours to occur, which can be seen below. This finding contrasts with what has been determined by Ewing (1999) and Romer and Sathisan (1997), who state that a width of 1.5 metres is ideal for a sidewalk. Encroachment on the narrow sidewalks forces pedestrians to spill over on to the carriageway, creating a safety concern.

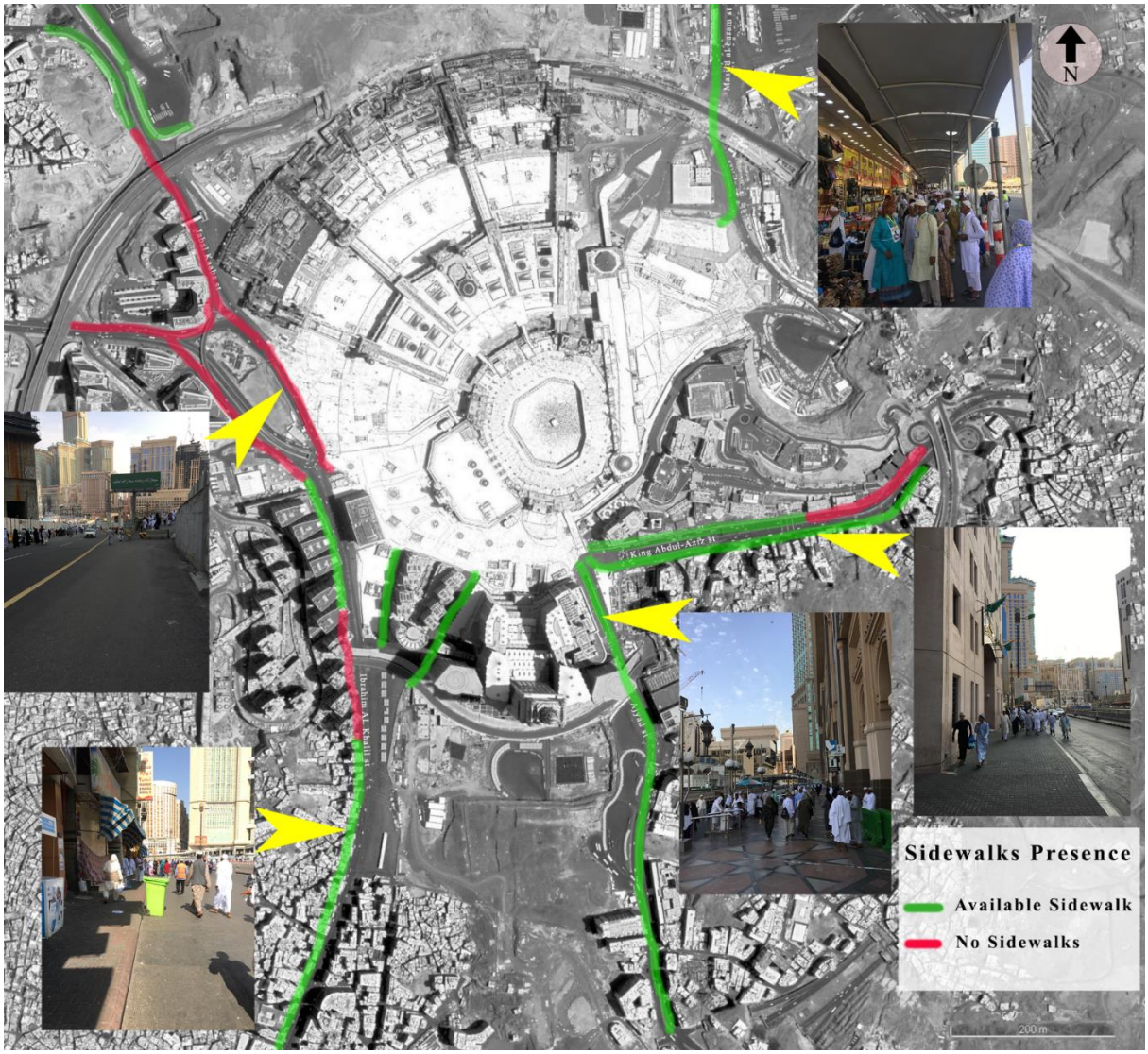

Figure 7.3 Presence of sidewalks in Central Makkah. Source: Fieldwork 2019.

The lack of sidewalks was mentioned as a limiting factor, among others, by 23% of the respondents, as mentioned before (Figure 7.1). Based on Table 7.1, since the p values are higher than 0.05 here, it may be concluded that factors concerning the lack of sidewalks as a limiting factor do not depend on any of the socio-demographic information. The results in Table 7.1 show that all socio-demographic categories of respondents expressed the importance of sidewalks, which indicates that they were all concerned and perceived this issue to be negative.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Type of user	Between Groups	.174	1	.174	.915	.339
	Within Groups	75.816	398	.190		
	Total	75.990	399			
Age	Between Groups	.000	1	.000	.000	.988
	Within Groups	447.510	398	1.124		
	Total	447.510	399			
Gender	Between Groups	.312	1	.312	1.709	.192
	Within Groups	72.648	398	.183		
	Total	72.960	399			
Nationality	Between Groups	.820	1	.820	3.818	.053
	Within Groups	85.490	398	.215		
	Total	86.310	399			

Table 7.1 Variations in significance concerning the availability of the sidewalks based on the mean value, which shows no significant variation across variables.

Based on the evaluation of the participants, more than half of them (see Figure 7.4) were in agreement that the physical environment in Central Makkah area did not encourage walking primarily because it was based on a car-orientated design. This supports Gehl's (2010) assertion that an essential requirement for people to walk is to provide good conditions and space to walk. For people to walk, there needs to be infrastructure in place, but there seems to be a dire need to build a pedestrian network in the Central Makkah area. The frequent use of phrases such as 'walkways are non-existent', 'sidewalks are unprepared', just goes to show the extent of the need.

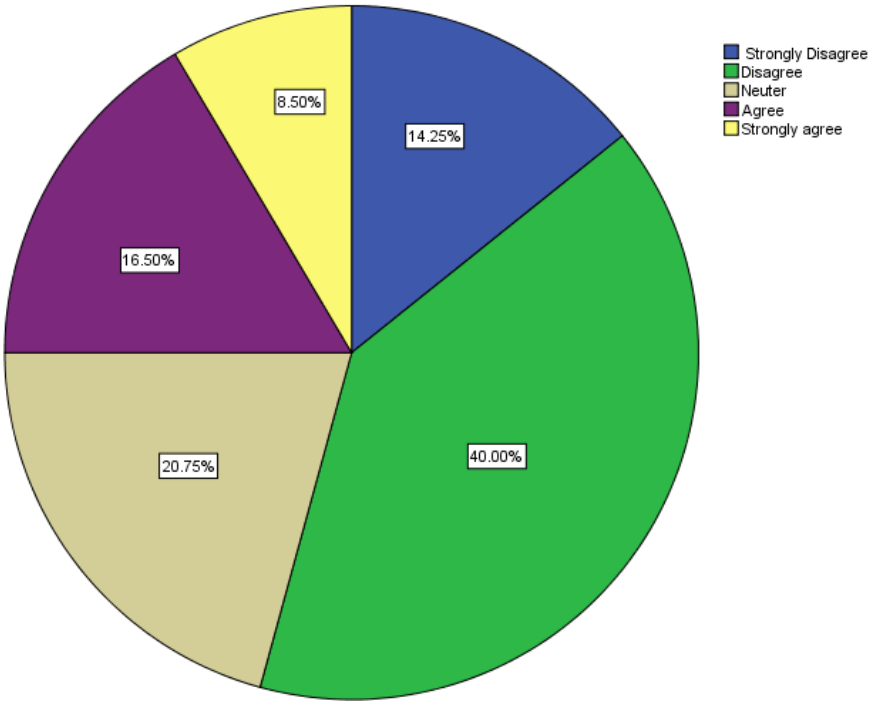

Figure 7.4 Users' perceptions on the degree of satisfaction about availability of sidewalks along most of Central Makkah streets.

Visual interest of the built environment (transparency and frontage)

Transparency and frontage

Currently, most of the buildings around the Masjid Al Haram Street have a variety of active and inactive frontages, denoting the connection between a building's ground-floor uses framing a street or space and thus the individuals walking in it (Roberts & Greed, 2001). There is a difference between the people on foot and the level of connection between the ground floor uses. A few buildings utilise transparent materials for separating the inside from outside areas, but are still apparently permeable, as figure 9.5 shows where the glass was used.

The city's traditional vernacular architecture, which incorporates aesthetic aspects from many countries and empires, reflects the necessity to accommodate the large number of pilgrims who come to pray at Islam's holiest mosque, the Masjid Al-Haram, which is centred on the Holy Kaaba. Makkah buildings' articulated elevations and windows are reminiscent of Ottoman

architecture, but the decorated wooden *mashrabiyas* (protruding oriel windows) appear to be influenced by Egyptian style (Omrania, 2018) (see Figure 7.5).

Figure 7.5 Active frontages. Source: field observation 2019.

The requirement for new buildings revolves around allocating corridors for use by pedestrians, emptying ground floors, and controlling the height of buildings, which was stated by the general director of planning and studies in the Comprehensive Plan of Makkah:

> *"The presence of open spaces and the allocation of corridors and pedestrian areas will be among the requirements for new buildings, and emptying the ground floor… the heights will be much lower, up to eight floors around the Grand Mosque, and gradually rising to 20 floors near the second ring."* – E1

Architectural Diversity

Along the streets in Makkah, the architectural design is dominated by a "modern" style, characterised by a few buildings around the Masjid Al Haram still retaining their traditional style from 1979 (Martens, 2020). However, the change to a modern façade does not always apply to the entire building, with a large number of them just cover up the façade by combining new components. For example, as shown in Figure 7.6, the glass was used to provide another look with a 'modern style'. A few buildings remain the use of traditional façade designs (materials), which are the buildings located on the west side of the Masjid Al-Haram such as the Makkah Company building, the Makkah Tower, and the Dar al Tawhid Makkah Hotel. In

the meanwhile, the facades of some buildings have remained unchanged but have been covered with other materials.

The façades of contemporary architecture in Makkah Al-Mukarramah lack the character of distinct Islamic heritage, and have moved away from the factors of originality stemming from the cultural values of Islamic and traditional architecture, thus losing their unique character that distinguished them to the extent of their continuity of the civilisation. All development and urban fabric within the city of Makkah is considered to be a reflection of the religious history, the culture of the region, the environmental setting, and the social forces that affected daily life for the next generation. In relation to pedestrians, interesting façades, as asserted by Frank et al. (2003), would encourage their activity and interaction between the interior and exterior of the building (such as doors, windows, etc.)

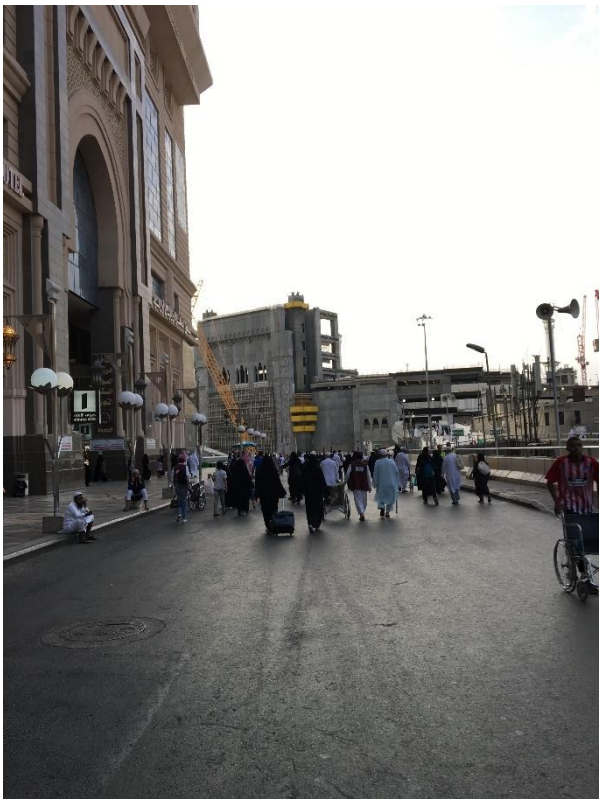

Figure 7.6 Façade design of buildings around the Grand Mosque. Source: field observation 2019.

Landscape

Green spaces, particularly trees (as also discussed in Chapter 6), are a significant feature in urban spaces to give shade and induce activity (Whyte, 1980). The finding was likewise upheld by Simonds (1994) whose research focused on green spaces rather than aesthetics; the existence of trees, ground coverings, and open water in an open area would reduce the surface temperature by 30 degrees compared to that of sun-heated paving. Site observations showed that trees were planted in some locations of Central Makkah streets where canopies seemed more dominant than trees (Figure 7.7). This did not help to create a comfortable environment for walking, which was noted by respondents, who suggested that increasing vegetation coverage such as trees and installing water features such as water sprinklers and fountains would significantly reduce thermal stress and encourage walking, as follows:

> *"The existing sidewalks, if developed with trees, fountains and water sprinklers [would] help and encourage pilgrims and people to walk comfortably."* – P7

Based on the observations, the area does not support the provision of enough shade for pedestrians, which causes the volume of pedestrians to drop at certain times during daytime. According to on-site observations, the majority of activities occurred in shaded and sheltered locations (Figure 7.8). Humans congregate in these spaces to engage in more constant activities, because such places make them feel more comfortable than in uncovered areas where only lively activity is seen. Additionally, it has been established that on days that are sunny and hot in the area, locals have a preference to go under covered paths such as the shop corridors and beneath the shadow of the buildings along the street, with only shaded seating spaces being occupied.

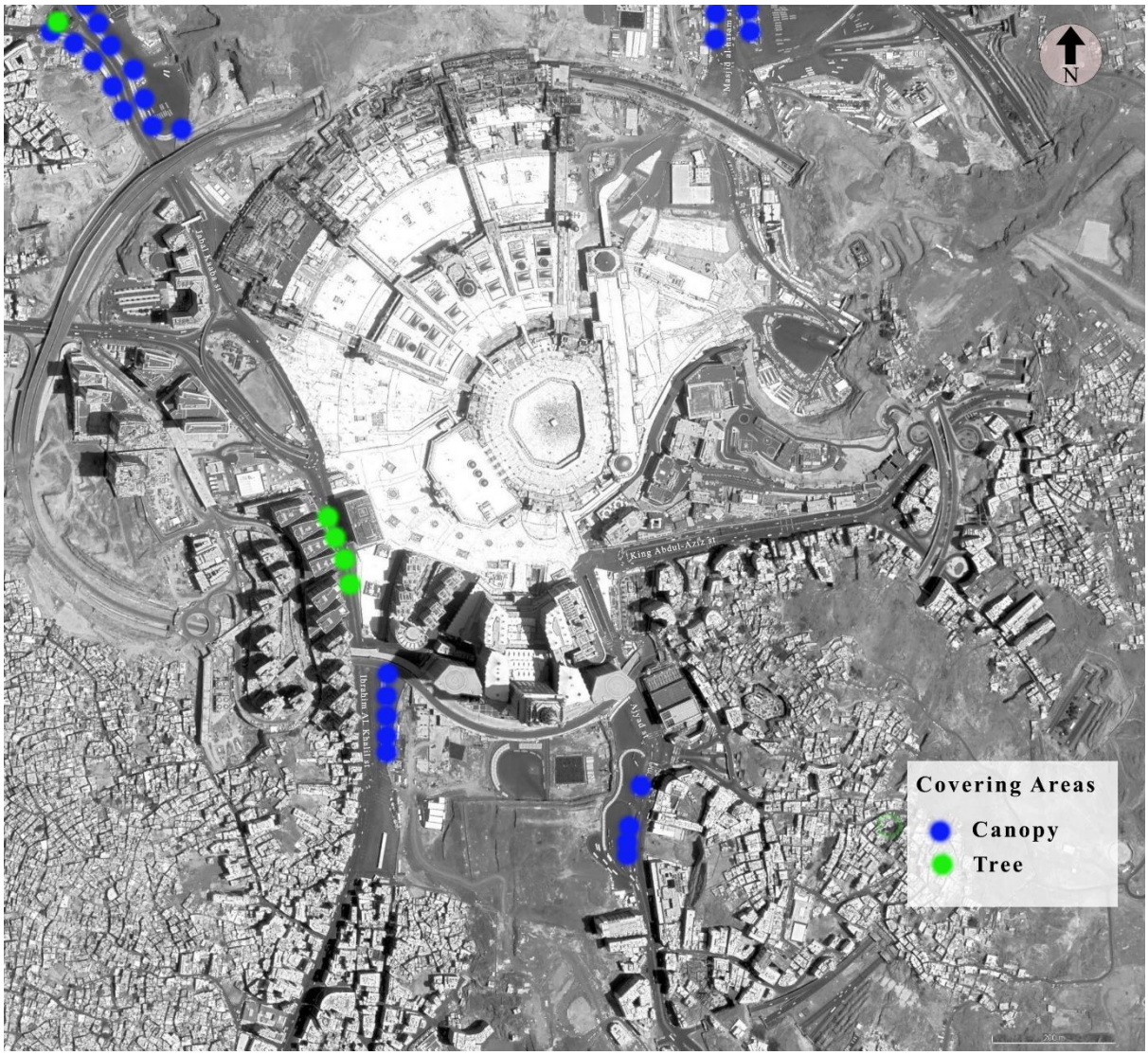

Figure 7.7 Coverage location in Central Makkah. Source: Fieldwork observation, 2019.

Figure 7.8 Covered paths in some parts of the street where activities take place.
Source: Field observation, 2019.

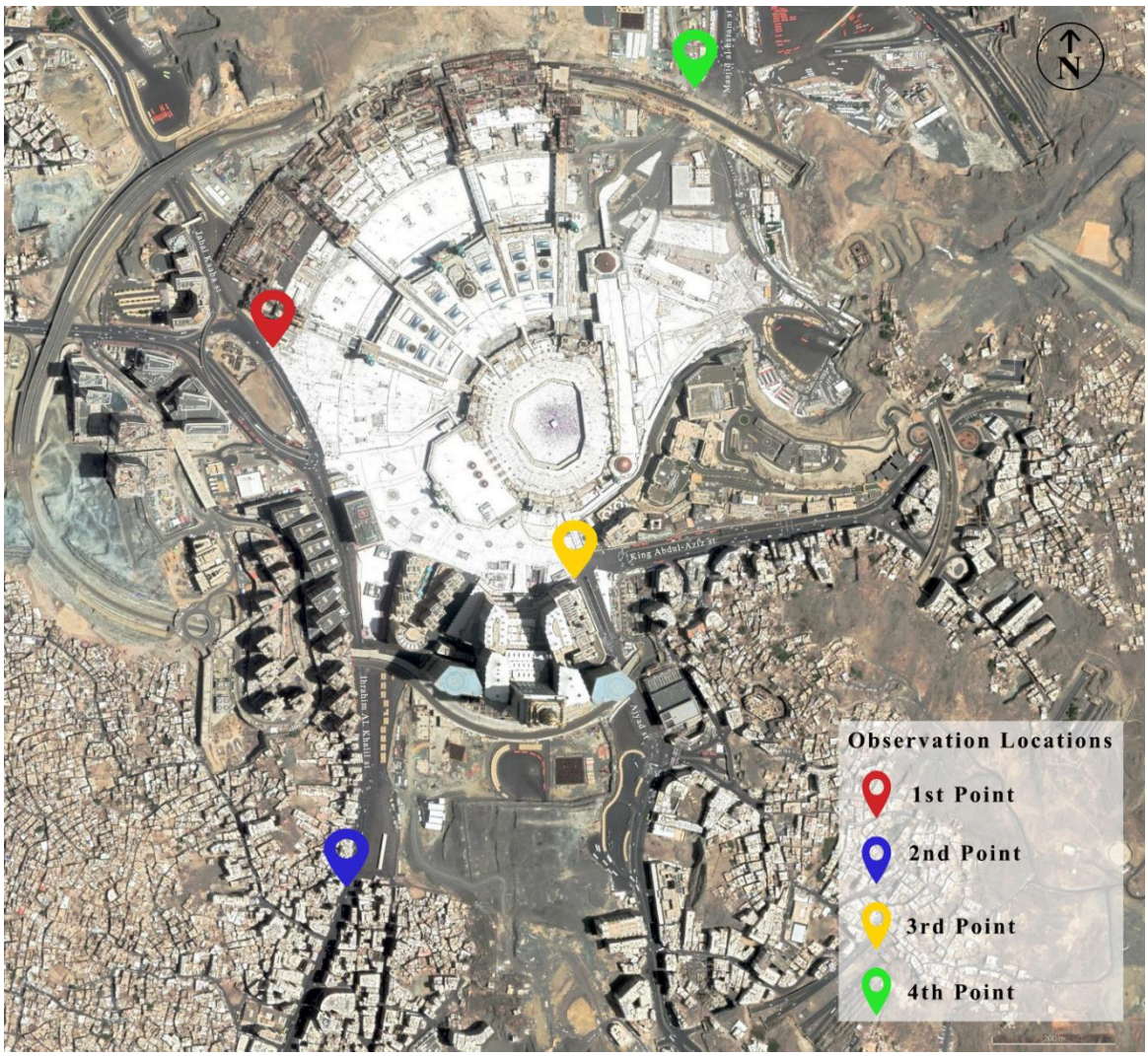

Figure 7.9 Observation locations. Source: Adapted from Google Earth and redrawn by author.

7.2.2 ***Path quality (width, paving, lighting, crosswalk)***

Based on the observations, it seems the sidewalk design might have forced some concerning behaviours to occur, as discussed. Encroachment on the narrow sidewalks has forced pedestrians to fall over on to the carriageway, creating a safety concern. The essential features of a sidewalk have been recorded as follows:

Width

Results from the interviews show that another factor causing difficulties while walking was the width of the sidewalks. Respondents felt that the sidewalks were too narrow for pedestrians and

merchants together, mostly because the merchants occupied the greater part of the sidewalks and forced pedestrians to spill over on to the carriageway, creating a safety concern:

> *"Most of the sidewalks have been occupied by merchants which can make walking difficult and unsafe because I need to walk on the street sometimes."* – P3

Where pedestrian paths existed, they were of poor quality. For one thing, they were too narrow for the volume of pedestrians. One respondent reported that the paths were only 60 cm wide and yet used for a variety of activities. Besides the pedestrians, merchants displayed their goods on the sidewalks and some people used them for prayer. These activities affected the flow of pedestrians:

> *"The path leading to Al-Haram is only 60 cm wide, forcing people to walk down the street and endangering their lives."* – E8

From the quote above, it may be inferred that the presence of width brings numerous implications, such as discouraging the user from using streets which have more space for pedestrians and reducing the function of sidewalks as pedestrians' space to walk. Therefore, this supports similar results by Samarasekara et al. (2011) who found that walkability was primarily determined by the existence of a clear safe (here determined as safe from motor vehicle traffic) place to walk. The evidence shows that with wide sidewalks, people tend to walk more comfortably rather than with narrow sidewalks, which cannot be properly accessed.

The results from the observations revealed that sidewalk width is a factor that causes difficulties while walking. Some of the streets are missing sidewalks in some parts, while small parts of selected streets have wider sidewalks. The available sidewalks were too narrow for both pedestrians and merchants; on top of that, the merchants occupied the larger part of the sidewalks, which made it difficult for pedestrians to use the sidewalks (see Figure 7.10). People are forced to use the carriageway to walk because there is not enough space on the sidewalk. There is no consistency in sidewalk width, as some parts are wider than others.

Figure 7.10 Sidewalk width. Source: Observation, 2019.

Additionally, the width of the sidewalk influences pedestrians' sense of comfort on the street. Based on the observation of certain areas in Central Makkah, walking on the sidewalks may be hazardous to the pedestrians and reduce the amount of space available to them.

> *"If there [were] wide sidewalks, my walk [would] be better and comfortable and away from cars."* – P3
>
> *"I [would] walk more comfortably if the sidewalks [were] wider."* – P14

Sidewalk width was selected by respondents as the element that is most important to improve in order to create a more comfortable environment in which to walk in comparison with the current width. Based on the observations, the current width of sidewalks is not enough to accommodate the flow and activity of pilgrims, which may lead to some behaviour that can cause harm to or discomfort for pedestrians.

In the case of Central Makkah, people feel that they are being pushed to walk on the street, as the walking infrastructure – narrow sidewalks – is not enough for them on which to walk. When an alternative is not available, a person being made to participate in such behaviour will respond adversely and resist in response to the force of being pushed about (Risser & Šucha, 2020). Consequently, the behaviour of pedestrians walking on the street is a result of the previously

mentioned reasons, which create an uncomfortable feeling and may conflict with oncoming traffic.

According to the survey, pedestrians' views on sidewalk widths demonstrate a lack of satisfaction about the current conditions of the sidewalks, as they do not meet the comfort needs of pedestrians walking to the Masjid Al-Haram (see Figure 7.11). The result shows that 60% of the responses demonstrated dissatisfaction about the area not providing wide sidewalks, while 19% of responses were neutral, and 21% agreed that there were wide sidewalks along the streets; those respondents might have had different experiences considering the width of the sidewalks. The width of the sidewalk is one of the key principles of accessible streets design, with a width of at least 1.5 metres; some sidewalks in Central Makkah are less than one metre wide and some streets have no designated sidewalks (Deichmann, 2004).

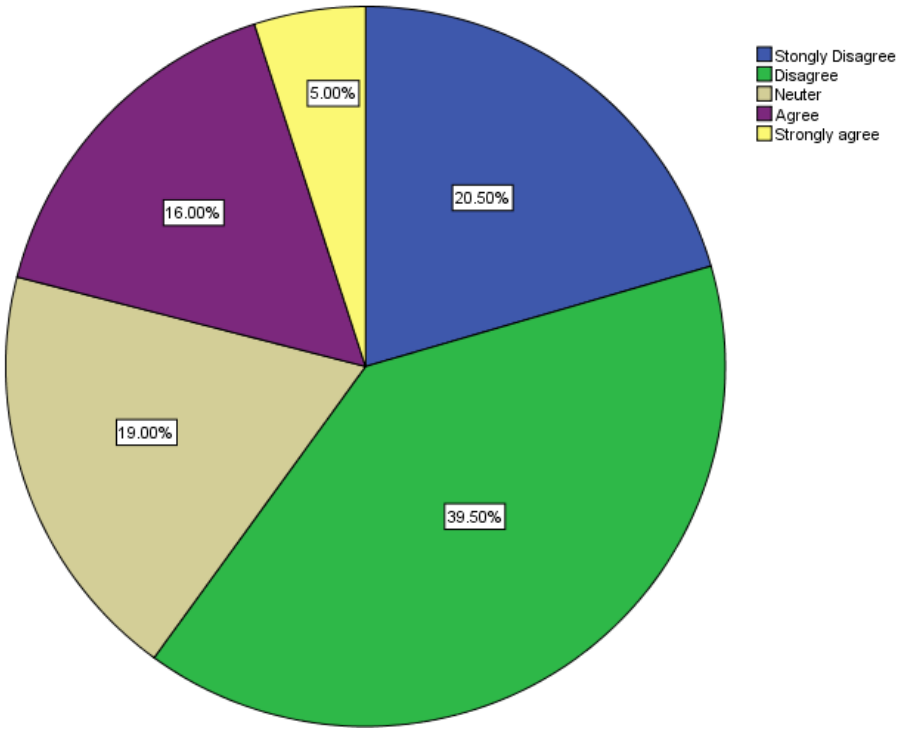

Figure 7.11 Users' perceptions on the degree of satisfaction with sidewalk width along Central Makkah streets.

Variations between different socio-demographic backgrounds concerning sidewalk width along Central Makkah streets

Since the p values are higher than 0.05 here, it may be concluded that factors concerning sidewalk widths do not depend on socio-demographic categories. The results in Table 7.2 show the socio-demographic information of the respondents who expressed the importance of comfort attributes, and indicate that all the respondents were concerned and perceived the sidewalks to affect the comfort of walking.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Gender	Between Groups	.572	4	.143	.780	.539
	Within Groups	72.388	395	.183		
	Total	72.960	399			
Nationality	Between Groups	.118	4	.029	.135	.969
	Within Groups	86.192	395	.218		
	Total	86.310	399			
Age	Between Groups	4.285	4	1.071	.955	.432
	Within Groups	443.225	395	1.122		
	Total	447.510	399			
Type of user	Between Groups	1.586	4	.396	2.105	.080
	Within Groups	74.404	395	.188		
	Total	75.990	399			

Table 7.2 Variations in significance concerning comfort attributes (sidewalk width along Central Makkah streets) based on mean value, which shows no significant difference across all variables.

Paving– materials and maintenance

The path network was not improved with the needs of all users in mind. Some of the most affected groups were the elderly, who used wheelchairs, because the sidewalks were poorly maintained and had bumps, making it hard to use electric wheelchairs because the paths had not been levelled.

The pavement is in poor condition, and in certain areas, the material's surface is not suitable for those living with disabilities, which is particularly challenging for those facing mobility issues. When it rains, the material used for pedestrian crossings in certain places in Central Makkah is not adequate and becomes slippery, posing a threat to pedestrians (Figure 7.12). It was determined that the sidewalks are uneven and littered, which makes it difficult for

pedestrians, particularly the elderly and those with impairments, to move about safely and efficiently. This is reinforced by the following statements made by the respondent:

> *"... the corridor is located in bumps in the pavement and is not fixed, there are elderly people using wheelchairs and it is difficult to use the sidewalks for that..."* – E7

Also, the pavement materials were not user-friendly to blind pedestrians.

Slope

Based on observations, there were uneven surfaces in some parts of sidewalks in particular streets. Slopes have been identified as making walking a tiring experience and increasing the amount of time required to reach one's destination. Elderly and disabled people are those who have the most difficulties using sidewalks in this condition, as it was discovered through observation that the absence of ramps at surface changes and tactile areas on sidewalks makes it difficult for individuals with impairments to use the sidewalks safely. The investigations also revealed that, besides the curb extension condition being a little steep, the sidewalk has improper grating, making it not welcoming for walkers, particularly those living with disabilities (Figure 7.13).

Figure 7.12 Paving materials and clutter, which create an unfriendly environment for pedestrians. Source: Observation, 2019.

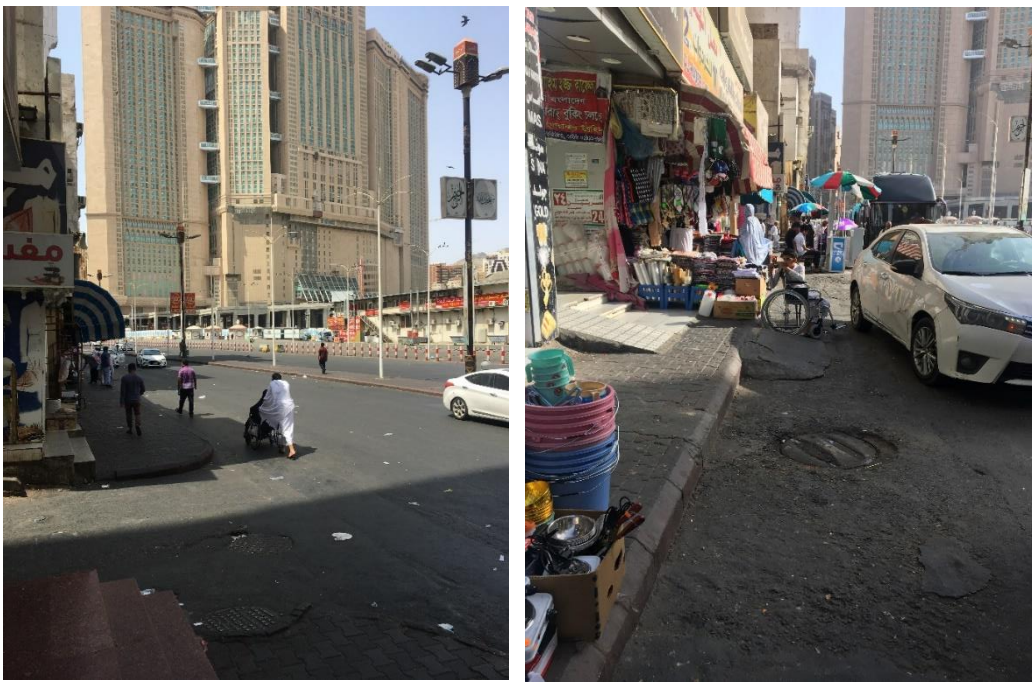

Figure 7.13 Ramps and curbs along Ibrahim Al-Khalil Street. Source: Observation, 2019.

In order to register pedestrian movements, destinations, and activities during their journey, the researcher randomly followed pedestrians using phone GPS to register the routes and a notebook to record their activities.

A couple were walking out of the mosque; the man walked some steps ahead of his wife as she was walking very slowly. There was a crowd of people and cars that interfere with their walking; again, they walked together to cross to the other side of the street, passing the big bollards, and once more there was a gap between them. There was no crosswalk between the two sides of the street, yet there were many cars sharing the space; the sidewalk was filled with rubbish bins and telephone boxes, which narrow the space and force people to use the street to walk. The couple walked slowly, with the woman stopping a couple of times and the man being the guide. Because of the non-continuous sidewalks, the temperature, and the cars, it seems that the journey of the woman was more difficult than that of the man. Finally, they arrived at the hotel.

The man was the guide, and the woman was walking slowly, without turning her head a lot, and the man was the same, with little turning of the head. The temperature had an influence on their walking (see Figure 7.14).

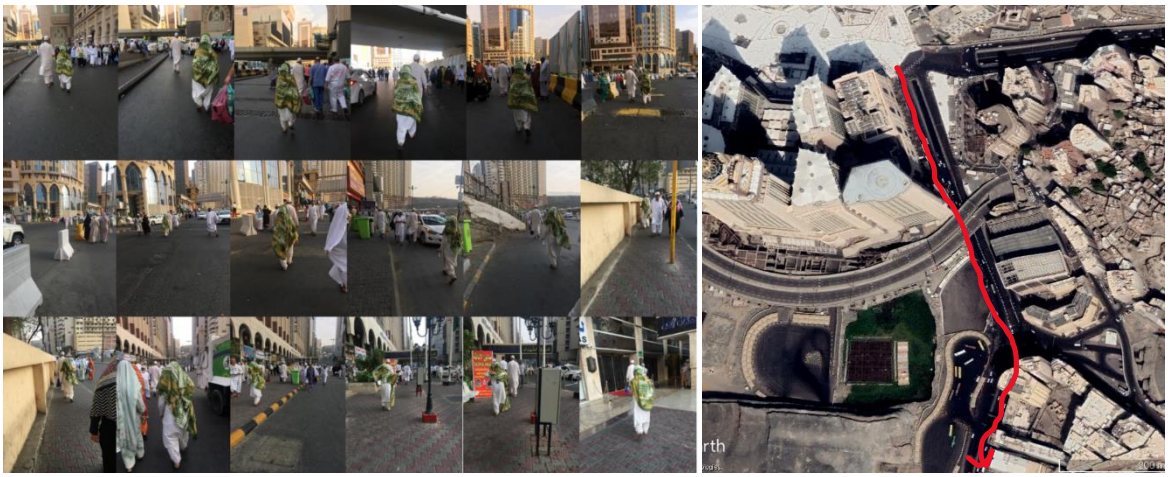

Figure 7.14 Observing pedestrians by tracking them from the Masjid Al-Haram to their residence. Source: Field observation, 2019.

Variations between different socio-demographic backgrounds concerning the condition of the sidewalks along Central Makkah streets

The condition of available sidewalks was seen as a limiting factor by 15% of respondents, among other factors, as mentioned before (see Figure 6.1). Based on Table 7.3, since the p values are higher than 0.05 here, it may be concluded that factors concerning the condition of the available sidewalks as a limiting factor do not depend on any of the socio-demographic categories. The results in the table show the socio-demographic information of the respondents who expressed a view on the importance of quality sidewalks, which indicates that all the respondents were concerned and perceived this issue to be negative.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Type of user	Between Groups	.002	1	.002	.011	.916
	Within Groups	75.923	397	.191		
	Total	75.925	398			
Age	Between Groups	2.034	1	2.034	1.814	.179
	Within Groups	445.259	397	1.122		
	Total	447.293	398			
Gender	Between Groups	.447	1	.447	2.451	.118
	Within Groups	72.455	397	.183		
	Total	72.902	398			
Nationality	Between Groups	.037	1	.037	.170	.680
	Within Groups	86.174	397	.217		
	Total	86.211	398			

Table 7.3 Variations in significance concerning the availability of signage along Central Makkah streets based on mean value, which shows a significant association in the age category

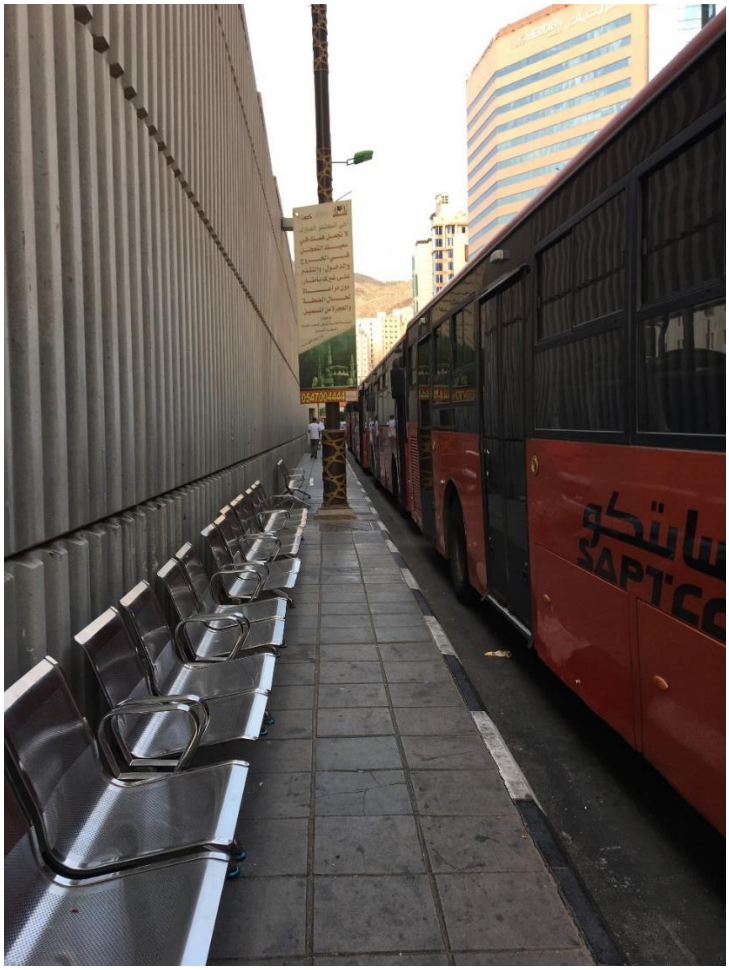

Figure 7.15 Benches placed on a narrow sidewalk, serving one activity and neglecting others. Source: Field observation, 2019.

Street signage

A total of 219 respondents answered that there were not enough guidance signs on sidewalks, while only 78 agreed that there were. Out of all the respondents who did not agree, 166 were visitors and 53 were locals. A total of 94 respondents were neutral on the subject. Out of 78 respondents who agreed, 65 respondents were visitors and only 21 were locals. Most of the respondents were not satisfied and were concerned they might lose their way walking to the mosque or returning to their locale, which means that the area is not supported by enough signs to guide visitors (Figure 7.16). Signage is one of the essential parts of street furniture that should be provided along the sidewalks.

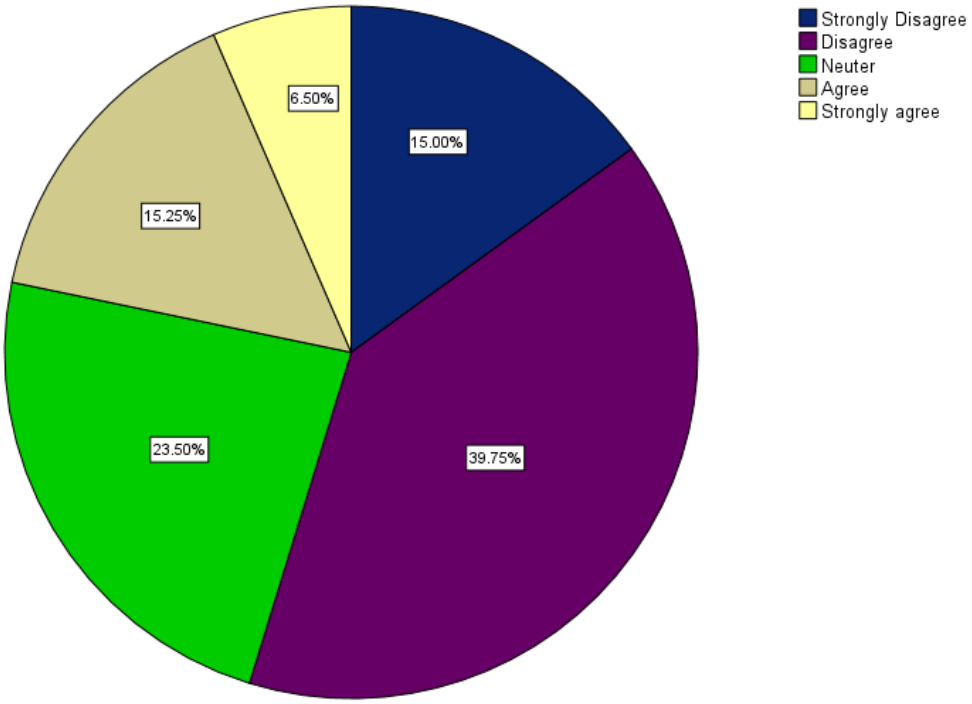

Figure 7.16 Users' perceptions on the degree of satisfaction about the provision of street signage.

Variations between different socio-demographic backgrounds concerning of the availability of signage along Central Makkah streets

Based on Table 7.4, since the p values are higher than 0.05 here, it may be concluded that factors concerning the provision of signage do not depend on any of the socio-demographic information except the age category.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Type of user	Between Groups	.614	4	.153	.804	.523
	Within Groups	75.376	395	.191		
	Total	75.990	399			
Gender	Between Groups	.481	4	.120	.655	.623
	Within Groups	72.479	395	.183		
	Total	72.960	399			
Age	Between Groups	12.127	4	3.032	2.751	.028
	Within Groups	435.383	395	1.102		
	Total	447.510	399			
Nationality	Between Groups	.528	4	.132	.608	.657
	Within Groups	85.782	395	.217		
	Total	86.310	399			

Table 7.4 Variations in significance concerning the provision of signage along Central Makkah streets based on mean value, which shows a significant difference in the age category

Variation according to age group

According to Figure 7.17, the age factor does show significant association with the topography as a limiting factor; since the p values are higher than 0.05 here, it may be concluded that the provision of signage does depend on the age category, so there is a highly significant relationship between them. Based on the survey results, the age group 20–30 have more satisfaction than other groups, as younger age groups are more likely to use their phone to navigate the place, whereas older people prefer to use signage. The level of satisfaction decreases slightly as the age increases, so in the age groups 31–40 and 41–50 and those above 50 years old, 58% of each group are not satisfied about the current provision of signage. This supports the findings from the observations where people looked lost due to the lack of signage along the sidewalks, especially the elderly. As one gets older, declining visual acuity makes it harder to see what is ahead of you, perceive things to your left, read small print, and identify fine detail or faces (Burton & Mitchell, 2006).

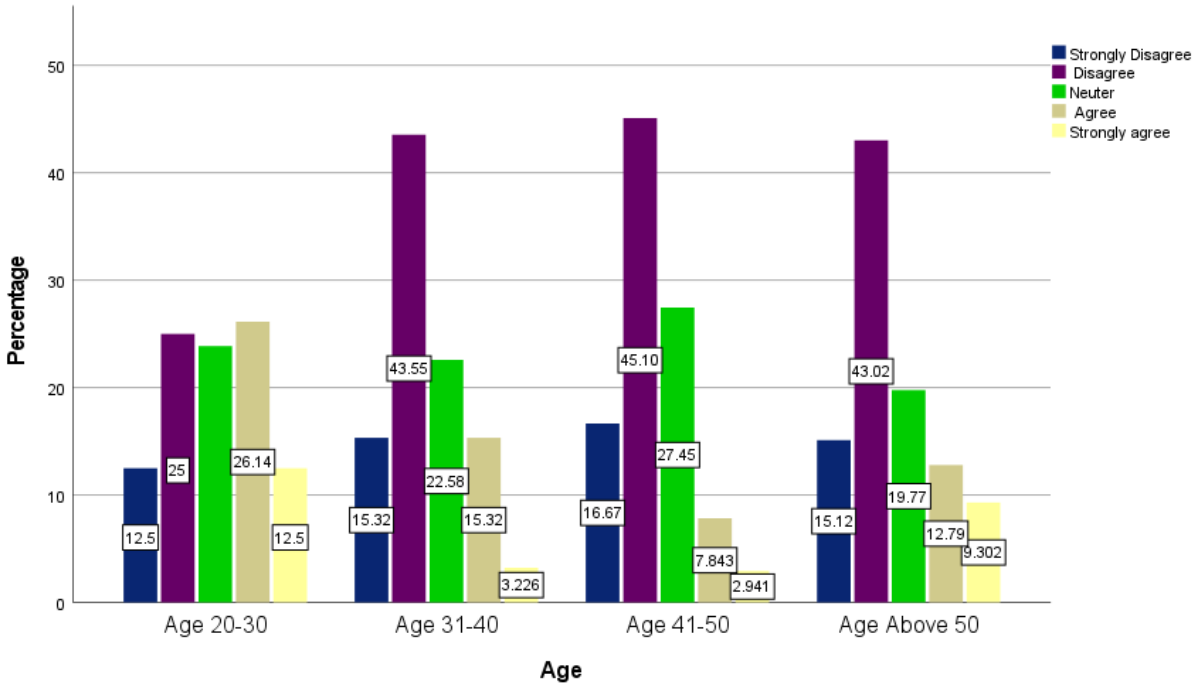

Figure 7.17 Users' perceptions on the degree of satisfaction concerning available shade along Central Makkah streets based on age group.

Lighting

Life in Central Makkah continues at all times as pilgrims and non-pilgrims can visit the Masjid Al-Haram at any time to worship – day or night. Since all shops and restaurants are permitted to remain open 24 hours a day, this also encourages people to go out.

Based on observations, activities at night do not differ from those in the daytime, as everyone is still walking and enjoying the cooler temperatures away from the burning sun; but there are a lower number of women, as described earlier. During the daytime, the number of people is comparable to that of night-time, specifically after sunset when it is much more crowded. After the *Isha* prayer, which is the last prayer of the day, the number of pedestrians start to decrease gradually. The age group of the pedestrians varied, with more young people ranging from 30 to 40 years old and fewer elderly people. Twenty percent of interview participants agreed that the best time to walk in Central Makkah was at night-time, because the temperature is lower than during the daytime.

People's purpose and motivation to visit the Masjid Al-Haram is mostly to perform Hajj or *Umrah*, or to pray. The streetlights are mostly well maintained, apart for some that need more attention, such as some parts of Masjid Al-Haram Street and Jabal Bakkah Street. The streetlights are specially designed by the Holy Makkah Municipality; however, public night life on the street has still not successfully improved in places where there are some parts of streets that do not have enough lights (Figure 7.21). So, the street lights should be placed in appropriate ways and are recommended to be illuminated and provide cover along the street (Choi et al., 2006). Despite this, pedestrians still walk and enjoy commercial activities in the central area. Whyte (1980) assures us of the importance of providing light in open spaces, stating that:

> *"Urban open spaces shall be illuminated throughout with an overall minimum average level of illumination of not less than 2 horizontal foot candles (lumens per foot). Such level of illumination shall be maintained throughout the hours of darkness"* (Whyte, 1980, p.113).

Commercial activities play an essential part in terms of attracting people to walk where there are many places to shop and eat around Masjid Al-Haram, which contributes to the liveability of the street. Respondents commented on the best time for walking being at night because of the temperature, as follows:

> *"The best time to walk is after sunset and the sun in the daytime is very hot."*
> – P5

"[I] usually shop at night because it is hot during the day." – P8

"The best time to walk is after sunset and the sun in the daytime is burning." – P5

Results from the survey indicate that users do not have issues with lighting during the night where it is provided (Figure 7.18). In general, most of the respondents seem to have no concerns with walking on sidewalks during the day or night, which suggests that the eyes on the street and the number of people contribute to that.

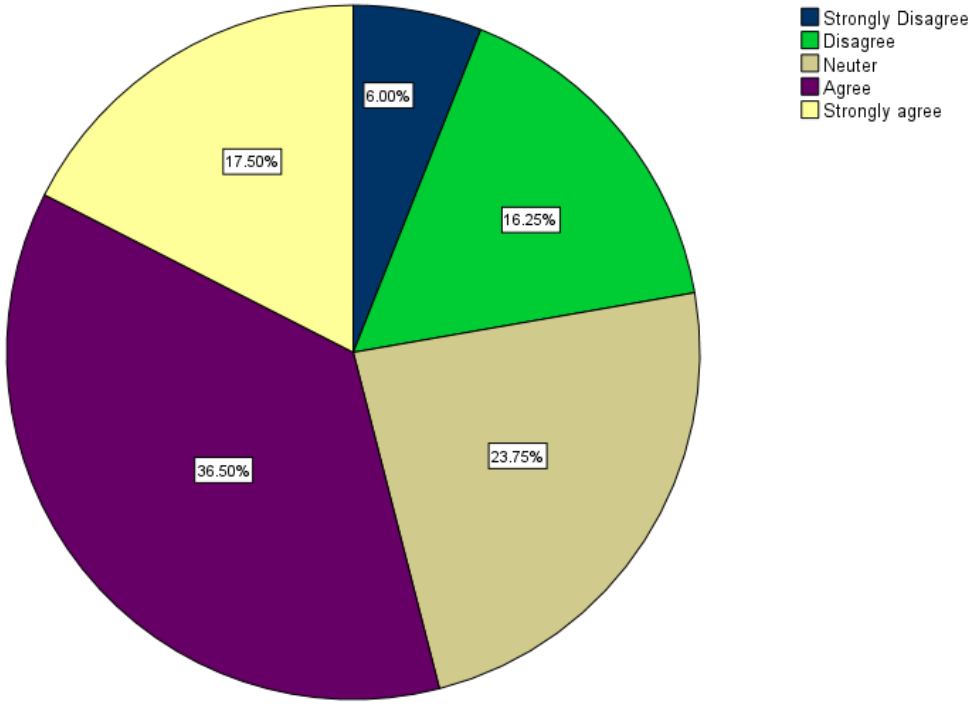

Figure 7.18 Users' perceptions on the degree of satisfaction concerning provision of lighting during the night-time.

Variations in perception between different socio-demographic backgrounds concerning the provision of lighting during night-time

According to Table 7.5, it may be concluded that variables that concern the provision of light on sidewalks at night do not have significant differences, except for gender, which is highly significant. This will be explained below in more detail.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Type of user	Between Groups	.680	4	.170	.892	.469
	Within Groups	75.310	395	.191		

	Total	75.990	399			
Age	Between Groups	4.042	4	1.010	.900	.464
	Within Groups	443.468	395	1.123		
	Total	447.510	399			
Gender	Between Groups	2.076	4	.519	2.892	.022
	Within Groups	70.884	395	.179		
	Total	72.960	399			
Nationality	Between Groups	.723	4	.181	.834	.504
	Within Groups	85.587	395	.217		
	Total	86.310	399			

Table 7.5 Degree of safety attributes (provision of light during night-time) based on mean value, which shows a significant difference in some variables.

Variation accodring to gender

According to Figure 7.19, there is a variation in respondents' perception about the provision of lights along the sidewalk at night. There is a slight varation in that the male group demonstrates more negative reactions than the female, which indicates the importance of providing light at night. This supports the findings in Chapter 6, where there were a lower number of women walking in the evening. In terms of these negative responses, males demonstrate more of these while the female group's responses were less negative and more neutral. That might explain why the male group mostly walk at night, which may contribute to their negative perceptions about the light. These reuslts are supported by observation, in that most of the people walking at night are males (Figure 7.20). Also, there is a lack of lighting in some areas, as shown in Figure 7.21.

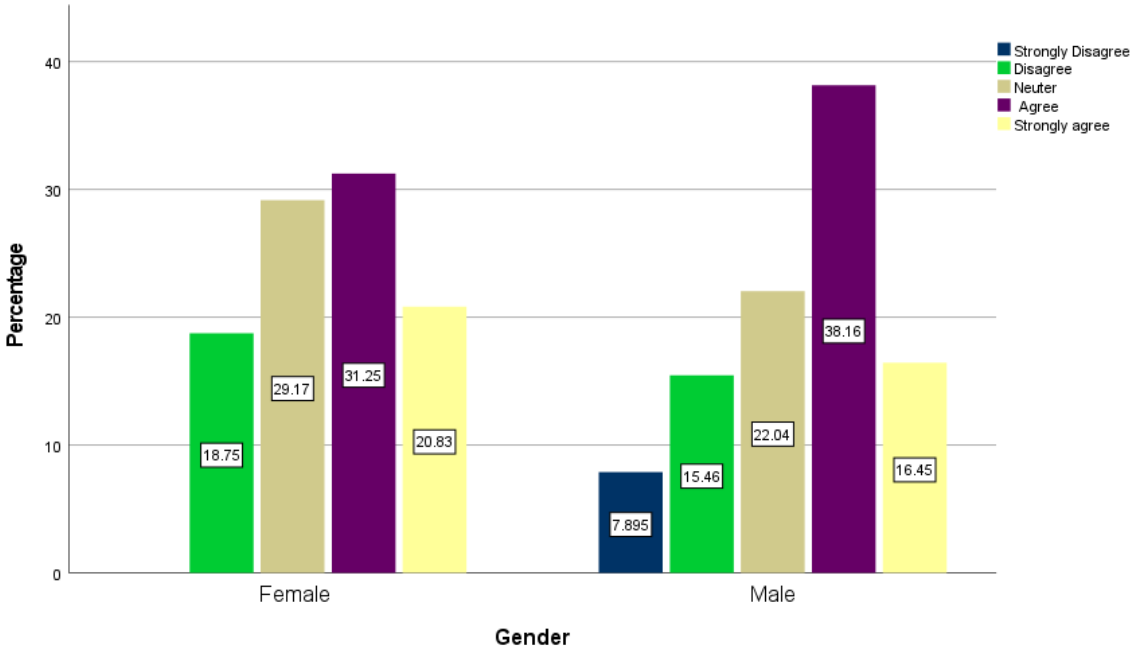

Figure 7.19 Users' perceptions on the degree of satisfaction concerning provision of lighting during night-time based on gender.

Figure 7.20 Poor lighting during the night. Source: Field observation, 2019.

Figure 7.21 Locations of missing/poor light at night in the central area. Source: Field observation, 2019.

Crossing roads

The result of the observations in Central Makkah revealed that the majority of users crossed at any point along the streets rather than using an official pedestrian bridge, which is only available in one location in Masjid Al-Haram Street. However, the overhead type of crossing is not extensively used by street users in Central Makkah. According to the observations, individuals prefer to cross the street illegally in areas where there is no designated crossing. Two locations along Ibrahim Alkhalil Street and Ajjyad Street are controlled by the police to help pilgrims to cross. The street width in the central area differs from street to street. People are still fearful of crossing, and it is difficult for the disabled to cross without help from others. Wide streets are challenging and take more time to cross. Hence, pedestrians have to deal with automobile traffic

for longer periods. On most of the streets, the distance to be crossed is greater than 20 metres (Appendix B).

Connectivity

In general, Central Makkah streets and their surroundings lack connection in terms of the number of intersections and pedestrian continuity on sidewalks (Figure 7.23).

Street network

During the fieldwork, connectivity was measured based on intersection density. In terms of intersections, the central area has a poor level of connectivity within the area of study based on the low number of four-way intersections surrounding the Masjid Al-Haram, as well as the block length as introduced by Cervero and Kockelman (1997) (Appendix B). The lack of connection between streets may be seen as a result of the rapid changes that have occurred over time, as well as the topography of the area.

Connectivity of sidewalks

The links between sidewalks are poor, which for the pedestrian is the most important part of the street. So, there are indirect long routes for pedestrians to negotiate, but also, there are not enough choices possible to take different routes to other destinations around the Masjid Al-Haram. There are a few off-street paths dedicated to pedestrians only, which were previously part of traditional street networks (see Figure 7.22). Crosswalks between sidewalks on both sides simply do not exist; therefore, pedestrians risk dangerous situations to cross to the other side of the street.

Large blocks and disconnected streets create a less comfortable environment for pedestrians in which to walk. This supports the assertion by Cervero et al. (2009) stating that to encourage walking and cycling, street designs and layouts should be considered and given specific attention to make the street more connected. The block size is large, ranging from 300 to 512 metres, which is one of the factors in the area that forces pedestrians to walk a long distance to reach other parts of the central area. Connectivity also naturally has an effect on walking time. The poor connections between sidewalks increase the time and distance to people's destinations, as they have to walk around long blocks. Poor connectivity, which can be described as gaps between sidewalks, making walking difficult and tiring for users as they have

to step down to the street and back up to the sidewalk, was not easy for everyone. This issue was picked up in the interviews with pedestrians:

> *"Shopping takes more than 10 minutes because of the crowded and poor connection of streets, for example if I want to get to the other side of this block you need to walk around."* – P8

However, it was not only the pedestrians themselves who cited connectivity issues, but also a respondent from the planning department in the Holy Makkah Municipality who mentioned large blocks, limited intersections, and the lack of over- or underpasses as the reason behind this:

> *"... the connection between the sidewalks on to the other side of the street is non-existent in the central area, [such] as pedestrian bridges or crossings which [would] encourage pedestrians to walk and move safely."* – E3

Figure 7.22 The only pedestrian paths that are separated from vehicle traffic. Source: Field observation, 2019.

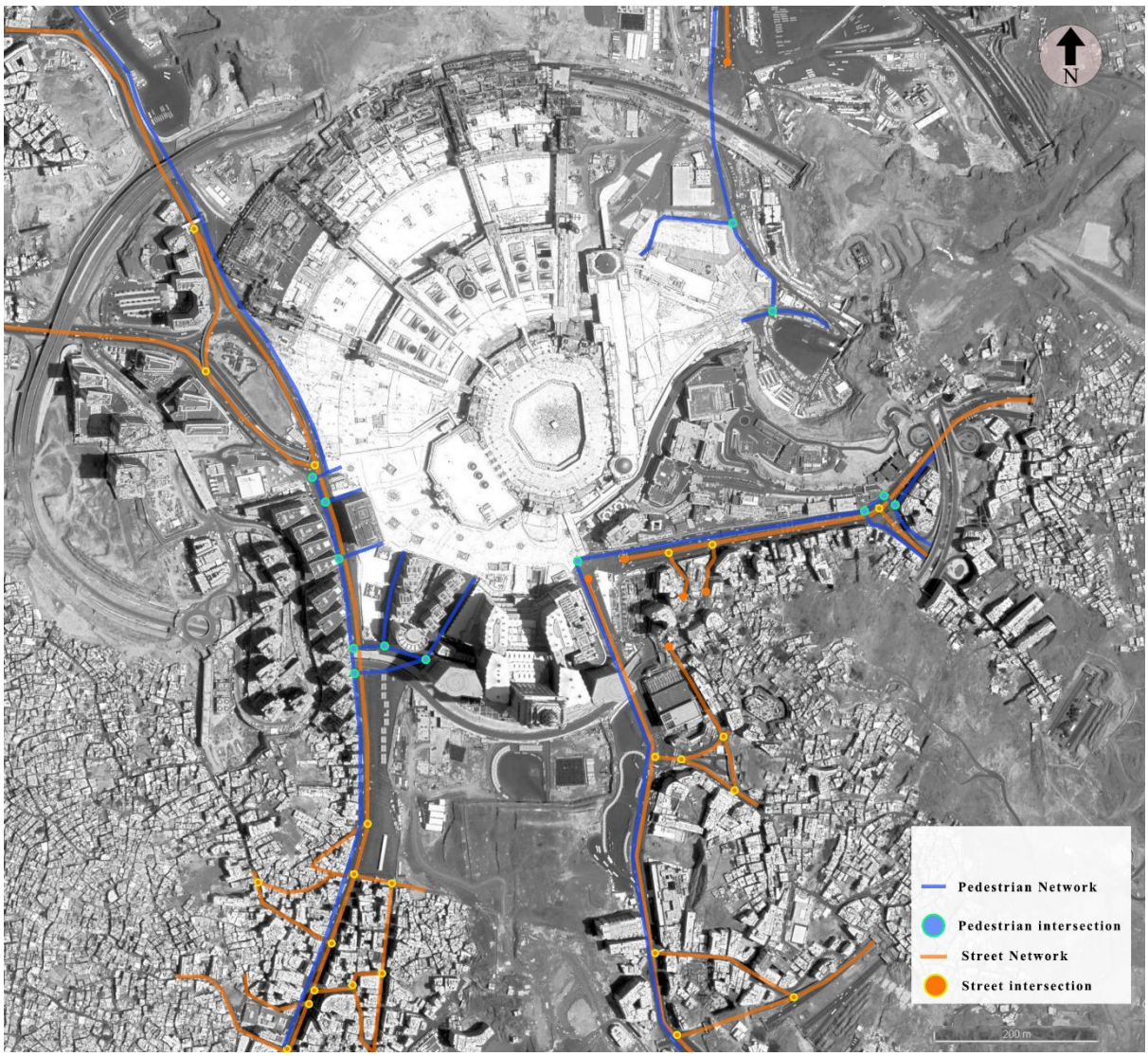

Figure 7.23 Connectivity of street and pedestrian network. Source: Field observation, 2019.

The results from the survey support previous findings from the observations, showing that sidewalks in the area lack connection, which can make walking difficult and not easy to go to different places, which means that the block lengths have a crucial part in this issue. The results indicated negative responses, where almost 56% of respondents found that the current sidewalks were not helping them to reach their destinations easily (see Figure 7.24).

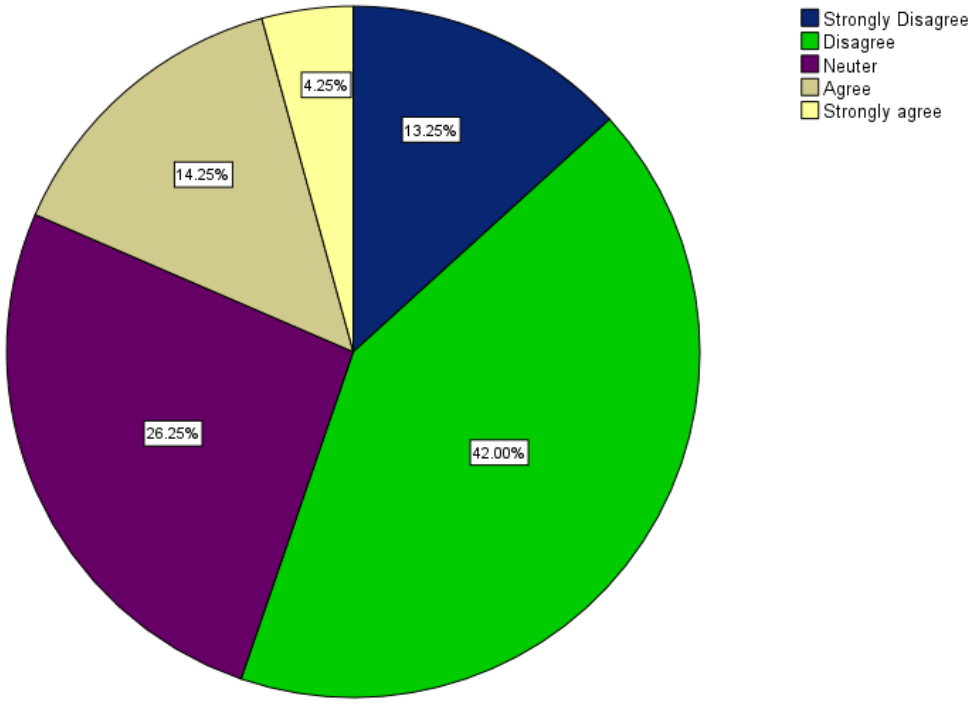

Figure 7.24 Users' perceptions on the degree of satisfaction about the connections between destinations.

Variations in perception between different socio-demographic backgrounds concerning the connection between sidewalks and places

According to Table 7.6, since the p values are higher than 0.05 here with some variables, it may be concluded that variables that concern the connections between sidewalks and destinations do not have significant differences except for the gender and age group variables, which is explained below in more detail.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Type of user	Between Groups	.268	4	.067	.349	.845
	Within Groups	75.722	395	.192		
	Total	75.990	399			
Gender	Between Groups	2.852	4	.713	4.017	.003
	Within Groups	70.108	395	.177		
	Total	72.960	399			
Age	Between Groups	15.549	4	3.887	3.555	.007
	Within Groups	431.961	395	1.094		
	Total	447.510	399			
Nationality	Between Groups	.631	4	.158	.727	.574
	Within Groups	85.679	395	.217		

Total	86.310	399			

Table 7.6 Variation in significance concerning the connections between destinations based on mean value, which shows a significant difference in some variables.

Variation according to gender

According to Figure 7.25, there are variations in respondents' perceptions concerning the connections between sidewalks and destinations. There is a slight variation between the two gender groups, where the female group show more positive responses than the male. There is a slight variation in terms of negative responses about the current connections between destiantions: also the females demonstrate more negative responses while the male group shows fewer. Observations and interviews offer no clue as to why this variation might occur.

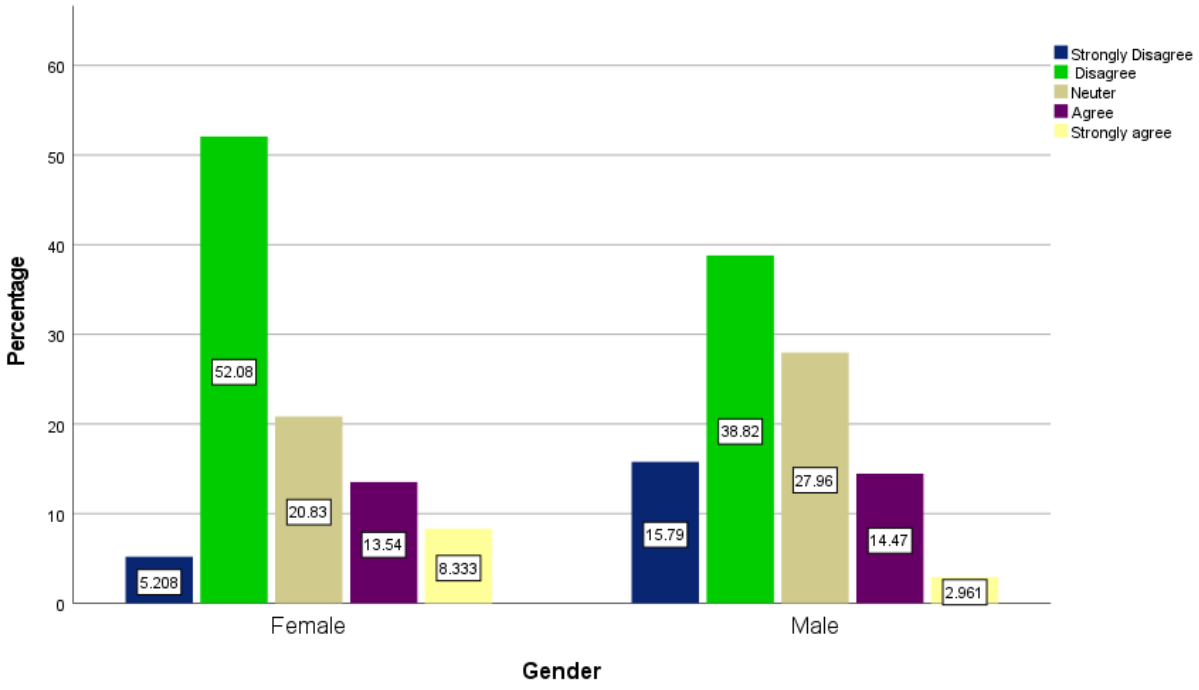

Figure 7.25 Users' perceptions on the degree of satisfaction concerning connectivity between destinations in Central Makkah.

Variation accodring to age group

The results from the survey (Figure 7.26) indicate that the connection between sidewalks and destinations do not meet the same level of satisfaction for all age groups, meaning that the sidewalks were not designed for use by all users, as they should have been. It can be seen that the p value is smaller than 0.05, from which one may conclude that the connection between

sidewalks and destinations and age groups have a strong relationship. Considering four age groups, those aged 20–30 demonstrated more satisfaction and agreed that the current sidewalks helped them to reach their daily destinations more than other groups. This may be because this age group is physically able to walk longer distances than other groups. It was observed that most people who either disagree or strongly disagree with the statement about the sidewalks' connectivity ranged from those aged 41–50, followed by those aged above 50, then by those aged 31–40 who believe that the area has poor connections when it comes to pedestrian destinations. These respondents perceived the current sidewalks as having insufficient connections and they did not help them to reach their daily destinations successfully, which may affect and limit the use of the street when considering different physical needs concerning walkable streets compared with other age groups.

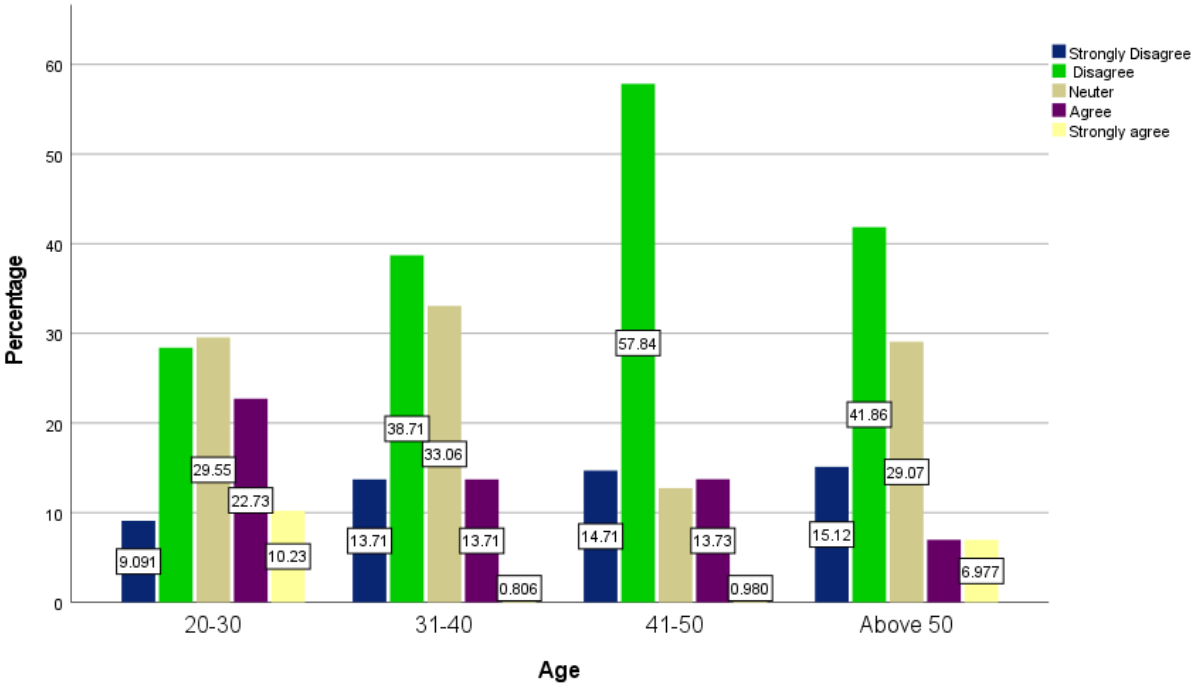

Figure 7.26 Users' perceptions on the degree of satisfaction concerning connectivity between destinations in Central Makkah based on age group.

Accessibility and proximity

Access for pedestrian

Access from one place to another by foot is based on different criteria and requirements for people (Burton & Mitchell, 2006; Yang, 2018). It is dependent on connected paths, the ability to walk around, facilities and services, and distance. Based on observations, sidewalks are not accessible to all users, especially people with disabilities, due to the lack of infrastructure that

would support the access and quality of the elements provided along most Central Makkah streets. The accessibility infrastructure did not support all sidewalks, as only specific locations had ramps, which facilitated access to private businesses but were not dedicated to pedestrian use of the sidewalk, as Figure 7.27 shows.

The layout of the modern central area, which is oriented around the automobile, has overlooked walking as a primary form of movement inside the area. This has had a detrimental effect on the usage of private automobiles as a primary form of mobility inside the central area. Moreover, the distant and inconvenient locations providing services and fasciitis, which were perceived as not meeting the criteria for a walking distance to a place of public transport, encouraged individuals to use motor vehicles rather than walk.

Figure 7.27 Access to sidewalks is limited to creating areas with private benefits. Source: Field observation, 2019.

All the respondents walked daily. Some walked up to six times per day. The duration of walking ranged from five minutes to more than an hour. The walking distance ranged from a few metres to around five kilometres per day. Most respondents walked for religious and commercial purposes. Only a few walked to work or dine out. Different respondents seemed to have different time preferences for walking. Most preferred to walk in the early morning, after sunset, and at night.

According to Figure 6.28, the respondents used four modes of transportation: walking, public transport, taxi services, or driving and then walking. However, walking was still the main mode of transportation among the respondents.

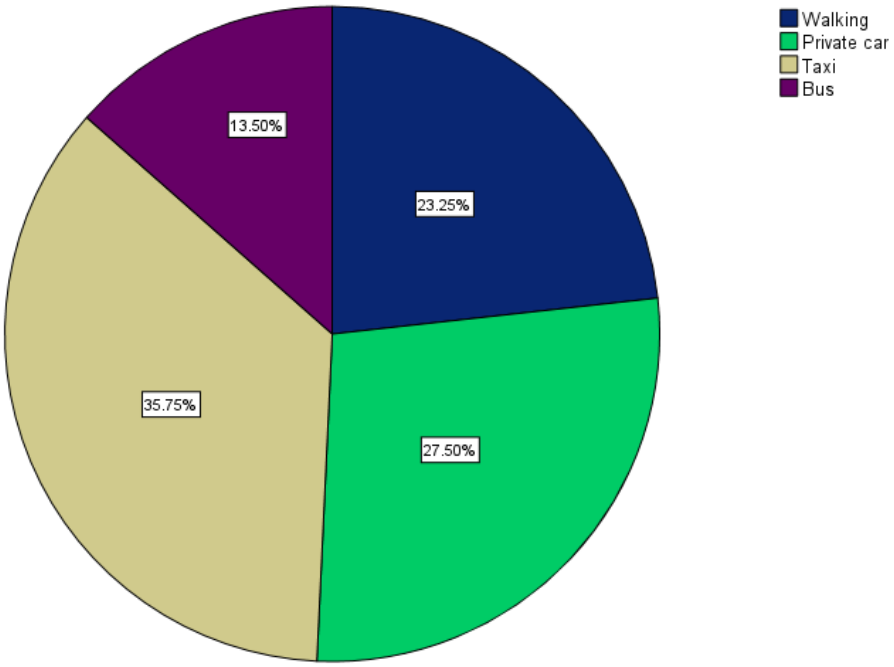

Figure 7.28 The main transportation mode that respondents used to reach the central area of Makkah city.

Proximity

The time, distance, and ease of route required to reach a destination from the place where people were staying seemed to influence the frequency of walking to services. In general, instead of a long-distance walk, people gave up and took a taxi. More specifically, using sidewalks can be difficult for wheelchair users and the elderly, due to the lack of ramps that could help them.

The time and distance required to reach a shopping area from the area where people were staying seemed to influence the frequency of walking to the shops. Respondents that shopped more frequently preferred to live close to the shops while those that did occasional shopping lived farther away. For instance, three respondents said they shopped three times a day and lived within five minutes' walking distance:

> *"I walk three times a day and shop daily; I prefer to be close to shopping places."* – P3

Another person said that they shopped only once or twice per week and lived far away from the Central Makkah area.

> *"I shop once-twice a week; I prefer to shop outside the central area."* – P8

However, the data showed that respondents were willing to walk for a long time and distance to meet their daily needs. The distance to such needs ranged from one to five kilometres, but certainly that depended on the person's age and health condition:

> *"I can walk 3-4 kilometres."* – P9

and some could walk for more than an hour:

> *"More than an hour walking is the nature of my work."* – P19

Another major aspect that discouraged walking was the lack of access to quality complimentary services. Pedestrians had to walk long distances to access public toilets.

> *"… people walk more than 250 metres and [do] not have basic services such as public toilets."* – E2

Food services were poor as well. Sometimes, pedestrians walked long distances only to obtain food of unsatisfactory quality:

> *"…pedestrians walk down the street all the time, and if they go out of Al-Haram and go to eat, they have a problem with the quality of the food [services] around them." – P5*

In regards to the walking distance that respondents walked from their locale, for example to Masjid Al-Haram, this varied; most of them walked for six to ten minutes, which equates to about two kilometres. The data shows that some people walked more than two kilometres, which is a long walk that is difficult for some. What this means is that the connection between the origin and destination (Masjid Al-Haram) is potentially a long distance, as the block size does not reduce the length of the walk (Figure 7.29).

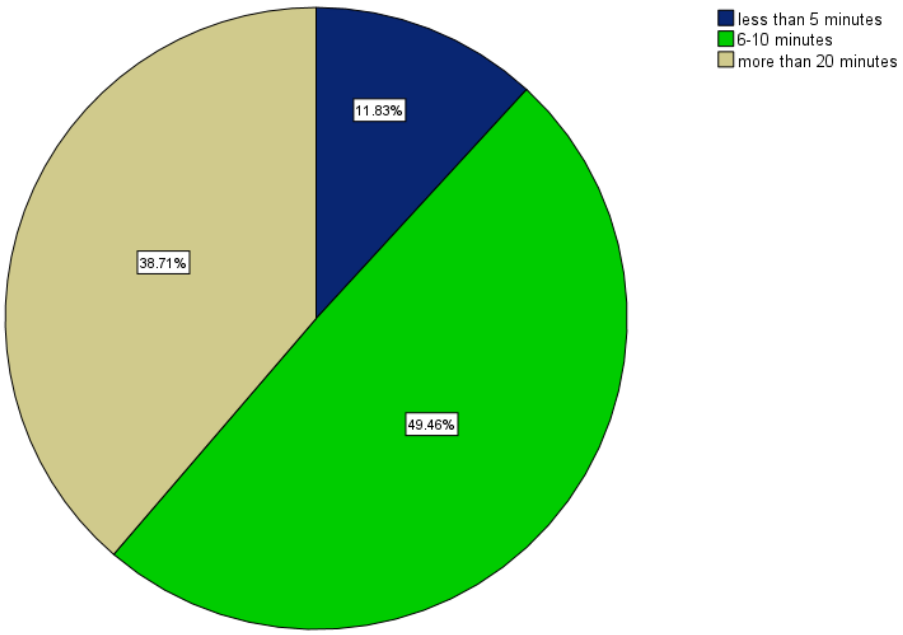

Figure 7.29 Users' perceptions on the distance of walking to reach their destinations.

Frequency of visit and distance

People are more likely to walk if the distance to their destination is not too far away. In the case of visitors to Makkah, the long distance has an effect on the frequency of visits, based on the results from the questionnaire.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	34.597[a]	14	.002
Likelihood Ratio	34.568	14	.002
Linear-by-Linear Association	3.377	1	.066
N of Valid Cases	93		

a. 15 cells (62.5%) have expected count less than 5. The minimum expected count is .24.

Table 7.7 Chi-square test for frequency of visit and distance in Central Makkah.

It can be seen that the p value is smaller than 0.05, from which one may conclude that these two variables have a strong relationship (Table 7.7). The distance between origin and destination influences the respondents' frequency of visits to Masjid Al-Haram. According to the survey's findings, the shorter the distance, the more often the visits (see Figure 7.30).

According to the figure below, 8% of the respondents who walk for less than five minutes and 7% who walk for more than 20 minutes used Central Makkah streets daily.

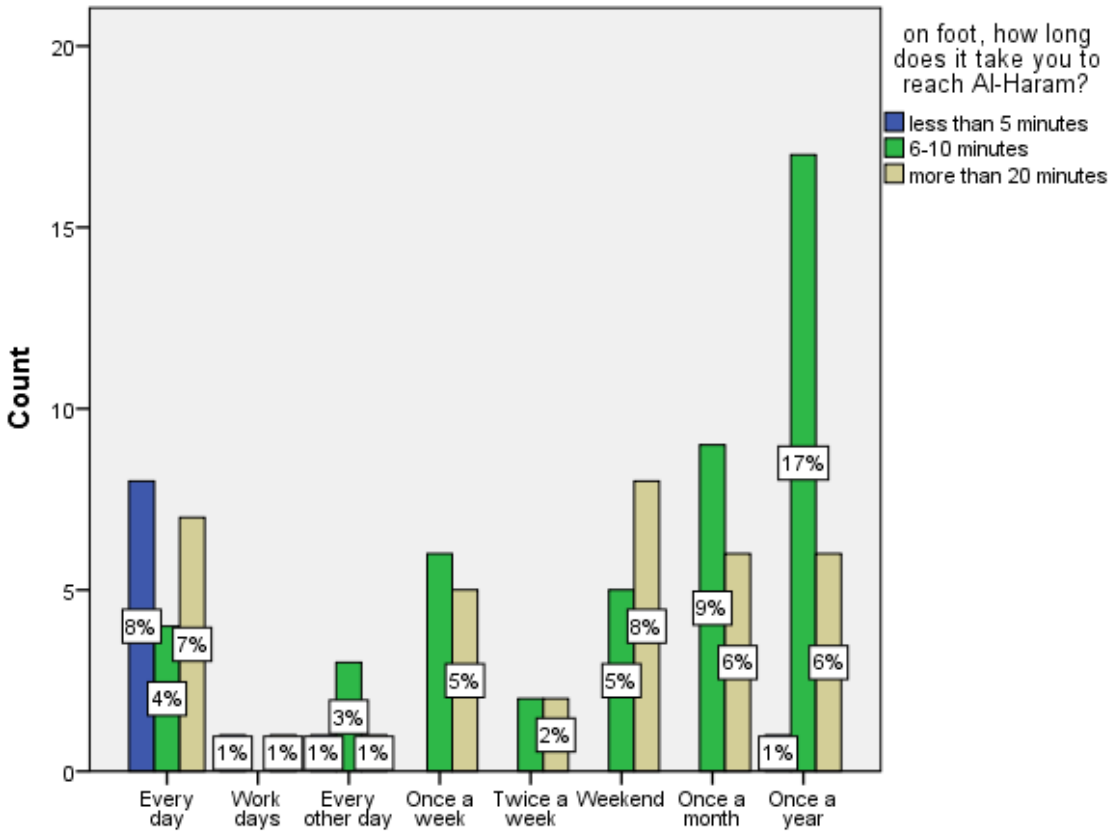

Figure 7.30 Relationship between respondents' frequency of visits to Masjid Al-Haram with distance when travelling on foot.

Transportation access

The journey by visitors from their local area to the central area should be undertaken by other means of transport such as car, taxi, or bus; therefore, it is essential to consider the relationship between the provision of these and needs of the pedestrian. Private cars, taxis, and buses are the main modes of transport used to reach the central area, so there are five points controlled by traffic police to manage access for taxis and cars, while buses have allocated stations. From these points, the visitors and local people start walking on the street to reach the gates of the Grand Mosque.

Based on the site observations, Central Makkah has good access for all transportation. In some parts access is limited and for public transport access only – buses and taxis – which is controlled by police, and depends on how crowded the area is. Due to the enormous level of

daily traffic in Central Makkah, it is obvious that accessibility is primarily for vehicular transportation, despite the presence of adequate pedestrian amenities. Central Makkah is easily accessible through private vehicles and reasonable public transportation modes for example buses and taxis, and served by several bus stops (Figure 7.31).

One aspect of accessibility to public space is how easy it is to reach through different transportation modes. Some bus stations, for example, are well connected to the pedestrian network; as they are situated in Central Makkah, some streets have good access to bus stations, such as the two in south Masjid Al-Haram (Ajjyad station and the King Abdulaziz project), while others require people to walk long distances, such as Jarwal station, which is about 1 km away, and Ghaza station, which is about 600 m distant (see Figure 7.31).

The second most popular option was to drive one's personal car or to take a taxi and then walk. It seemed that the respondents who used this option were generally locals of the city but who lived far from Central Makkah.

> *"It takes about 20 minutes to get here by car in the seasons (Hajj and Umrah in Ramadan). Sometimes I need to park my car far away, about two kilometres, and come to work by foot."* – P15

While bus services had access to the central area, they were not considered reliable and thus were not a favoured option:

> *"I usually walk to work for 25–30 minutes because the cars are not allowed to enter some places close to the mosque and the buses are delayed."* – P2

In terms of the main mode of transport that pedestrians (both visitors and locals) used to reach Central Makkah, the data shows that the most used type of transportation given by respondents were taxis, which have closer drop-off locations to Masjid Al-Haram than buses; then people can continue by walking (see Figure 7.28). Looking at the type of user, the main transportation used by visitors is the taxi, with walking recorded as the second most popular mode. For locals, the private car is the most used type of transportation to reach the central area, whereas the bus is the least popular option.

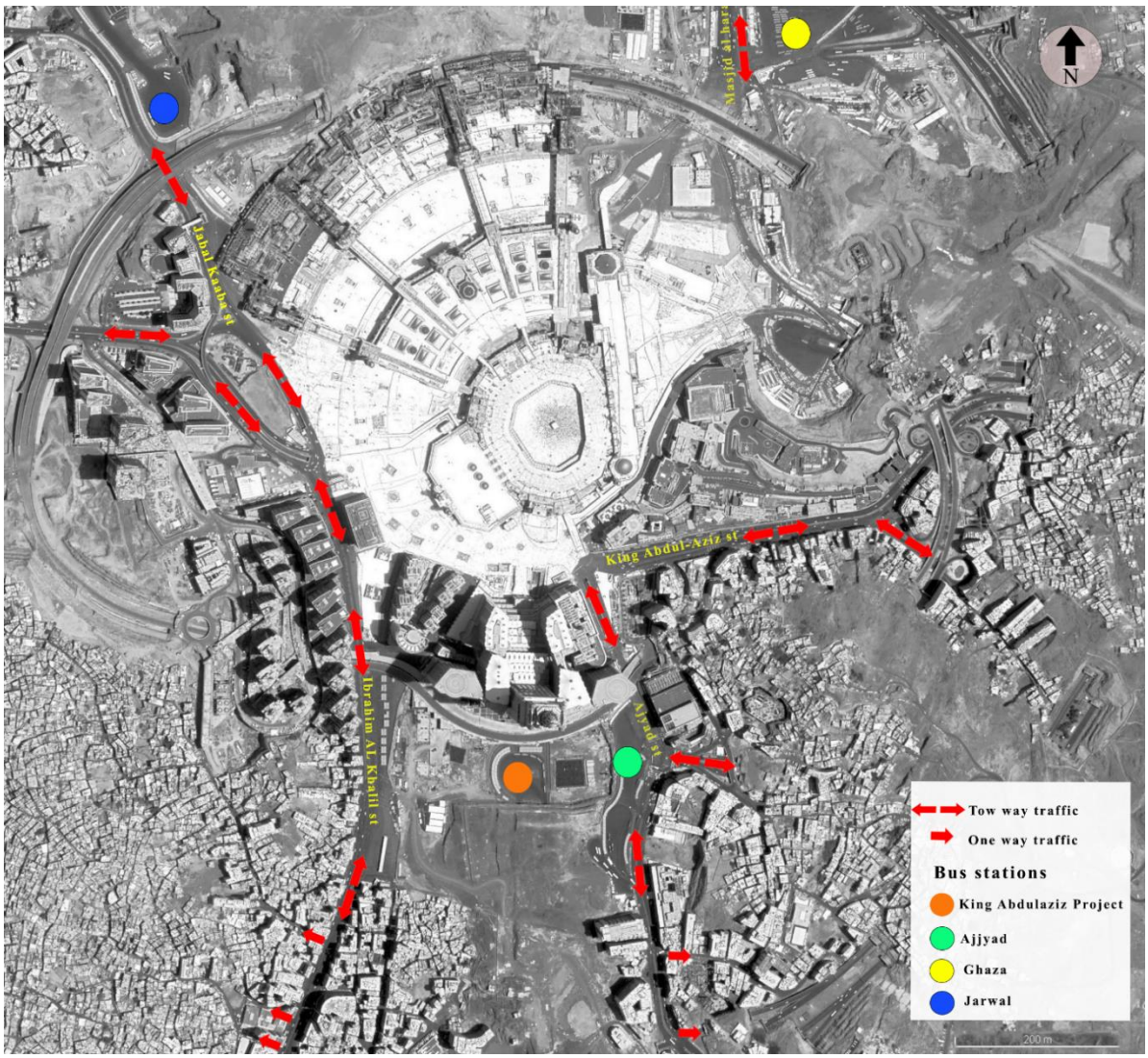

Figure 7.31 Accessibility of Central Makkah streets. Source: Field observation, 2019.

Variations in perception between different socio-demographic backgrounds concerning accessibility

According to Table 7.8, since the p values of some variables are higher than 0.05, it may be concluded that variables that concern accessibility do not have significant differences except for the type of user and age group variables, which is explained below in more detail.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Type of user	Between Groups	3.423	3	1.141	6.227	.000
	Within Groups	72.567	396	.183		
	Total	75.990	399			

Age	Between Groups	10.107	3	3.369	3.050	.029
	Within Groups	437.403	396	1.105		
	Total	447.510	399			
Gender	Between Groups	.698	3	.233	1.275	.282
	Within Groups	72.262	396	.182		
	Total	72.960	399			
Nationality	Between Groups	.557	3	.186	.857	.464
	Within Groups	85.753	396	.217		
	Total	86.310	399			

Table 7.8 Variations in significance concerning accessibility based on mean value, which shows significant differences in some variables.

Variation accodring to user type

It may be seen that the p value is smaller than 0.05, from which one may conclude that these two variables have a strong relationship (see Figure 7.32). Most of the locals use their private cars to access the central area. That may be because of their familiarity with the area and living close to the Grand Mosque, with taxis as a second option, which may depend on how the crowded the area is. Visitors usually walk from where they are staying, depending on how close the Grand Mosque is to their hotels, while the taxi is always a second option. There is more reliance on cars by the locals, while walking is more popular for visitors than using private cars and buses. Public transportation is used less by both types of users when compared with other modes of transport, which supports the findings from the observations and interviews.

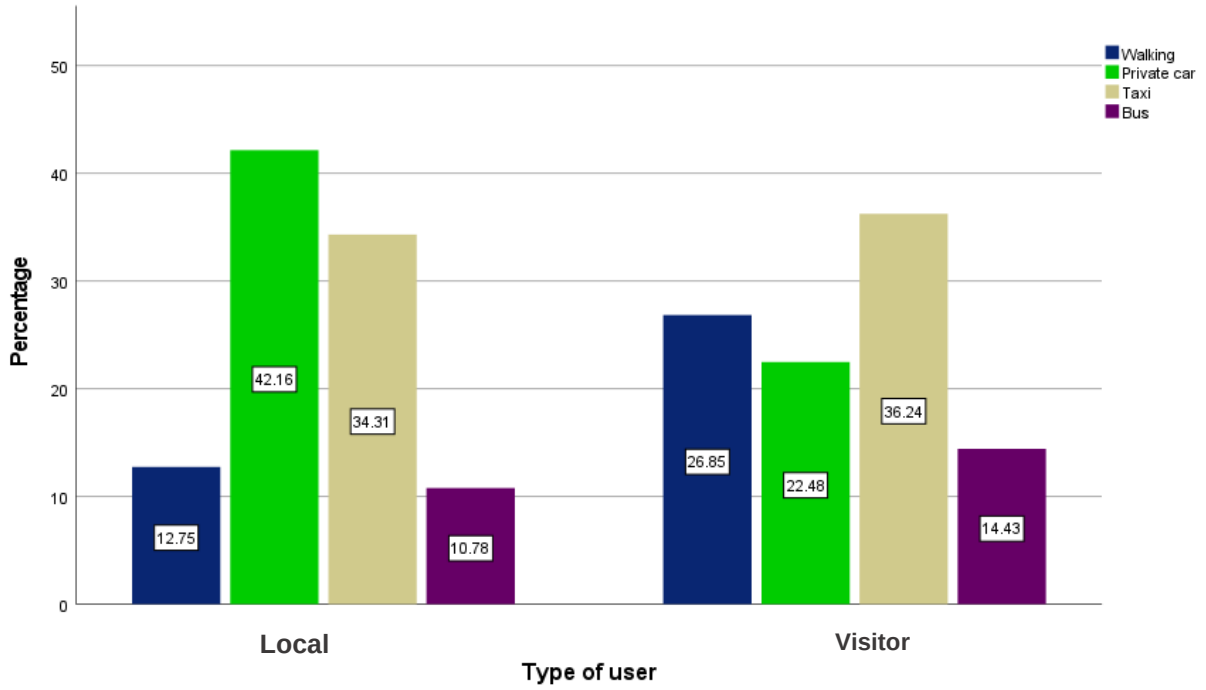

Figure 7.32 The variations between the main types of transportation used to reach the Grand Mosque according to the type of user.

Variation accodring to age group

According to Figure 7.33, the age factor does show significant association with accessibility; since the p values are higher than 0.05 here, it may be concluded that accessibility does depend on age group so there is a significant relationship between them. There may be differences in people's ability to walk and proximity between users depending on their age, which may explain the variances in these kinds of attributes. Based on the survey results, those aged 20–30 mostly used private cars and taxis in the first place, rather than walking. Those aged 31–40 used private cars and taxis equally, while the number walking was lower. It was shown that those aged 41–50 relied on taxis more than younger age groups. Those aged over 50 mostly used taxis to access the central area, while private cars were used less but the number walking was greater than those using cars, which explains this age group's use of buses more than other groups. Public transportation is least used to access the central area and that might be because it is inconvenient, or because there is no accessibility to the street via public transportation, or because the stations for public transport are too far from the user's destination that they are not convenient. According to Turel et al. (2007), when creating outdoor spaces for the older adults requires the consideration of factors, ease of activity, mobility, and accessibility.

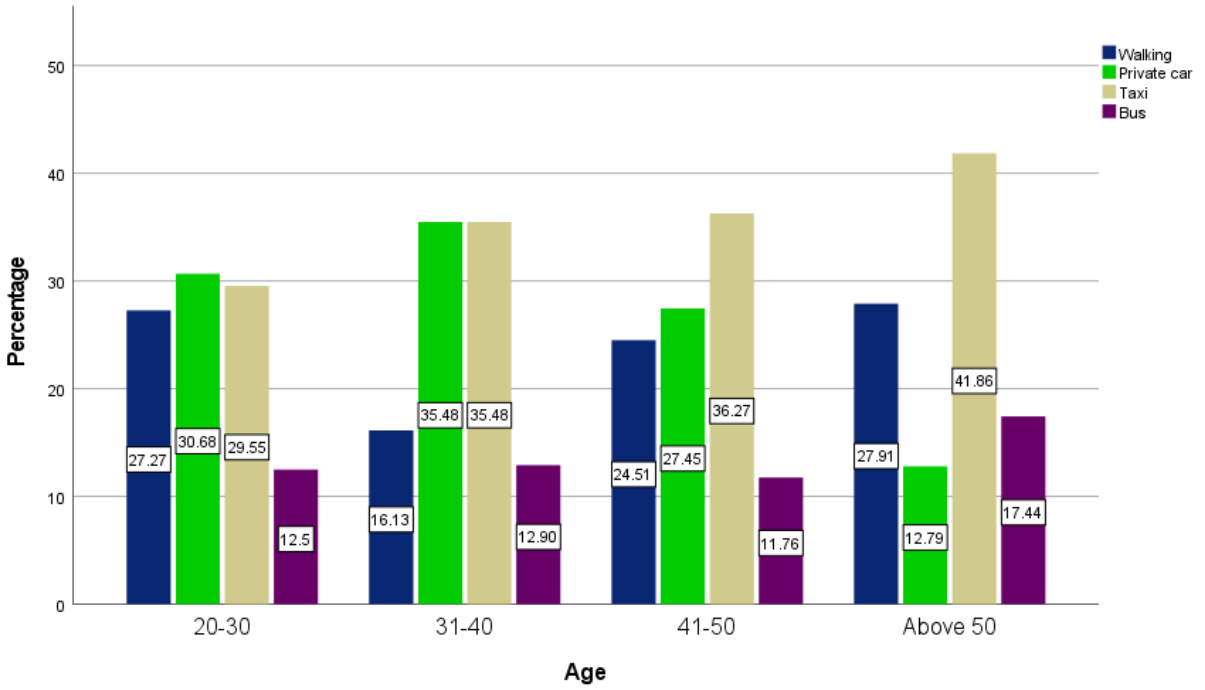

Figure 7.33 The variations between the main type of transportation to reach the Grand Mosque according to age group.

7.3 Conclusion

The aim of this chapter is to determine the physical characteristics that may encourage or discourage walkability in a hot, arid climate, and specifically in Central Makkah. It also determines the variations of needs and patterns of visitors and locals. It has been noted that the user's needs on streets in central Makkah street are associated with physical factors: path context which includes street design, visual interest of built environment, greenery/trees, and path quality which includes width, paving, street furniture, connectivity, accessibility. It was revealed that in respect of the central area of Makkah, physical factors dominated users' needs over functional ones.

The findings indicate that comparable variables influenced common user needs in a walkable urban street in Saudi Arabia with the needs of individuals from cities in other countries. Nevertheless, there are significant discrepancies between the walkable street and prior research in terms of the relative relevance of various factors. This might be in connection with a place's culture, climate, and the environment, which differ from prior studies.

It was revealed that in the case of Central Makkah streets, issues relating to street design, especially the width of sidewalks in terms of the design or the presence of merchants on most

of the sidewalks, are significant. These contribute to the street's crowdedness, which causes it to become uncomfortable for walking, thus creating a feeling of stress and an unsafe environment also.

The findings show that comfort attributes influence walking decisions where certain feelings and experiences and behaviour occur in response to the physical environment in the Central Makkah area. It was found that in the case of Central Makkah streets, the issue relating to street design, especially the quality of the sidewalks (accessibility and connectivity) is serious and explains the importance of city design and why it should be prioritised over vehicles. The findings show that accessibility and connectivity are important factors that encourage walking, but in the current environment they are not fully supported. The findings also revealed that there may be differences in people's ability to walk and the proximity between users depending on their age, which may explain the variances in these kinds of attributes.

Under the variations of perceptions of physical features that encourage walkability, visitors and locals mostly perceived the physical characteristics of the place more negatively. Both types of user had comparable perceptions of the critical features that contribute to encouraging walking, which include sidewalk width, pavement materials, lighting, and crossings. Where the attributes show significant differences between age groups under physical features is street signage. Those people aged 31 and above demonstrate more concern about these attributes compared with young adults. Lighting is one of the physical features that shows significant difference between respondents, where females show more dissatisfaction compared with males. The respondents perceived the current sidewalks as having insufficient connectivity and not helping them to reach their daily destinations successfully, which may affect and limit the use of the street when considering different physical needs for walkable streets compared with other age groups.

Apart from walking, other modes of transportation were perceived differently according to the type of users. The majority of locals use their individual automobiles to enter the central area, whereas visitors walk more. The age factor shows significant association with accessibility to the Grand Mosque. Those aged above 50 mostly use taxis to access the central area, while private cars are used less but the percentage of those walking is greater than those using cars, which explains why this age group uses buses more than other age groups.

Chapter 8. Social Factors Influencing Walkability

8.1 Introduction

This chapter presents the findings from analysis of the data related with the fourth objective of the research, which explores the relationship between physical characteristics and socio-cultural and psychological issues that influence people's decision-making, with specific reference to Makkah and the Umrah/Hajj pilgrimage, when using streets in Central Makkah. These findings are the results of the analysis of both qualitative and quantitative data.

8.2 Pedestrians' perception of the features and characteristics that make a street walkable

The next section explores the characteristics that contribute to a walkable street, as well as the variations in perceptions of walkable street attributes across various socio-demographic backgrounds.

8.2.1 ***Safety and security features/elements to encourage the use of sidewalks/streets***

Based on observation, safety appeared to be an important factor in supporting pedestrians walking along the Central Makkah streets. The pedestrian's needs are based on their experience and feelings about the current condition of the place, and people's perceptions were based on the type of users and age group. When in a space, people may behave differently if they feel unsafe or may try not to walk or use the street if others do. Participants were asked about their experience and perception of safety while using Central Makkah streets.

The section that follows addresses the attributes characterising street safety. However, it remains crucial to show the safety attributes that are least or most vital in the Central Makkah context. These findings are parallel to Gehl's (2011) assertion that a feeling of safety is crucial to entice people to walk in urban areas and that individuals themselves contribute to the city's perceived and experienced safety.

Congestion

The street environment is critical to encourage people to walk and use the street more often. Congestion may be classified into two types in this study, pedestrian congestion and traffic congestion, both of which contribute to one of the impediments to walking in the central area. It was observed that the number of pedestrians on the sidewalk was one of the major factors causing difficulties in walking, with the crowds forcing some respondents to seek alternative means of transportation. This is corroborated by the survey's findings, which identified congestion as a factor impeding people's ability to walk (23%) (see Figure 6.1).

Pedestrian congestion

As mentioned above, pedestrian congestion is one of the main reasons that limits walking in Central Makkah. Findings from observations support this claim, as the sidewalks are congested with pilgrims, merchants, and beggars (see Figure 8.1).

Pedestrian volume was cited as having the greatest effect on walking time. Even though most respondents said that they were staying in a hotel close to the shops where they visited, they reported that they had to walk more than ten minutes in searing heat and attributed this to crowds that decreased mobility and increased the walking time.

"I need more than ten minutes for daily needs due to overcrowding." – P20

Congestion caused by crowds makes people feel uncomfortable and unsafe, which limits the use of the sidewalk. Most respondents reported that religious festivals such as Hajj and Ramadan attracted crowds of pilgrims on the sidewalks, causing people to push each other and make walking an unpleasant experience. The crowds forced pedestrians to spill over on to the carriageway, causing safety concerns. This supports what Krupat (1984) stressed, the number of people on the street influences one's perception of comfort when walking on the street. The subjective or psychological experience caused by the realisation that one has less space than desired represents the concept of crowding.

To clarify, pedestrians did not have any alternative mode of transport as personal cars are not allowed into the Central Makkah area and the bus services are not reliable, while more freedom was given to taxis.

> *"Hajj affects walking [differently] from the rest of the year – there is congestion, pavements are full, and the street is used and is dangerous with cars and buses, the number of buses has increased, and the entry of small cars is not allowed and there is the problem of waiting a long time for buses."* – P2

However, the feeling of crowding might also be a different experience for some pedestrians (pilgrims). Crowded streets might be a positive experience for some pedestrians as they may produce a sense of belonging (spirituality). This supports the findings by Clingingsmith et al. (2009), who stressed that attending the Hajj strengthened pilgrims' feelings of unity, equality, and harmony with fellow Muslims, though in fact only one respondent reported having a great walking experience during the religious festivals.

> *"The Hajj season is impressive for walking when you see so many people walking together."* – P19

> *"In the middle of white spaces (surrounding the Grand Mosque) other than the time of prayers it is quiet, but for 30 minutes before or after prayer it is usually crowded."* – P15

The crowds forced some respondents to seek alternative means of transport:

> *"After* Isha[6] *prayer is finished, this makes access to the central area more difficult. The congestion is difficult, and the weather is hot, which usually forces me to take a taxi to work."* – P19

The situation became worse during religious festivals such as Hajj and Ramadan, as crowds of pilgrims on the narrow sidewalks caused people to push each other and made walking an unpleasant experience. A respondent commented on this, saying:

> *"The Hajj season affects the movement of the walk greatly, as if you are walking in front of a wave of the sea."* – P18

The number of pedestrians was not affected by the day of the week; some weekdays recorded higher numbers due to people's sense of comfort in walking (see Figure 8.2). However, some factors may affect people's decision to walk, forcing some to walk even when the temperature

[6] *Isha*: One of the five mandatory prayers and considered to be the last prayer of the day (the night-time prayer).

is high, or where some people avoid certain times away from the crowd to walk, as one respondent commented:

> *"Before the* Duhor *prayer is the best time to walk and shop to avoid crowds."* – P9

Although people expect to find the central area to be congested, some do not know how just congested the place may be. Being part of the crowd in Central Makkah is a cultural aspect that people know about, where some feel comfortable and some do not. In this study, however, it is clear that the crowd is one of the limiting factors that may influence the decision to walk, which relates to the psychological expectations where the fear of crowds is one reason and what the physical environment for walking is like is another reason. The psychological motives of a person influence the point in the hierarchy at which a person decides to walk (Alfonzo, 2005). In the current study, most people prefer to avoid walking or using the street if the place is crowded, as it may create an unsafe and uncomfortable environment. For each user, though, the feeling of crowding is distinct. It was claimed that "capacity is self-levelling. People have a nice sense of number that is right for a place, and it is they who determine how many is too many" (Whyte, 1980, p.172). If we compare that to other places, Central Makkah is a unique case where the crowd is a famous part of its culture.

Figure 8.1 Walking environment in Central Makkah. Left: large number of pilgrims coming out of the Grand Mosque after the morning prayer on Ibrahim Alkhalil Street. Right: pedestrians' space ten metres from the white space of the Grand Mosque, illegally occupied by merchants, which makes the space limited to walk in. Source: Field observation, 2019.

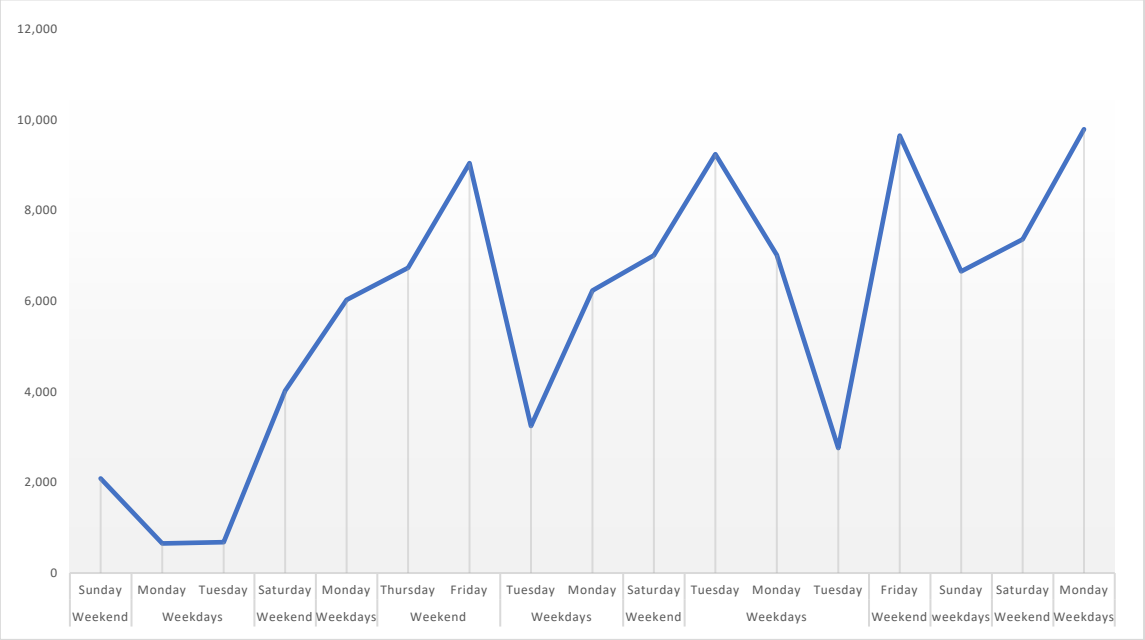

Figure 8.2 Pedestrian numbers on weekdays and weekends. Source: Field observation, 2019.

Traffic congestions

Based on observation, the streets were crowded; however, this was also the result of a combination of pedestrian and motor vehicles. This was especially so in Ibrahim Al Khalil Street, where there are three traffic lanes in each direction (see Figure 8.3). The high use of cars, and especially taxis, which have more access than private cars to the central area, caused this congestion. According to the mode of transportation used to reach Masjid Al-Haram, the primary means of transport used by respondents were taxis (35.8%) and private cars (27.5%), followed by walking (23.3%), and buses (13.5%) (Table 10.1). Taxis have become a necessity to support the flow of pedestrians due to the inability of public transportation to cope with the huge number of pilgrims. However, based on observation, the large number of taxis around Masjid Al-Haram and the behaviour of taxi drivers, which will be explained later in more detail, contribute to the creation of an uncomfortable environment for pedestrians walking, which decreases the walkability quality of the street.

Mode	Frequency	Percent	Valid Percent	Cumulative Percent
Walking	93	23.3	23.3	23.3
Private car	110	27.5	27.5	50.7
Taxi	143	35.8	35.8	86.5
Bus	54	13.5	13.5	100
Total	400	100	100	

Table 8.1 Transportation mode to travel to Masjid Al Haram. Source: field survey 2019

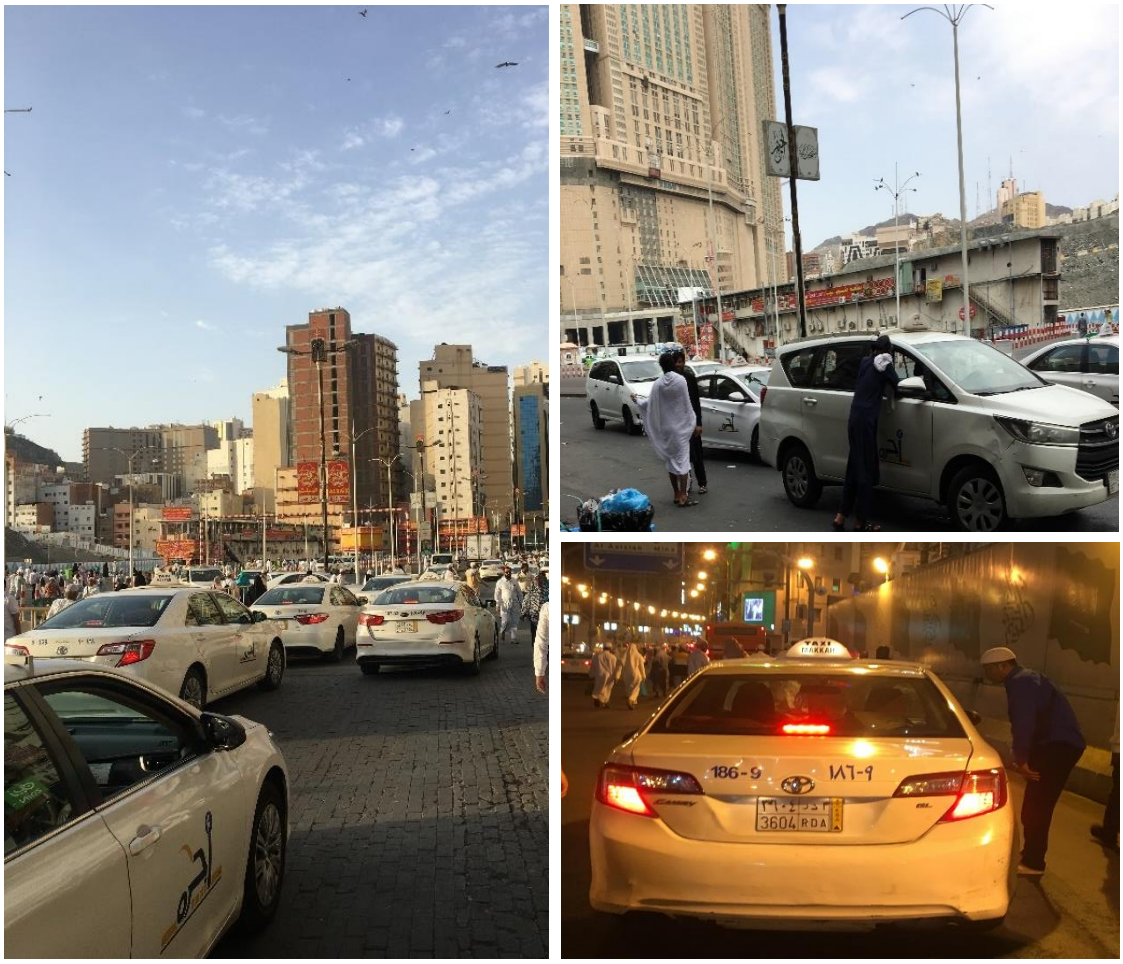

Figure 8.3 A huge number of taxis are looking for rides. Source: Field observation, 2019.

The outcome of a survey of questionnaires showed that congestion is one of the causes of respondents not feeling safe and not being satisfied because the sidewalks/corridors are not

separated from the traffic, even though people are still walking along them (Figure 8.4). This is in keeping with the conclusions of a study, which reveals that there is a negative correlation between the pedestrianised areas and streets with light vehicles and levels of stress (Knöll et al., 2018). The separation from fast-moving traffic was perceived by respondents as an important factor for safe walking where the available paths, which were separated from the public streets, were limited to one location. This is in line with the statement that separating the pedestrian path from automobile traffic, as exemplified by a pedestrian mall, can also improve movement comfort and relaxation. During periods of inactivity, however, the characteristics that contribute to a pleasant environment may enhance people's fear about their safety (Carr et al., 1992; Carmona et al., 2010). Sharing the same space with vehicles, which may cause harm to pedestrians where they have no choice of a place to walk, may increase the feeling of danger. So, the limited separated space for walking may lead to pedestrian accidents, which is discussed in the next section.

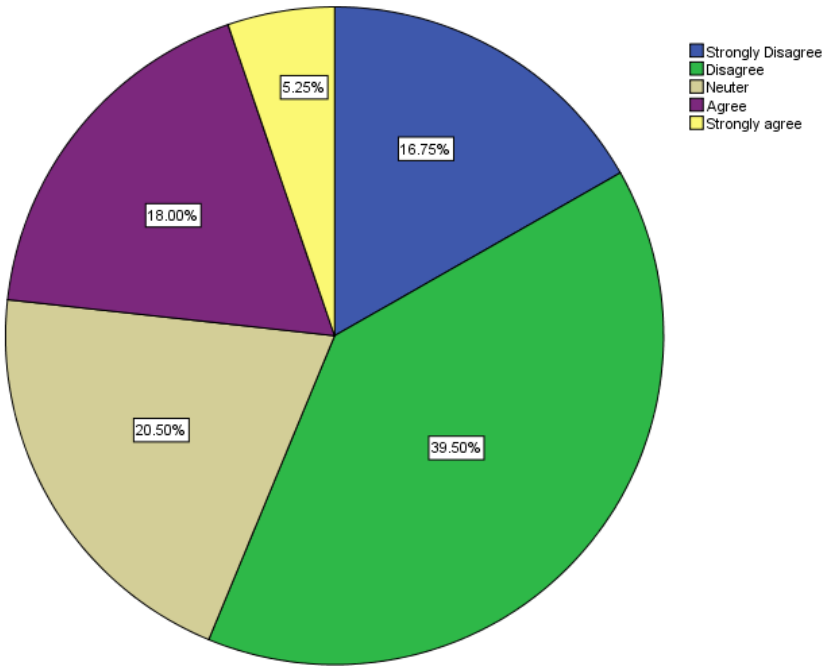

Figure 8.4 Users' perceptions of the degree of satisfaction about the existence of appropriate corridors adjacent to or separate from the public streets around Al-Haram.

Variations in perception between different socio-demographic backgrounds concerning existence of appropriate corridors adjacent to or separate from the public streets

Based on Table 8.2, since the p values are higher than 0.05 here, it may be concluded that factors concerning the existence of appropriate corridors adjacent to or separate from the public streets do not depend on socio-demographic information except for the type of user. The results in the table show the socio-demographic information of the respondents who expressed the importance of separation from traffic, which indicates that all the respondents were concerned and perceived this issue where there is a variation within the type of user variable.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Type of user	Between Groups	4.008	4	1.002	5.498	.000
	Within Groups	71.982	395	.182		
	Total	75.990	399			
Age	Between Groups	4.806	4	1.202	1.072	.370
	Within Groups	442.704	395	1.121		
	Total	447.510	399			
Gender	Between Groups	.533	4	.133	.727	.574
	Within Groups	72.427	395	.183		
	Total	72.960	399			
Nationality	Between Groups	.362	4	.090	.416	.797
	Within Groups	85.948	395	.218		
	Total	86.310	399			

Table 8.2 Degree of safety attributes (the existence of appropriate corridors adjacent to or separate from public streets) based on mean value, which shows a significant difference in some variables.

Variation according to type of user

According to Figure 8.5, it may be concluded there are variations between the responses concerning the existence of appropriate corridors adjacent to or separate from the public streets that make the walking experience safe. The results show that visitors and locals expressed the importance of safety attributes, but the locals show more dissatisfaction about that than visitors. The reason for that might be that the locals face the issue daily and perceive it more negatively,

while the visitors spend a limited time in the place and feel more blessed and excited about their visit, since for some of them it might be the only visit in their lifetime.

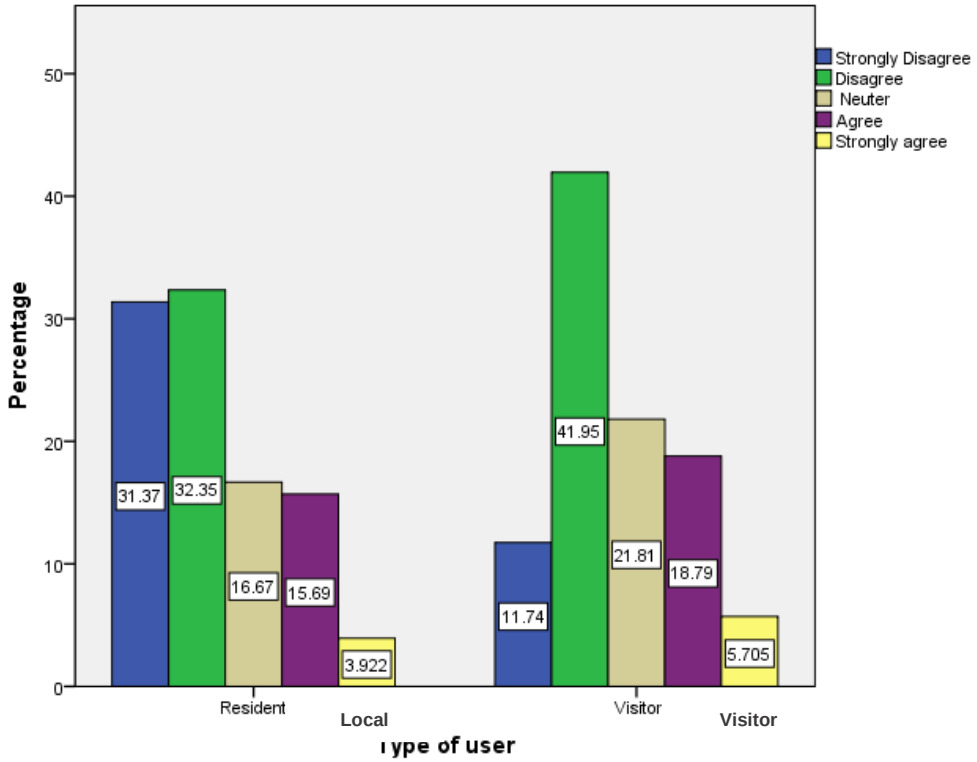

Figure 8.5 Users' perceptions on the degree of satisfaction about the existence of appropriate corridors adjacent to or separate from the public streets.

The need for an accident-free environment

Based on Figure 8.6, the central area of Makkah has a large number of pedestrian accidents. The data were extracted from the Holy City Traffic Department, and showed a significant increase in serious injuries between 2016 to 2018 by 600 accidents each year. Comparing these data with a city such as Najaf,[7] which had about 460 pedestrians seriously injured in 2017 (Al-Jameel et al., 2019), Makkah city had 752 accidents.

Based on the literature review, to provide safety for pedestrians from traffic, there are important design elements that create a walkable environment. Kerbs and sidewalks are the most effective ways to separate pedestrians from vehicles and therefore to keep them secure (Jacobs, 1996). It

[7] Najaf city: 'One of the most holy sites in Shi'a Islam, attracting high numbers of religious tourists from within Iraq and abroad, and a centre for religious scholarship' (Inter-Agency Information and Analysis Unit, 2010).

is possible for them to be distinctly separate, but not always sharing a sense of security or peace. By planting trees along the kerb line, particularly if they are close together, a pedestrian zone with a sense of security is created.

A major safety issue in Central Makkah area as reported by respondents was the interference to pedestrians by cars. Lack of clear separation between traffic lanes and sidewalks encouraged cars to interfere with pedestrians.

> *"Car interference makes pedestrian movement uncomfortable and unsafe."*
> – P17

Poor signage of pickup and drop-off points made them very disorganised and unsafe for alighting passengers.

The Department of Liveability Urban Scene Improvement Unit was keen to improve this situation by separating vehicular and pedestrian traffic using kerbs in new street projects.

> *"Sidewalks will be completely separated from cars: there are residential neighbourhood projects where a particular neighbourhood will be studied and developed, and the sidewalk will be separate from cars and buildings."*
> – E4

Other approaches taken to enhance pedestrian safety included installing street bollards and lamp posts in the middle of footpaths and removing sign pillars that could obstruct or hit pedestrians.

The interface with vehicles in the area and inappropriate behaviour of drivers contributed to these unexpected accidents. In areas where there are no pavements, pedestrian–vehicle accidents are more than twice as likely (Retting et al., 2003). Also, this may relate to the quality of physical characteristics such as the width of the sidewalks, which force the user to walk on the street instead.

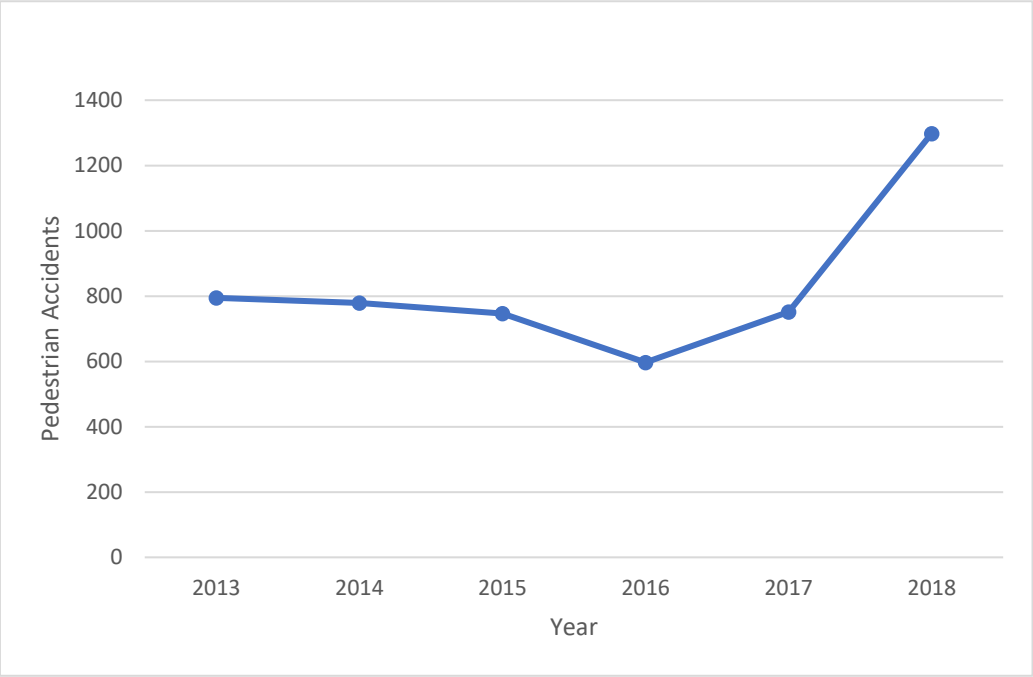

Figure 8.6 Pedestrian accidents from 2013 to 2019. Source: Holy City Traffic Department.

It has been discovered in most of the Central Makkah area the streets are dominated by motorists. This is because the width of street ranges from 13 to 40 metres, which increases the use of private cars and taxis and encourages traffic and speed as well. This issue is referred to as the drivers' lack of respect for laws in general, and the lack of respect for pedestrians specifically. Drivers who believe the street is theirs do not give way to pedestrians and disregard rules in general, such as not slowing down or stopping for pedestrians. Specifically, the behaviour of taxi drivers to obtain customers makes them more likely to disobey the street rules, such as not reducing their speed or stopping at random for pedestrians where there is no set place to pick them up or drop them off. If there is no enough space on sidewalks people walking on the streets which seen by drivers, thus when traffic speeds up, that causes pedestrians to feel frightened and uncomfortable.

The results from the survey support what has been observed and show that for safety reasons, the majority of respondents are concerned about pedestrians being separated from vehicular traffic. Nevertheless, as long as the streets are controlled by vehicle use more than pedestrian use, walking activities will not be supported and the use of the street will not be encouraged. Figure 8.6 shows that separation from traffic and the carriageway is preferable and gives pedestrians more safety in walking, which implies that pedestrians are not protected while walking when not separated.

The presence of street merchants on the sidewalks is another factor that may lead to accidents (see Figure 8.7). In the current conditions, there are both positive and negative impacts of street vendors. Their positive impact is that they enhance the street environment's appearance and liveliness, with the negative influence occurring when merchants operate on narrow sidewalks, which may cause danger to pedestrians who are walking there (Yatmo, 2008). The situation is unclear as the vendors have freedom to use part of the sidewalk and are disregarding the city regulations.

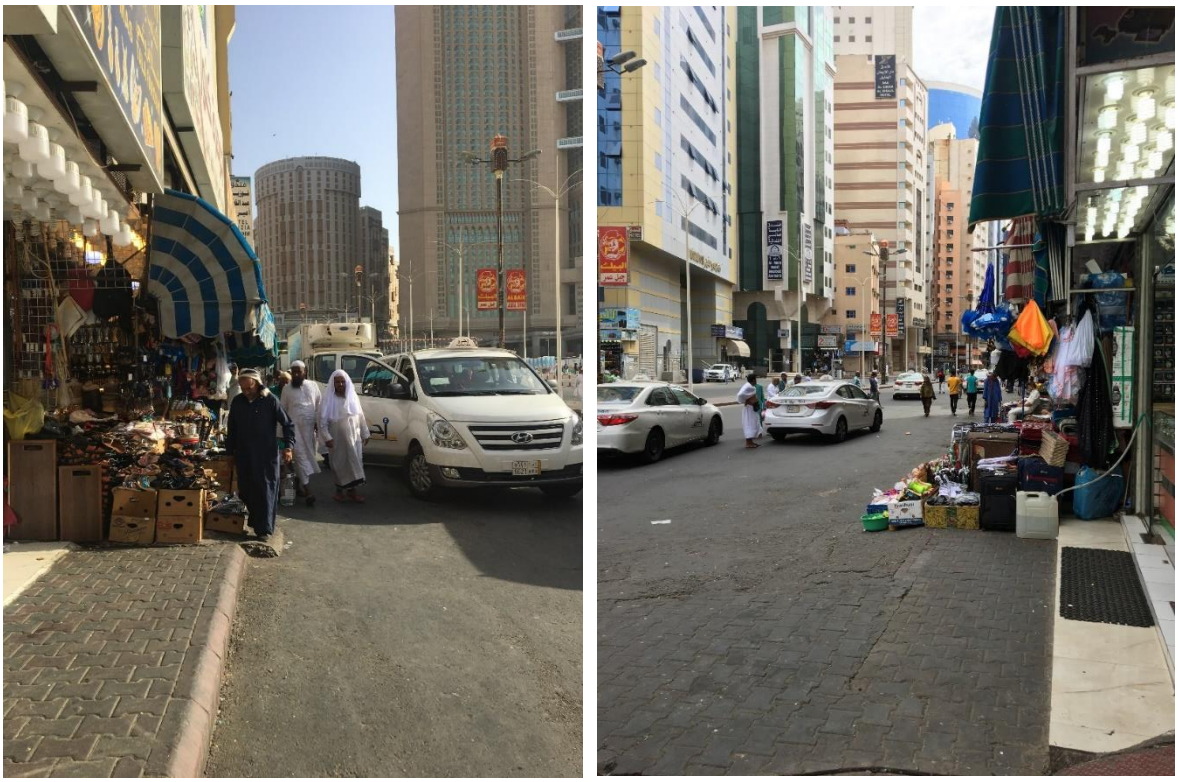

Figure 8.7 Street vendors using the sidewalks, causing people to walk on the carriageway. Source: Field observation, 2019.

Results from the survey are in line with what had been found earlier; the safety factor may have an impact on how people use the street and how safe they feel in a place may make people use the street more comfortably (Figure 8.8). People's behaviour may be associated with their feelings, which leads to them avoiding walking because of their fear. Based on the survey, 74% of respondents using Central Makkah streets agreed, and perceived that the segregation between walkways and traffic made them feel safer.

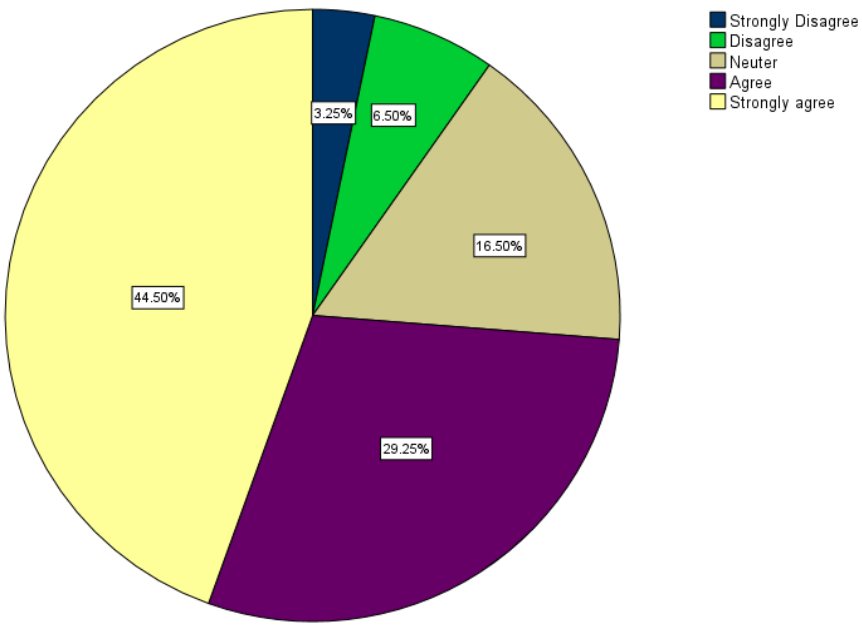

Figure 8.8 Users' perceptions on their feeling of safety when sidewalks are separated from traffic.

Variations in perception between different socio-demographic backgrounds concerning feeling of safety when sidewalks are separated from traffic

According to Table 8.3, since the p values are higher than 0.05 here, it may be concluded that the socio-demographic information of the respondents does not affect their responses in regard to feeling safe when there is separation between the traffic and walkways. No variations were found in respondents' perceptions.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Type of user	Between Groups	.672	4	.168	.882	.475
	Within Groups	75.318	395	.191		
	Total	75.990	399			
Age	Between Groups	5.339	4	1.335	1.192	.314
	Within Groups	442.171	395	1.119		
	Total	447.510	399			
Gender	Between Groups	.747	4	.187	1.021	.396
	Within Groups	72.213	395	.183		
	Total	72.960	399			
Nationality	Between Groups	1.014	4	.253	1.174	.322
	Within Groups	85.296	395	.216		

Total	86.310	399			

Table 8.3 Degree of safety attributes (feeling safe when sidewalks are separated from traffic) based on mean value, which shows no significant difference across all variables.

It can now be concluded that being safe from adverse incidents is an extremely crucial factor encouraging individuals to walk and see the street as a more walkable space. This supports Carmona et al. (2010), who added that the safety of the street is associated mostly with crime and fast-moving vehicles on streets. The physical characteristics of streets play a significant role in providing a safe environment for pedestrians to walk in and contribute to the feeling of comfort.

Safe crossing methods

According to the findings of the interview, safe crossing methods are an important feature that contribute to a safe and walkable street. The findings revealed that respondents felt that the pedestrians should have right of way at pedestrian crossing points.

> *"…there is a danger with the number of buses and [they] must give priority to pedestrians to cross the street which is most needed."* – P4

Based on observation of Central Makkah streets, pedestrians have no right of way at most intersections, where there is random crossing and a lack of crosswalks (see Figure 8.10). There are no crosswalks on any Central Makkah street except the one on Masjid Al-Haram Street, which is a bridge (for pedestrians to cross the road overhead) that is not used often, as stated by a member of the planning and traffic department:

> *"The crossing bridge on Masjid Al-Haram Street is not used much, and we do not know how to encourage pedestrians to use it"* – E3

Based on a tracking observation, a pedestrian was followed from his residence to his destination (Masjid Al-Haram), where the issue was about where he crossed three streets (Figure 8.9):

The man with a hat was going to the mosque from the hotel, walking on the sidewalk and crossing the street randomly where there was no designated crosswalk, and there were bollards on the street island, but he walked through them, and there were others for the sidewalks. The

man did not turn his head except while crossing the road with increasing speed and looking for goods on the right side.

It seems the sidewalks were not safe and wide enough to walk where the merchants' goods are. His head was looking down when there is sun; there is a crowd gathering around an unauthorised merchant, but that did not disturb the man walking as he went through them. His walking speed under the sun was fast, in contrast to that when in the shade, when he walked slowly.

Figure 8.9 A pedestrian's journey from his residence to Masjid Al-Haram. Source: Field observation, 2019.

From the tracking description above, it can be interpreted that the walking speed changed while crossing when the pedestrian felt unsafe, so he increased his speed to reach the other side of the street. This may be one of the reasons for the increased number of accidents in the past few years, as street safety was not considered by providing crosswalks, with the intersection being designed only for vehicles, not pedestrians. Based on observations, people prefer to cross the street from any part of it illegally rather than using the control point where the police control the traffic. This is due to a number of factors, such as the street being wider in some areas than others, and with cars speeding, the number of people crossing encourages others to do the same.

From observations, the decision to cross the road by pedestrians has been shown to be subject to a range of factors. Firstly, if one of the pedestrians has already begun to cross, others will start to follow; however, other pedestrians cross when the gap between vehicles is not large enough to cross safely. Some pedestrians observing others while crossing may think they have

an opportunity to cross as well without paying attention to oncoming traffic, which may cause an accident. With a lack of crosswalk lights along most Central Makkah streets, this may contribute to the random crossing of the road by pedestrians from side to side that occurs, which increases the number of accidents (Figure 8.6). This suggests that, generally, the missing safety display features, urban design, and technological crossing elements appear to result in this behaviour, so crosswalk lights for pedestrians would help to guarantee that they had enough time to cross the street without thinking about the surrounding traffic. There is only one type of pedestrian crossing device provided, which is the one on Masjid Al-Haram Street north of the Grand Mosque.

Figure 8.10 Pedestrians crossing the street. Source: field observation, 2019.

The findings from the interviews and observations also support the findings from the survey. The results reveal that a large number (69%) of respondents are not satisfied when trying to reach another part of the street, meaning that there are no designated crosswalks for pedestrians to cross safely (Figure 8.11). As was observed, the presence of a crossing device such as a crosswalk or overhead bridge is another important feature that contributes to a sense of safety while crossing the street.

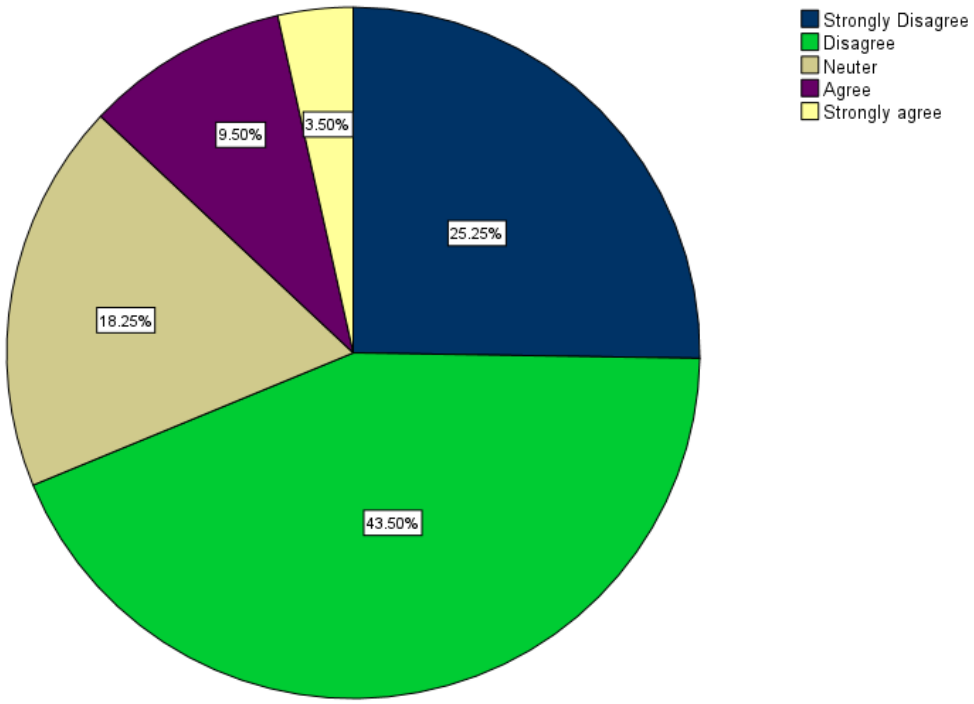

Figure 8.11 Users' perceptions on the degree of availability of crosswalks along Central Makkah streets.

Variations in perception between different socio-demographic backgrounds concerning the availability of the crosswalks along the streets

Based on Table 8.4, since the p values are higher than 0.05 here, it may be concluded that factors concerning availability of crosswalks along the streets do not depend on any of the socio-demographic information, except for the gender and user type, which is explained in more detail below.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Type of user	Between Groups	3.564	4	.891	4.859	.001
	Within Groups	72.426	395	.183		
	Total	75.990	399			
Age	Between Groups	6.657	4	1.664	1.491	.204
	Within Groups	440.853	395	1.116		
	Total	447.510	399			
Gender	Between Groups	1.857	4	.464	2.579	.037
	Within Groups	71.103	395	.180		
	Total	72.960	399			

Nationality	Between Groups	1.684	4	.421	1.965	.099
	Within Groups	84.626	395	.214		
	Total	86.310	399			

Table 8.4 Degree of safety attributes (availability of crosswalks along the streets) based on mean value, which shows no significant difference across all variables.

Variation according to type of user

According to Figure 8.12, it may be concluded that there are variations between the responses concerning availability of crosswalks along the streets that would make the walking experience safer. The result shows that visitors and locals expressed the importance of safety attributes, but the locals demonstrate somewhat more negative responses about this than visitors. Also, the locals' group show more neutral responses. On the other hand, visitors expressed more satisfaction about the availability of crosswalks.

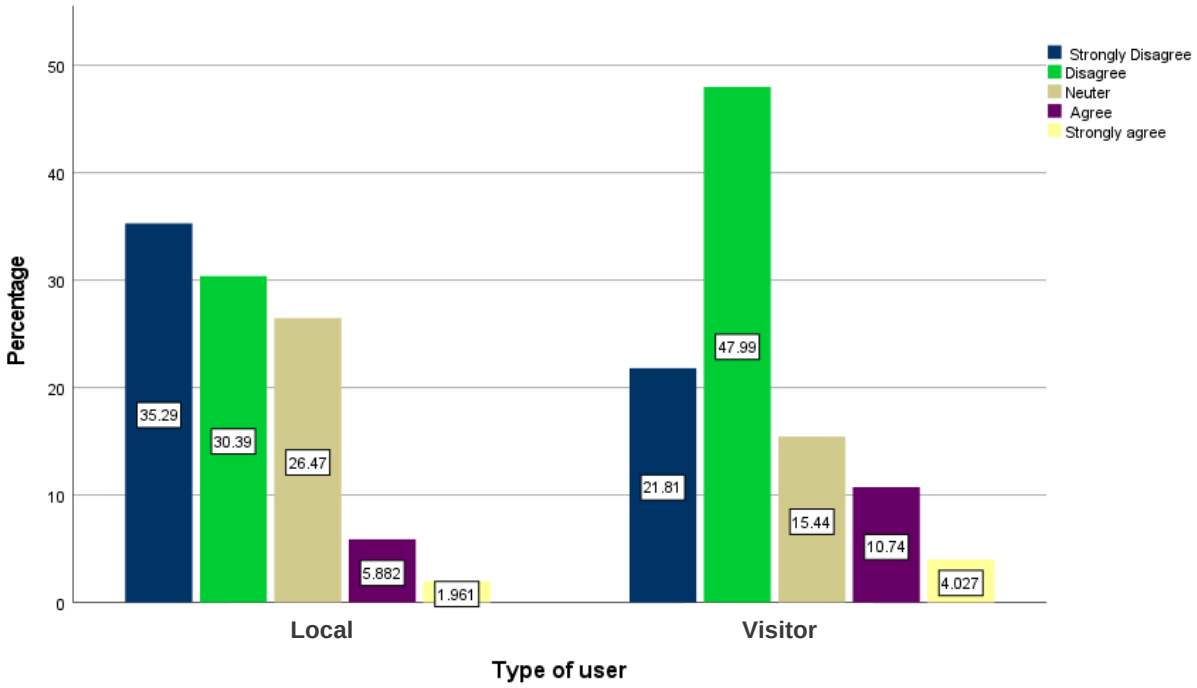

Figure 8.12 Users' perceptions on the degree of availability of crosswalks along Central Makkah streets based on user type.

Variation according to gender

According to Figure 8.13, there are variations in respondents' perception about the availability of crosswalks. There is a slight varation between the two gender groups, where the female group

show more positive responses than males. There is also a slight variation in terms of the negative responses: males demonstrate more negative responses whereas the female group shows fewer.

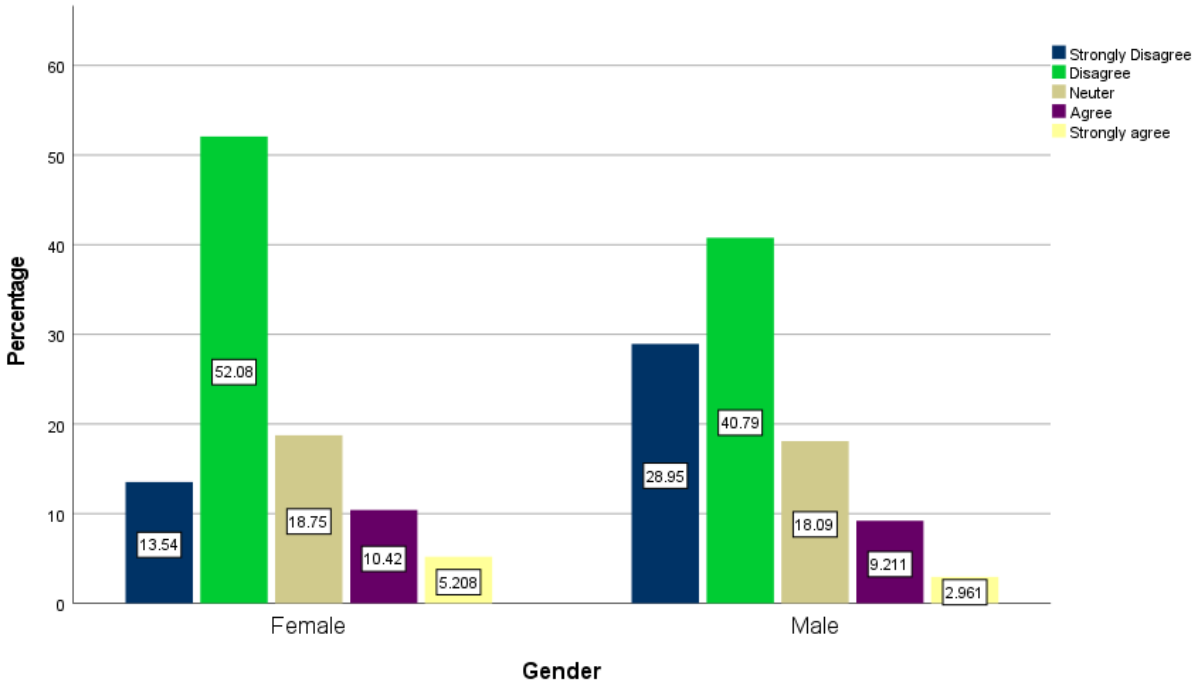

Figure 8.13 Users' perceptions on the degree of availability of crosswalks along Central Makkah streets based on gender.

The need for an inclusive environment for all, free from barriers and obstacles

The physical condition and quality of the environment are linked to a safe environment, making sure that the pavement and sidewalks are maintained and are safe for everyone. A safe environment is one of the substantial attributes that creates safe streets for walking, especially for the elderly, people with disabilities, and children. A respondent mentioned the difficulties using wheelchairs in the area, as follows:

> *"The use of a disabled wheelchair is very difficult here and [it is] necessary to allocate a special route to them because we are forced to use the bridge and cannot enter Al-Haram by the gates and there is a risk crossing the intersections."* – P20

There seemed to be very poor arrangements for groups such as elderly people to use the sidewalks, with accessibility being particularly difficult when the sidewalks are crowded, poorly maintained, and even blocked with merchandise and so on.

The street design additionally attracts the interviewees' attention. From the observation it was demonstrated that the state of the pavements and other street facilities along Central Makkah streets are undesirable to use, especially by elderly people and those users' mobility and other issues due to the quality of the pavement and the lack of features. Consequently, the design standard and materials used in the pavement are not up to the general public's satisfaction, as expressed by the participants:

> *"The elderly need attention to use sidewalks with their wheelchair or even walking."* – P13

> *"Difficulties in using the sidewalks especially for the elderly before the start of the Hajj."* – P16

Based on the observations, the existing physical environment and pedestrian experience agree that the space is not contributing to providing a safe environment for everyone. This is supported by Jacob (1961), who emphasised that safety allows individuals to enjoy, move about, and use the outdoors without fear of tripping or falling. For elderly people and those with mobility and other issues, access to sidewalks is not easy, and there are concerns regarding the quality of the sidewalks, which include clutter along the sidewalks such as lamp posts, shop goods, and waste bins (see Figures 8.14 and 8.15). Cain et al. (2017) found that surface hazards and obstacles correlate with people walking in a negative way, where major obstacles are placed wrongly, such as street furniture, lighting, and many others. Uneven slopes have also been identified as tiring and a limiting factor (see Figure 6.3) for elderly and disabled people, who have the most difficulties in using the space. A few respondents identified uneven terrain as making walking a tiring experience and increasing the amount of time required to reach one's destination.

> *"I can walk for an hour – [or] an hour and a half – and I'm tired with this topography … the topography is making walking more difficult in some areas to go up and down."* – P3

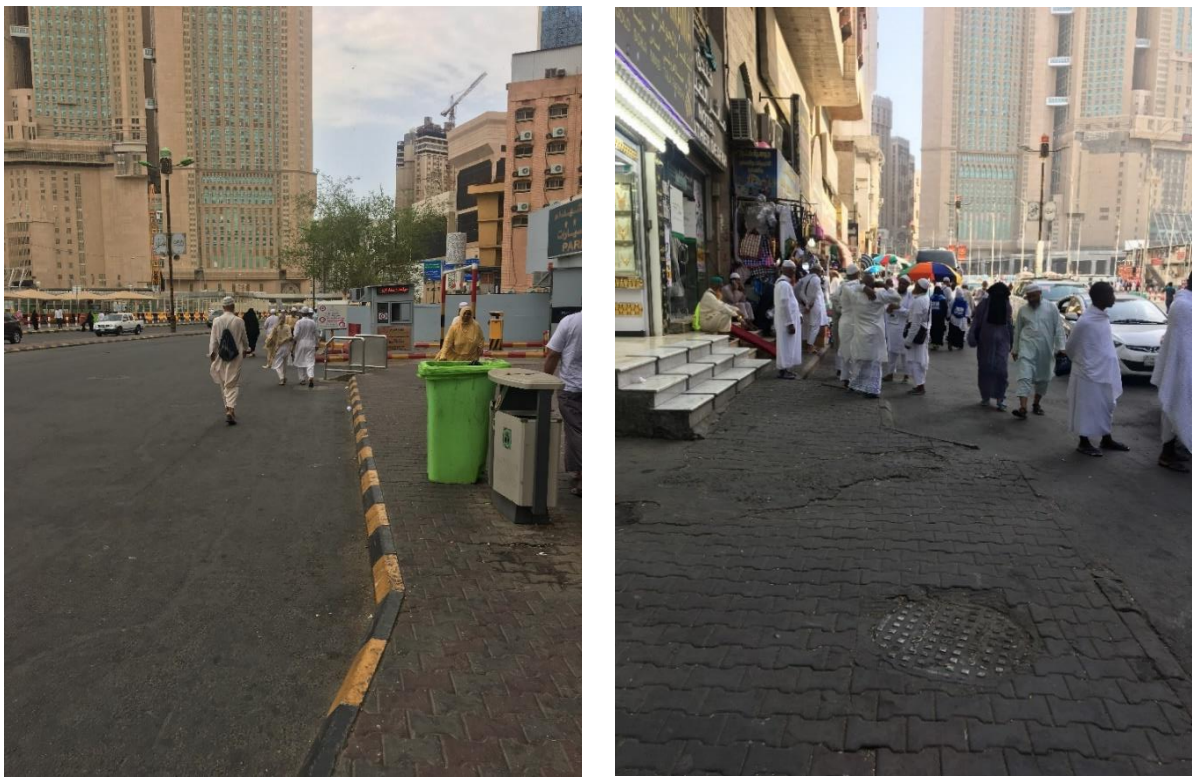

Figure 8.14 Access to sidewalks for wheelchair is not available. Source: Field observation, 2019.

Figure 8.15 Waste bins occupy the middle of the sidewalk and there is clutter along most of the sidewalks. Source: Field observation, 2019.

Based on tracking observations, pedestrians were followed going out of the Masjid Al-Haram to what was assumed to be their residence, with the issue being about using wheelchairs (Figure 8.16):

A couple were out after a prayer time; the woman was pushing the man who was in a wheelchair. The woman had no choice; she walked on the street instead of using poorly connected sidewalks. Among the buses and crowds, she still proceeded, pushing hard on an uneven surface. From her appearance and behaviour, one could assume that she was tired, which became clear as she stopped multiple times. After about 400 metres she gave up and decided to take a taxi to continue their journey to their destination.

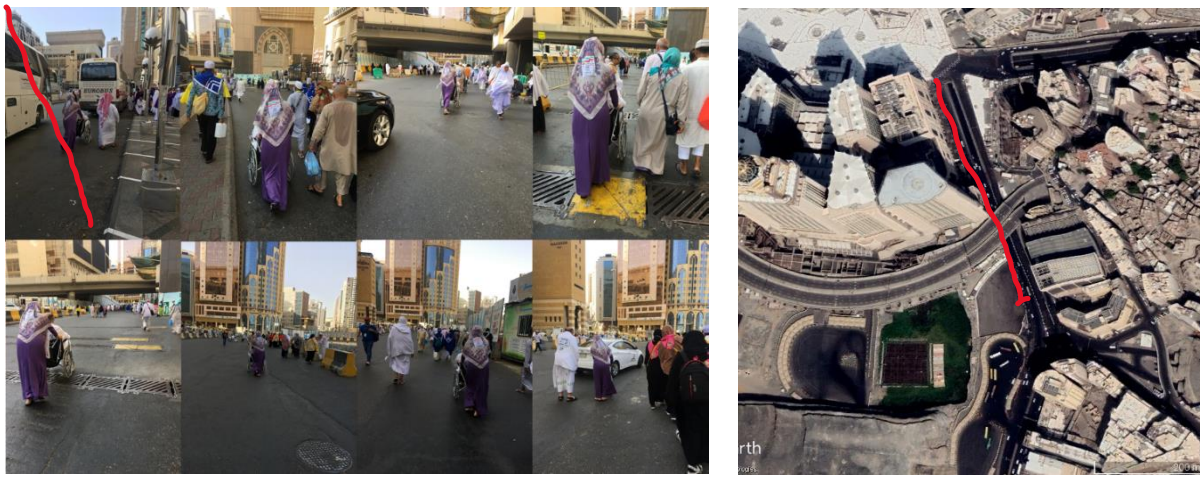

Figure 8.16 Observing pedestrians by tracking them from the Masjid Al-Haram to their residence. Source: Field observation, 2019.

The path network had not been improved with the needs of all users in mind. Some of the most affected groups were the elderly, who used wheelchairs, because the sidewalks were poorly maintained and had bumps, making it hard to use electric wheelchairs, because they had not been levelled.

> *"… the corridor is located in bumps in the pavement and is not fixed; there are elderly people using electric and other vehicles and it is difficult to use the pavement for that…"* – E9

Also, the pavement materials were not user-friendly to blind pedestrians.

Most people with wheelchairs were observed using the streets instead of the available sidewalks. As such, the quality of the current physical features of sidewalks, such as width and pavement condition, contribute to encouraging more use of the street, which is unsafe. The

findings from interviews and observations also supported the findings from the survey. The results show that almost 60% of respondents were not satisfied and claimed that the current sidewalks were not suitable for people with mobility issues, meaning that there are no designated spaces for those people to use the sidewalk safely (Figure 8.17).

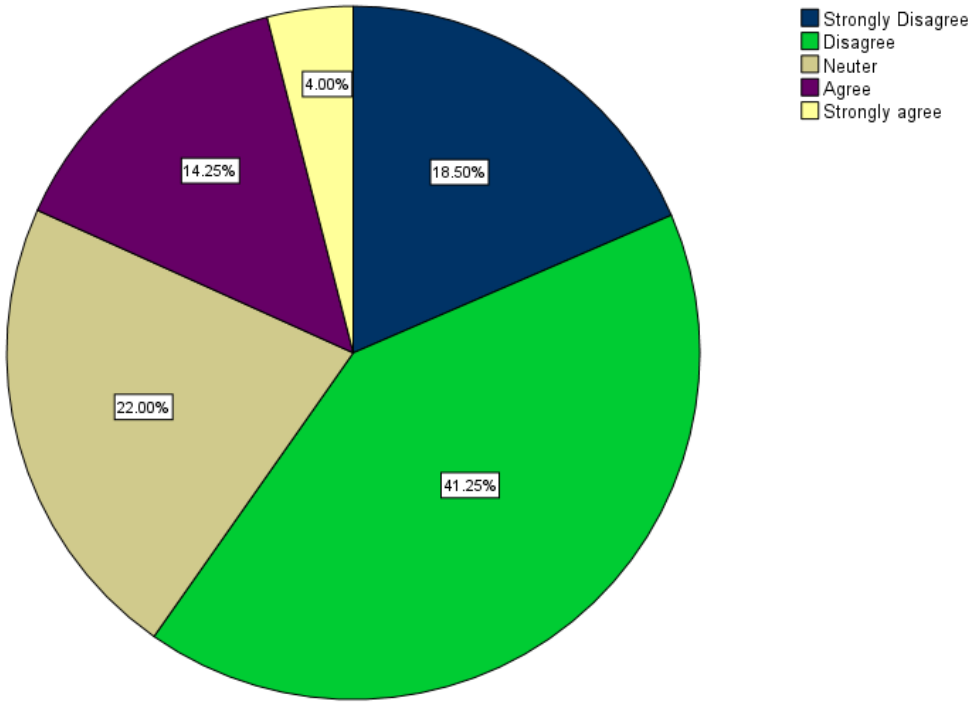

Figure 8.17 Users' perceptions on the degree of satisfaction about whether current sidewalks were suitable for pedestrians with special needs and mobility issues.

Variations in perception between different socio-demographic backgrounds concerning access for people with mobility issues

Since the p values are higher than 0.05 here for some variables, it may be concluded that variables that concern access for people with mobility issues do not have significant differences except for the type of user and age group variables, which is explained below in more detail in Table 8.5.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Type of user	Between Groups	2.550	4	.637	3.428	.009
	Within Groups	73.440	395	.186		
	Total	75.990	399			
Age	Between Groups	8.964	4	2.241	2.018	.001

	Within Groups	438.546	395	1.110		
	Total	447.510	399			
Gender	Between Groups	1.356	4	.339	1.869	.115
	Within Groups	71.604	395	.181		
	Total	72.960	399			
Nationality	Between Groups	.768	4	.192	.887	.472
	Within Groups	85.542	395	.217		
	Total	86.310	399			

Table 8.5 Degree of safety attributes (current sidewalks suitable for pedestrians with special needs and mobility issues) based on mean value, which shows a significant difference in some variables.

Variation according to user type

According to Figure 8.18, there is a variation in the respondents' perception between locals and visitors. There is a slight variation between the two groups in a negative way, in that visitors show more disagreement and strongly agree compared with locals, but at the same time the locals were more neutral.

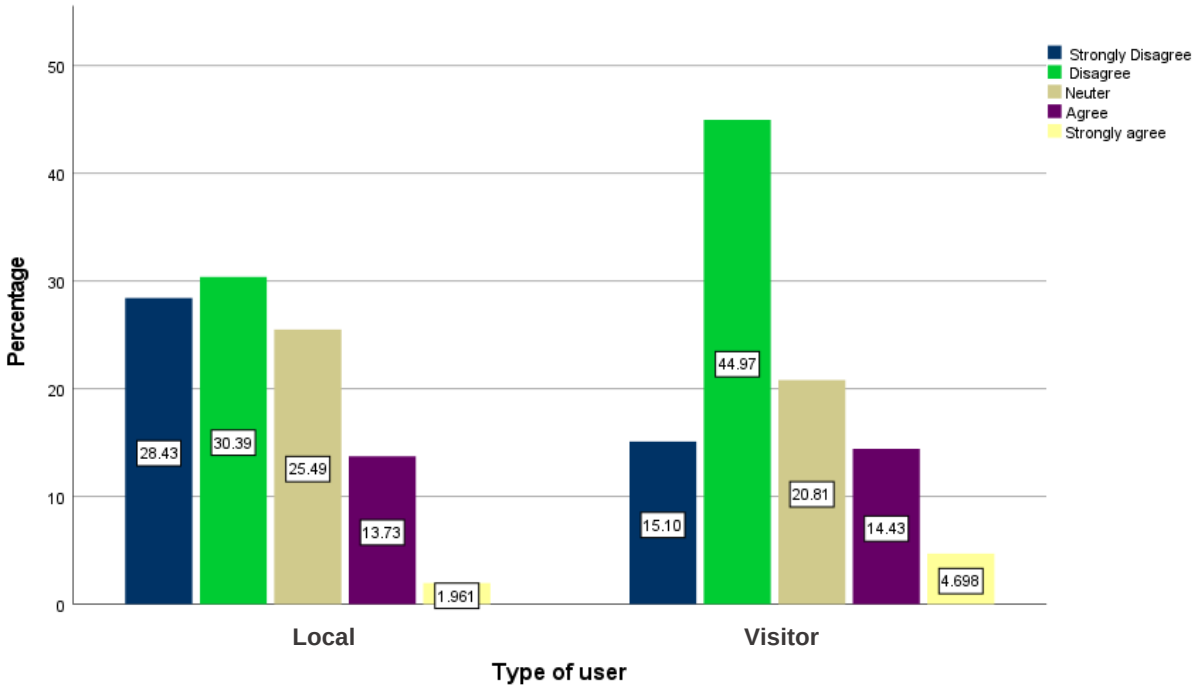

Figure 8.18 Users' perceptions on the degree of satisfaction about current sidewalks and their suitability for users with mobility difficulties.

Variation according to age group

The results from the survey indicate that the access to sidewalks is not equal for everyone, as people in wheelchairs or with other mobility issues have no access compared with others, meaning that the sidewalks were not designed for all users as they should be. It can be seen that the p value is smaller than 0.05, from which one may conclude that the age group and access for people with mobility issues have a strong relationship (see Table 8.6). It was observed that most people who either disagreed or strongly disagreed with the statement about the sidewalks being suitable for disabled use were in the 41–50 and above 50 age groups, and believed that the area did not provide a safe environment during their visit, whereas the 20–30 age group showed more satisfaction than others (Figure 8.19). This support the findings from Papaioannou et al. (2007) study which revealed that the key reason pedestrians believe that they are endangered and do not cross the road fast enough. Most people over 50 find it challenging to cross the road and those aged 66–80 feel unsafe. These pedestrians perceived the current sidewalks as uninviting and unsafe for them, which might affect and limit the use of the street when considering different physical needs for walkable streets compared with other age groups (Appendix G).

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	30.703[a]	12	.002
Likelihood Ratio	33.143	12	.001
Linear-by-Linear Association	7.468	1	.006
N of Valid Cases	400		

a. 4 cells (20.0%) have expected count less than 5. The minimum expected count is 3.44.

Table 8.6 Chi-square test result on existence of appropriate corridors adjacent to or separate from public streets based on age group.

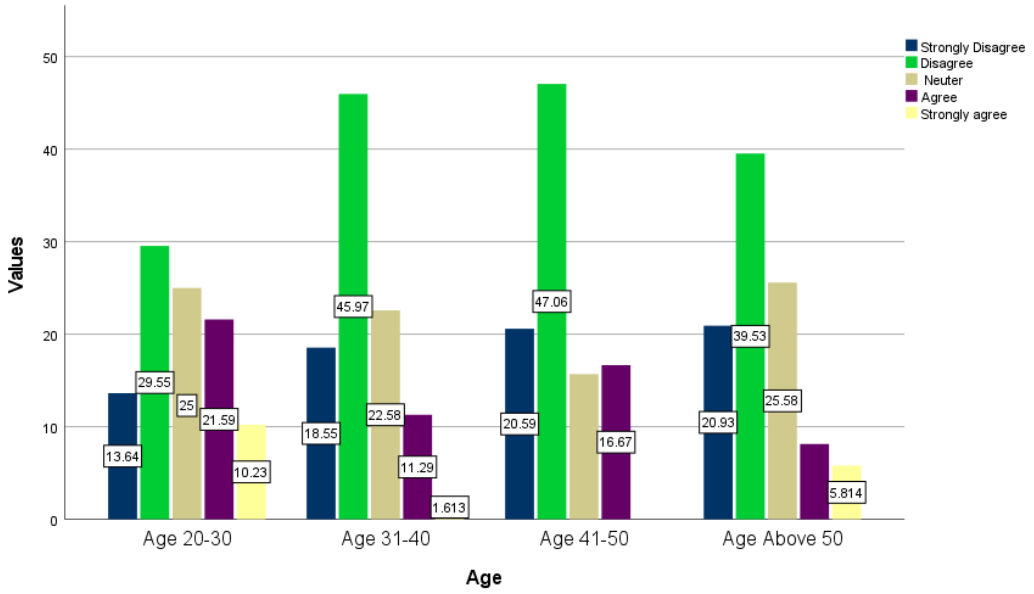

Figure 8.19 Users' perceptions on the degree of satisfaction about the suitability of current sidewalks for pedestrians with special needs and mobility issues based on age group.

Presence of police surveillance

The presence of the police all the time is one of the attributes that increases the sense of safety for pedestrians. In such a crowded area, the presence of police on the street is required to ensure a safe environment for visitors. These police officers are assigned to the Grand Mosque. People visiting Al Haram have full faith and believe they are in the holiest place in the world and place their complete trust in, firstly, God, and then depend on the existence of police surveillance. Some respondents felt that walking had improved significantly with time, and that the presence of traffic officers that controlled movement helped to ensure that traffic was flowing with ease.

> *"The experience of walking is now better [because of] emergency forces and Hajj security, who in turn organise the movement and others."* – P18

As a result, the existence of police monitoring and security officials is necessary for pedestrians to believe that they are safe walking along the street. It is subjective to discuss feelings of safety, as these are unique to different individuals. Based on observations, there are many police officers in the central area specifically to control and guide the crowd, especially during peak times, as this can increase the sense of security while increasing the use of the street (Figure 8.20).

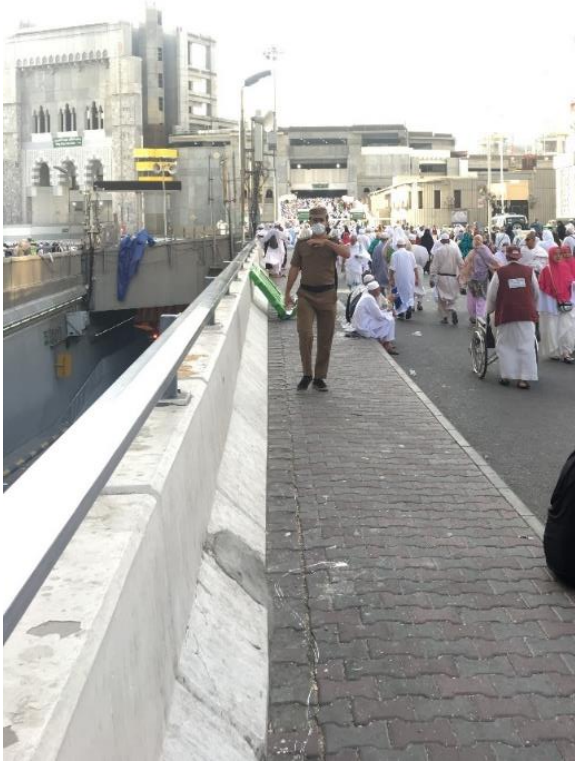

Figure 8.20 Police are available 24 hours a day on the streets. Source: Field observation, 2019.

Safety during the day

The value of security and police presence is reinforced by the survey's findings conducted, where respondents provided information regarding feeling safe during the day and night. During the day, 62.5% of respondents agreed that they felt safe, while 18.5% disagreed and perceived the environment to be less safe (Figure 8.21).

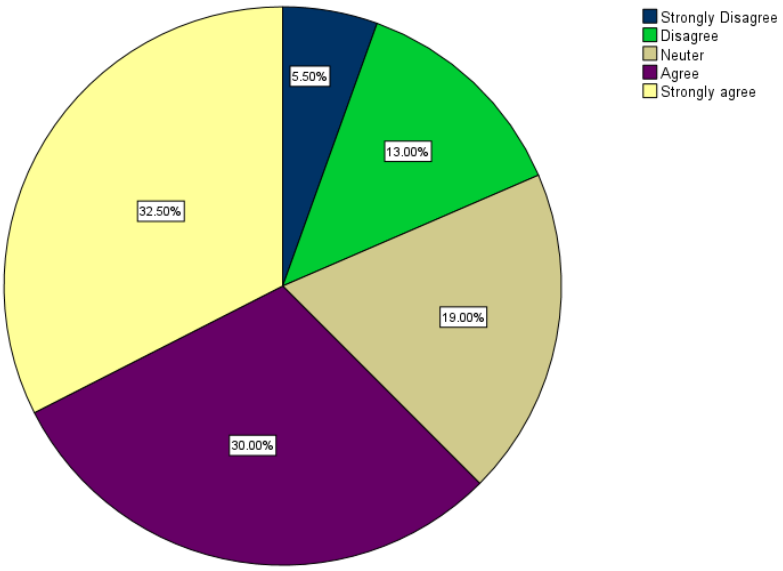

Figure 8.21 Users' perceptions on the degree of satisfaction about safety during the day.

Variations in perception between different socio-demographic backgrounds concerning feeling safe during the day

According to Table 8.7, it may be concluded that variables that concern safety during the day do not have significant differences except for the type of user and age group variables, which is explained below in more detail.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Type of user	Between Groups	2.040	4	.510	2.725	.029
	Within Groups	73.950	395	.187		
	Total	75.990	399			
Age	Between Groups	16.807	4	4.202	3.853	.004
	Within Groups	430.703	395	1.090		
	Total	447.510	399			
Gender	Between Groups	.275	4	.069	.374	.828
	Within Groups	72.685	395	.184		
	Total	72.960	399			
Nationality	Between Groups	1.066	4	.267	1.235	.295
	Within Groups	85.244	395	.216		
	Total	86.310	399			

Table 8.7 Degree of safety attributes (safety during the day) based on mean value, which shows a significant difference in some variables.

According to Figure 8.22, there are variations in the respondents' perceptions between residents and visitors. There is a slight variation between the two groups in a positive way in that residents show more satisfaction about safety, while the visitors show more dissatisfaction, which might be due to the crowd at certain times during the day.

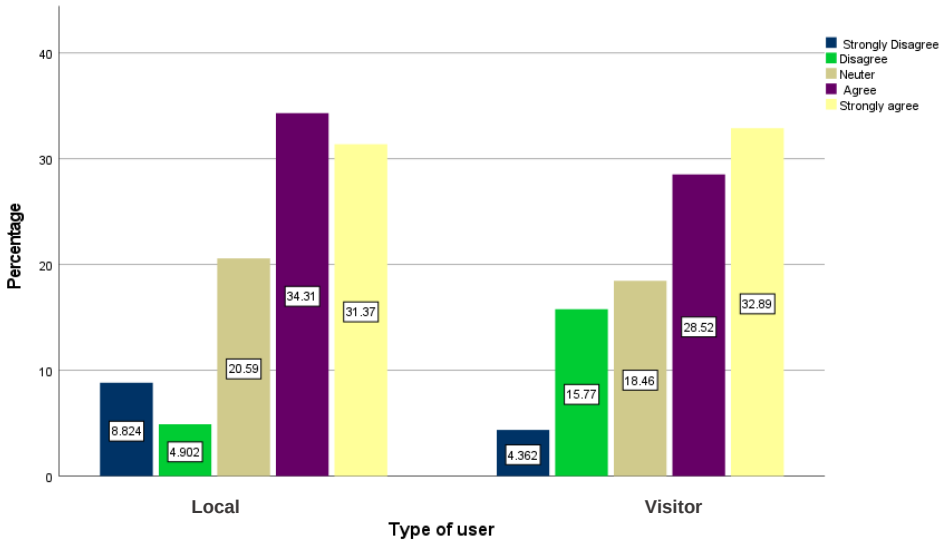

Figure 8.22 Users' perceptions on the degree of satisfaction concerning safety during the day based on type of user.

Variation according to Age

According to Figure 8.23, it may be concluded that the feeling of safety varies between age groups and that feeling safe during the day is very highly significant based on age groups. It was observed that most people who are satisfied and disagree less are from the 20–30 and 31–40 age groups, and demonstrate that they are more neutral than disagreeing, which might be because they have no issues during the day. In contrast, it is clear that as people's age increases, their feelings of safety become lower. For example, the 41–50 age group shows a slight difference in responses between agreeing and disagreeing, while those aged above 50 demonstrate more disagreement. The reasons for the higher level of disagreement in these responses support the finding by Burton et al. (2006), who discovered that difficulty walking, fear of falling, and fear of becoming lost are among the causes. It may be concluded that as people's age increases, they believe that they are not safe walking along sidewalks during the day, with the majority of elderly people agreeing with this.

Based on observations, this group (the over 50s) has a relatively small number of users walking at night, whereas during the daytime there are more. Regarding daytime and night-time activities, the 20–30 age group provided the most positive responses, followed by those aged 31–40. This confirms the findings by Carr et al. (1992) that it is difficult for older people to tolerate many activities in a particular place. Furthermore, the elderly group have different perceptions and have particular physical needs when walking relative to other age groups. Turel et al. (2007) accepts this assertion, stating that safety is therefore one of the main public space problems found by the elderly, as shown in their study in the district of Bornova in Turkey.

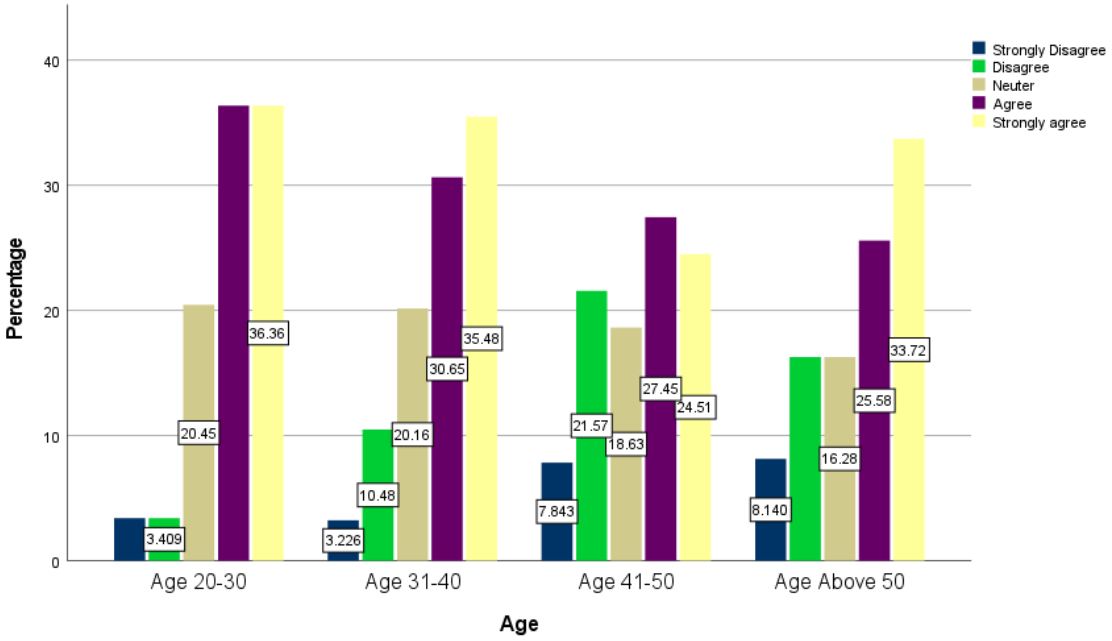

Figure 8.23 Users' perceptions on the degree of satisfaction about safety during the day based on age group.

Safety at night

In the results of the survey regarding feeling safe at night, the respondents agreed (55%) that they felt safe, which is lower compared with the daytime, while 22.25% disagreed and perceived the environment as less safe (Figure 8.24).

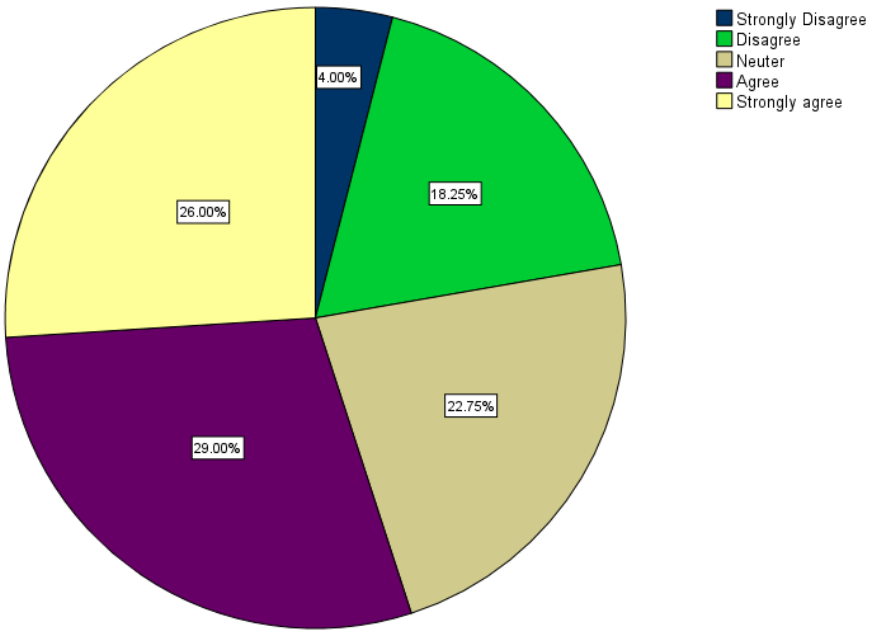

Figure 8.24 Users' perceptions on the degree of satisfaction concerning safety at night.

Variations in perception between different socio-demographic backgrounds concerning feeling safe at night

According to Table 8.8, it may be concluded that variables that concern safety at night do not have significant differences, except for the type of user, which is very highly significant. This will be explained below in more detail.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Type of user	Between Groups	3.171	4	.793	4.300	.002
	Within Groups	72.819	395	.184		
	Total	75.990	399			
Age	Between Groups	7.523	4	1.881	1.688	.152
	Within Groups	439.987	395	1.114		
	Total	447.510	399			
Gender	Between Groups	1.671	4	.418	2.314	.057
	Within Groups	71.289	395	.180		
	Total	72.960	399			
Nationality	Between Groups	1.430	4	.357	1.663	.158
	Within Groups	84.880	395	.215		
	Total	86.310	399			

Table 8.8 Degree of safety attributes (safety at night) based on mean value, which shows a significant difference in some variables.

Variation according to type of user

According to Figure 8.25, there is a variation in respondents' perceptions between locals and visitors. The variation between the two groups is that locals show more satisfaction about safety at night whereas the visitors show more dissatisfaction, which might be because visitors are not familiar with area compared with the locals. Also, the poor light during the night may contribute to them feeling unsafe.

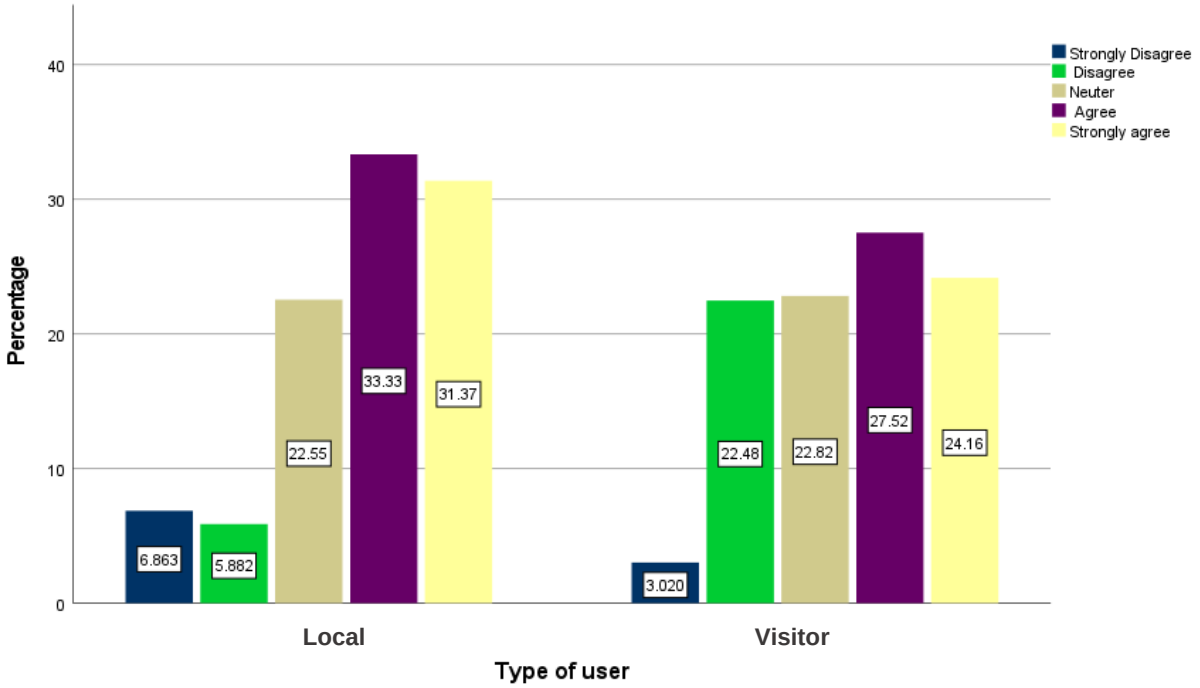

Figure 8.25 Users' perceptions on the degree of satisfaction about safety during at night based on user type.

Increased number of eyes on the street

Based on observations, the increased number of pedestrians and visibility of the street from residents' windows or doors increase the sense of safety for pedestrians (see Figure 8.26). There is no time where there are no people on the street, and while the Masjid Al-Haram is open, visitors may visit at any time, so the streets are never empty. In addition, the ban on private cars in the Central Makkah area has helped to decongest the area and improve pedestrian flow.

However, the sustainability of this approach was questionable. As one respondent noted, the level of congestion was still high as the number of pedestrians had increased.

"The walking experience is currently better than before because currently [the number of] cars are fewer, but the number of people has increased." – P7

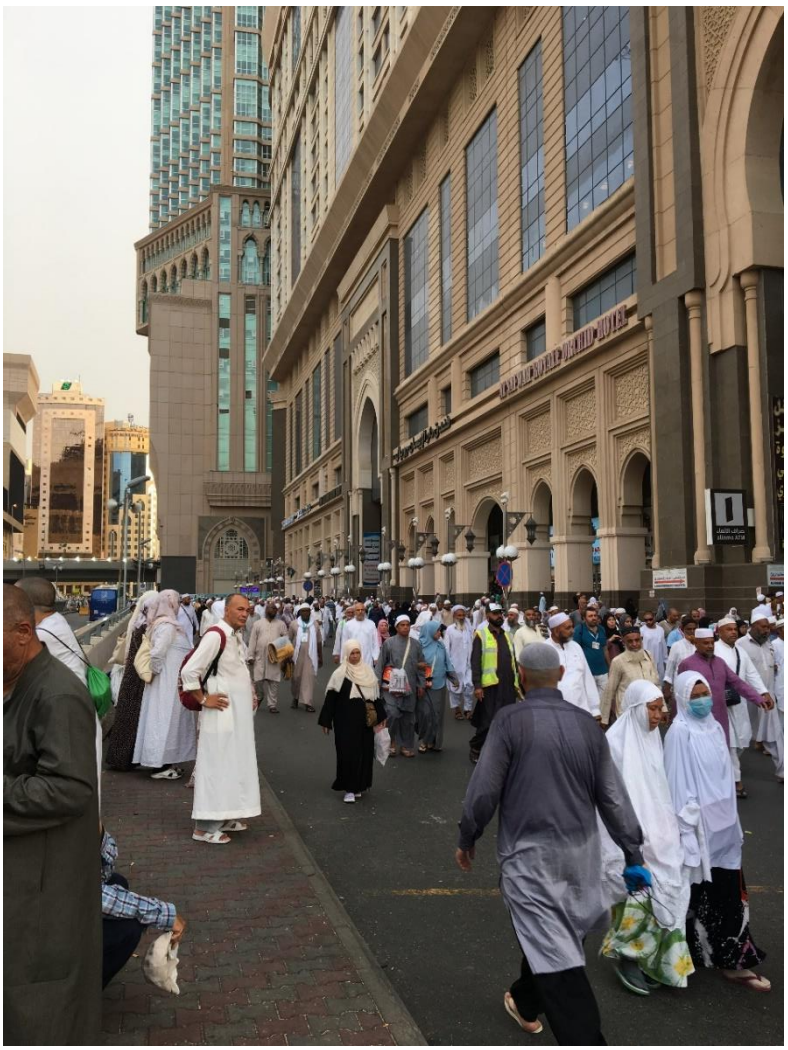

Figure 8.26 The large number of pilgrims and windows increase the number of eyes on the street. Source: Field observation, 2019.

Places to sit and relax

Most of the respondents felt that the sidewalks had not been designed in a way to encourage walking for social interaction. First and foremost, they lacked sidewalk seating where people could relax and interact with other pedestrians, and since pedestrians were always walking, they

might not have been approachable. Finally, there was a lack of social activities to bring people together and enhance interaction. In the interviews, most of the respondents mentioned the need to provide places for people to sit and rest such as chairs or benches.

> *"The area is not socially encouraging … we need chairs and umbrellas, and it is possible to create an intellectual and cultural forum where cultures are exchanged among Muslims from all countries of the world."* – P13

Most respondents said that they preferred to limit social interactions to indoors, where there was a likelihood of meeting groups eager to interact.

> *"The area is not encouraging, but if it has chairs, it is better to leave [them] inside a building where people can talk to each other as groups."* – P19

Others suggested standing or sitting on the stairway:

> *"The environment is encouraging [people] to communicate, because everyone can talk to each other and for example can stand or sit on the stairs sometimes."* – P17

The results from the observations reveal that most of the sidewalks have not been designed in a way to invite pedestrians to socialise. The lack of seats where pedestrians might relax and interact with each other is another feature that is missing in most parts of the streets. People always sit on stairs and even on the kerb to catch their breath or relax, often without paying attention, which is dangerous due to the presence of many cars and buses.

Most people prefer to sit under cover or in areas that have shade, and so the seating location is important in order to provide comfortable walking for pedestrians. However, when placing seating in the area, other street furniture such as lights, the width of sidewalks, and even the purpose of waiting areas should be carefully considered, For example, in many Southern European cities, specifically in the *campo* in Siena, square bollards are found as well-defined supports for standing and longer stays (Gehl, 2011) (see Figure 8.28). According to Whyte (1980), a 'sittable place' is one that provides access to sunshine, trees, food, and water, along with other amenities. Whyte (ibid, p.28) emphasised this argument by stating that it is specifically linked to "sitting up front, in back, to the side, in the sun, in the shade, in groups, off alone".

According to the survey, pedestrians' perceptions of public facilities such as seating or rest areas show little satisfaction about the current conditions of the sidewalks, as they do not meet the needs for comfort of pedestrians walking to the Masjid Al-Haram. The journey of pilgrims from their residences/hotels differs from person to person, and with some people not being able to walk without talking a rest, 72.5% showed dissatisfaction about the area not providing places to sit and relax (see Figure 8.27).

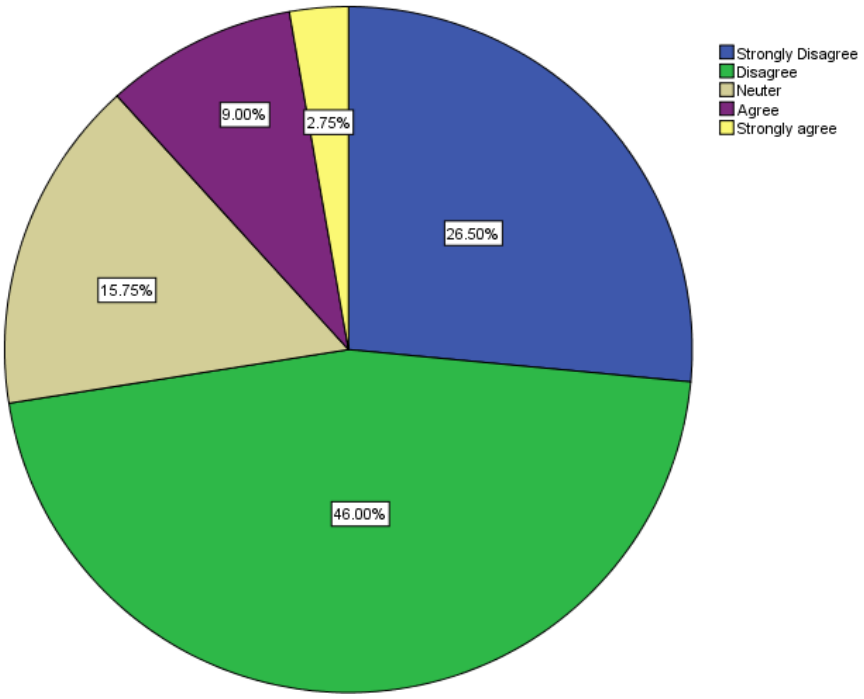

Figure 8.27 Users' perceptions of the degree of satisfaction concerning seating facilities in Central Makkah.

Figure 8.28 People sitting where there is no designated place to sit. Source: Field observation, 2019.

Variations between different socio-demographic backgrounds concerning the availability of seating facilities along Central Makkah streets

Based on Table 8.9, since the p values are less than 0.05 here, it may be concluded that factors concerning availability of seating facilities along Central Makkah streets do not depend on socio-demographic information, except for gender. The results in the table show the socio-demographic information of the respondents who expressed an opinion about the availability of seating facilities, which indicates that all the respondents were concerned and perceived this issue, where there is only a variation in one variable.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Type of user	Between Groups	1.596	4	.399	2.119	.078
	Within Groups	74.394	395	.188		
	Total	75.990	399			
Age	Between Groups	3.764	4	.941	.838	.502
	Within Groups	443.746	395	1.123		
	Total	447.510	399			

Gender	Between Groups	2.450	4	.612	3.431	.009
	Within Groups	70.510	395	.179		
	Total	72.960	399			
Nationality	Between Groups	1.419	4	.355	1.651	.161
	Within Groups	84.891	395	.215		
	Total	86.310	399			

Table 8.9 Degree of comfort attributes (availability of seating facilities along Central Makkah streets) based on mean value, which shows a significant difference in gender.

Variation according to gender

Figure 8.29 shows that there is a slight difference between the gender groups in terms of the availability of seats and rest areas along the Central Makkah streets. The two groups perceived a time preference for the availability of seating and rest areas. In detail, the dissatisfaction seems to be slightly different between the two groups and is more negative for females.

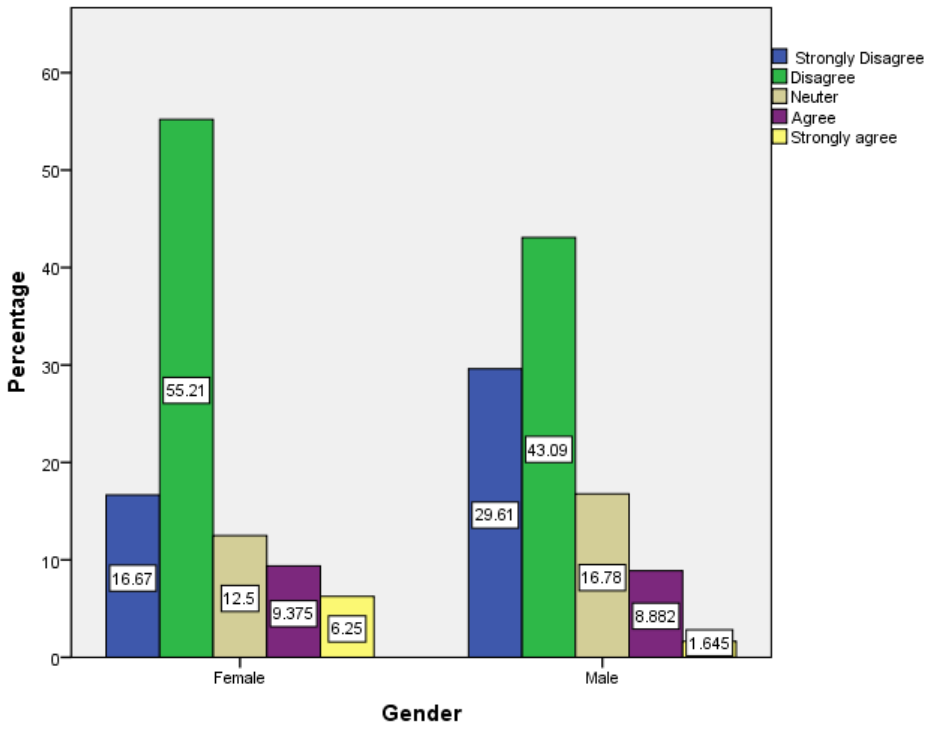

Figure 8.29 Users' perceptions on the degree of satisfaction concerning availability of seating facilities along Central Makkah streets based on gender.

8.3 Conclusion

The aim of this chapter is to explores the relationship between physical characteristics and socio-cultural and psychological issues that influence people's decision-making, with specific reference to Makkah and the Umrah/Hajj pilgrimage, when using streets in Central Makkah. These are often used to assess the similarities and disparities in walkability-related perceptions of attributes. The differences in perception between different socio-demographic contexts were studied in order to assess if these variables had any effect on perception.

In the present study, the social attributes linked play the most profound role in encouraging walkability. Under safety aspects, the level of congestion, freedom from accidents, safe crossing methods, the need for an inclusive environment for all that is free from barriers and obstacles, and security of place are the most critical attributes based on respondents' perceptions of what adds to the street's walkability. The results from the analysis show that safety attributes influence walking decisions where certain feelings and experiences and behaviour occur in response to the physical environment in the Central Makkah area. People should never be pushed or feel uncomfortable while walking; however, the current sidewalks force some behaviours that can lead to harm to pedestrians. Walking to the Grand Mosque is the only method of access for able-bodied visitors and is also the only way to get to the gates of the mosque. The decision to walk depends on the freedom and choice of every pilgrim and resident in the central area, so negative behaviour may be as a result of forceful engagement where there is no choice or freedom to behave appropriately. The experience and behaviour of pedestrians may be a psychological result of reacting to an unpleasant feeling, which leads to certain behaviours concerning the safety of the walking environment (Risser & Šucha, 2020).

Under variations of perceptions of social factors that influence walkability, visitors and locals mostly perceived the physical characteristics of place more negatively. In the findings of variations in perception between different socio-cultural groups, there were some significant differences found. The visitor and local groups expresses similar views regarding the most crucial attribute relating the safety of the environment, slight variations and significant differences were found in attributes such as the availability of crosswalks on streets, a suitable environment for people with mobility issues, and a feeling of safety during the day and the night. There were significant differences between age groups who showed concern that the environment was not supporting all ages, especially people with mobility issues, and those who

did not feel safe during the day. The only differences concerning the gender variable were the attributes that related to the availability of crosswalks on streets, which was more negatively perceived by males. Both types of user showed similar perceptions of current sidewalks and how suitable these were for users with mobility issues. Regarding age group, there was a strong association between age and this variable, which demonstrated more dissatisfaction about whether the current environment was suitable for users with mobility issues; the 41–50 and over 50 age groups believed that the area did not provide a safe environment during their visit, while the 20–30 age group showed more satisfaction than others. The perception of safety during the day varied according to type of user and age. There is also a variation in the respondents' perception between locals and visitors. There is a slight variation between the two groups in a positive way, in that locals showed more satisfaction about safety while the visitors demonstrated more dissatisfaction. Regarding age group, people who were satisfied and disagreed less were in the 20–30 and 31–40 age groups, and demonstrated more neutral attitudes than disagreement; this might be because they had no issues during the day, whereas in contrast, it is clear that as people's age increases, their feelings of safety are lower. On the other hand, safety during the night varies according to the type of user, where locals show more satisfaction about safety at night while the visitors demonstrate more dissatisfaction. Respondents showed dissatisfaction about the availability of public facilities such as seating or rest areas, and there are variations in responses according to gender, where the females show a more negative response.

The following chapter provides a summary of the significant findings from the earlier chapters. It also emphasizes the study's contribution and limitations. Finally, it provides general recommendations and suggestions for future research.

Chapter 9. Conclusions and Recommendations

9.1 Introduction

This chapter provides a summary of the thesis's key results, as well as the research's conclusions and recommendations. This chapter is divided into eight sections (after this one). The first section summarises the research agenda as well as the approaches that have been followed. The second section reviews the main findings of the research, which include how this research answers the questions that have been raised from the beginning. The third section discusses what the research has contributed to current knowledge, followed by the significance of the research, which explains its importance and how it will impact the research field. The fifth section explains what these findings might imply for urban design in the context of Central Makkah. The sixth part presents the limitations of the research, before the last part, which provides ideas for further research in areas that may be achievable. The final section summarises the whole research and provides recommendations for further research.

9.2 Research approach/agenda

The focus of this thesis is to explore and examine the walkability of Central Makkah from the experience, behaviour, and evaluation of pedestrians. In order to do so, it was important to identify the features and elements that contribute to making urban streets walkable, specifically in the context of Makkah city centre. Furthermore, the research pursues to identify the physical and perceptual characteristics that have an effect on people's usage of central area streets, as well as people's preferences regarding the street features and qualities that influence people's decision whether walk or not to walk. The characteristics of walkable streets were determined in this research using indicators that captured users' activities on the street and how they utilised it, as well as crucial qualities emphasised by respondents. Moreover, the differences and similarities regarding how a diverse array of users interact with the street, as were explored, as were their perceptions of the features and qualities related to the walkable streets.

According to Southworth (2005), a walkable street is a space that is of high quality and meets the criteria of all of its visitors. The assumption is that in the course of carrying out this research,

the characteristics that meet the needs of users will be included in those associated with walkable streets. In Chapters 2 and 3 a thorough review of the literature was conducted to identify the most important concerns that were significant to this research. According to this review, it was determined that the characteristics of a walkable street are composed of three major components:

- the environmental,
- the physical, and
- the social.

There are differences in the behaviours and needs of street users across various categories of users and those with varying socio-demographic backgrounds., as well as between different age groups. According to prior research, there has not been a specific study on the needs of users of streets in hot, arid climates, nor on the needs of users of urban streets in Makkah in particular, nor in connection to walkable streets in a similar environment. The majority of prior researches on user need have focused on urban areas, including parks, plazas, and squares in Western and European countries. Even though some researchers focussed on the characteristics of a walkable street, the majority of those concentrated on the physical environment and human behaviour instead of the present users' needs in a given context. It was decided to use the case study of Central Makkah streets as the basis for this research since it is one of the most important sets of urban streets in Makkah Al-Mukarmah city centre. Chapter 5 provided a detailed explanation of the case study's historical and contextual setting. Using the triangulation approach, the findings of the questionnaire and the analysis were reported in Chapters 6, 7, and 8. Specifically, there is **one** primary aim and approach that was used to fulfil the objectives of this research:

9.2.1 ***Relevance of the concept of walkability in a hot, arid climate***

Based on preliminary investigation and previous research, the examination focused on the physical features that create a walkable street for its users, which will be discussed in detail below. The characteristics examined in this study fall under the categories of environmental factors. Moreover, the examination helps to identify the limiting factors that may affect the walkability of the area and user needs. The findings of the observations and interviews were cross-analysed with the results of a face-to-face questionnaire.

9.2.2 ***Pedestrian behaviour and people's perceptions of comfort levels while walking in public spaces***

The factors that contribute to a walkable street were examined in light of the behaviour, perceptions, and the needs of the street's users - what drives users to walk more comfortably or not walk on the street, and why? A cross analysis of the findings was done in comparison to findings from observation (functional and physical) as well as the data from interviews with users in order to determine the factors contributing to walkable streets in the comfort context.

9.2.3 ***Physical characteristics that may encourage/discourage walkability in a hot, arid climate, and specifically in Makkah***

The thesis explored the physical characteristics that makes a street walkable may be correlated to the way pedestrians use the street, what makes them desist from using the street, and what might encourage them to use it more often. The current conditions were examined through the cross-analysis of observations and interviews with the face-to-face questionnaire of pedestrian behaviour and experiences of pedestrians walking in the study area.

9.2.4 ***Relationship between physical characteristics and cultural, psychological issues that influence people's decision-making with specific reference to Makkah and the Hajj pilgrimage***

The thesis explored the relationship between physical and socio-cultural characteristics and psychological issues that influence people's decision-making, with specific reference to Makkah and the Hajj pilgrimage using streets in Central Makkah. Chi-square test was applied to examine the significant associations between variables and attributes in the survey with the goal of discovering the variations in the walkability of streets for users with varying socio-demographic backgrounds. The findings from the interviews and observations were cross analysed with the survey, which revealed a statistically significant association between attributes.

9.3 Key Findings

Data collection and analysis were conducted using a mixed method approach and strategy. To obtain trustworthy conclusions, data from several sources – physical observation and activity observation on-site, interviews, and the questionnaire survey – were gathered, interpreted, analysed, and triangulated. Three major conclusions are highlighted in the analysis based on the research. The first key finding refers to the environmental factors that influence walkability – those such as temperature and topography were the most limiting factors – as well as the attributes and characteristics of comfort that contribute to a walkable street. The second finding refers to the physical characteristics of the street that contribute to its walkability. The third refers to differences in perceptions and demands of street characteristics and feature among diverse user types with varying socio-demographic backgrounds. The following are the thesis's main findings:

9.3.1 ***Environmental factors***

Under environmental factors that influencing walkability: factors such as temperature and topography were the most limiting factors. The characteristics that relate to environmental conditions, such as sun protection were very important attributes that people need. This also demonstrates how important microclimate and psychological comfort are in a hot, arid area like Saudi Arabia.

It was discovered that in the case of central Makkah streets the environmental attributes, like protection from the were very important attributes that people need. This can also be read to mean that in a country that is arid and hot such as Saudi Arabia, matters linked to psychological comfort and microclimate are vital.

To an extent, these findings support previous research (Westerberg et al., 2003; Bergström, 2004; Gehl, 2010; Mehta, 2008) that stressed that good weather is one of the most important criteria to ensure ease of people's mobility, which supports the use of the outdoor enviornment. However, this research identifies that too much exposure to the sun and high temperatures are a core factor in relation to walkability and that previous studies have not focused on this condition.

Covered pathways, a reasonable temperature, places to sit and rest, and adequate sidewalk width all contribute to a sense of comfort and convenience. The findings indicate that comfort attributes impact walking decisions in areas of Central Makkah where particular feelings, experiences, and behaviours occur in response to the physical environment. This may be due to the unique environment, climate, or culture of the location, in contrast to earlier research. It was discovered that in the case of Central Makkah streets, the impact of street design, particularly the width of sidewalks, is severe due to the design itself or the presence of merchants on the majority of sidewalks and covered routes (trees/canopies). This confirms the statements by Southworth (2006) and Alfonzo (2005), who mentioned the environmental qualities and design that support and promote walkability and that may have an effect on people's level of comfort.

It was found that in the case of Central Makkah streets, there is a great need for covered paths (trees/canopies) to protect people from the sun and make their walking comfortable. The factors that contribute to the walkability of streets in this study were mostly consistent with prior studies, but demonstrate the limiting impact of exposure to the sun. The factors themselves, therefore, change according to context. The factors that contribute to a street's comfort in Saudi Arabia may vary from those that do so in other countries, particularly those with a distinct climate and economic status.

9.3.2 ***Physical factors***

It was found that in the case of Central Makkah streets, the issues relating to street design, especially the width of the sidewalks, in terms of the design itself or the presence of merchants on most of the sidewalks, are significant. This contributes to the street's feeling of overcrowding and poor design, which causes the street to become uncomfortable for walking, thus creating a feeling of stress and an unsafe environment also.

Street design: it was discovered that the streets are mostly car orientated and the sidewalks only take up a small portion of the area of most of the Central Makkah streets around the Grand Mosque. Many scholars such as Oktay (1990), Cullen (1996), Moughtin (2007), Kumar (2009), and Carmona et al. (2010) emphasised the importance of street design, which plays an important role in encouraging walkabilty. However, this study demonstrates that buildings' heights benefit the street, as they may provide shade to pedestrians, which has not been mentioned in earlier studies.

It was discovered that in the case of Central Makkah streets, the issue relating to street design, especially the quality of sidewalks (accessibility and connectivity), is serious and explains the importance of city design and why it should be prioritised over vehicles. The findings show that accessibility and connectivity are important factors that encourage walking, but in the current environment they are not fully supported. The findings also revealed that there may be differences in people's ability to walk and proximity between users depending on their age, which may explain the variances in these kinds of attributes. These findings confirm what Geurs and van Wee (2004), Burton and Mitchell (2006), Frank et al. (2005), Southworth (2006), Gehl (2011), and Mehta (2008) emphasised concerning the importance of connecitity and accessbitilty to encourage walkability. However, in some cases this research found, in regard to accessibility and proximity, that people try to avoid walking short distances in the presence of crowds and also due to the obstacles along their route to their destinations. This is similar to what Al-Azzawi (2004) discovered in his study, that pedestrians strive to take the shortest path possible. However, they may not always be able to do so because of encounters with other pedestrians.

In central Makkah streets, it was discovered that users' needs rely on physical elements like visual interest of the built environment. Several authors (see, for example, Hillier, 1996; Roberts & Greed, 2001; Moughtin, 2007; Carmona et al., 2010; Ford, 2000; Gehl, 2010) stress the importance of active frontages to encourage walking. However, this research demonstrates that where those active frontages flow out onto the sidewalk, for example to display goods, which is a common practice in many cultures, they can actually act as a hindrance to walking. This is a point generally not made elsewhere, which again emphasises some of the Western and European countries' biases in walkability writing: cultures where displaying goods is often tightly regulated.

It was found that greenery and trees are one of the most physical factors that contribute to walkability and encourage more walking. This confirms the findings by Jaber (2013), which is that trees have been determined to affect the microclimate of city streets, reduce atmospheric temperatures, and afford a psychological cooling effect. The need for shade is important to reduce the heat and change the microclimate effect, providing shade along the route and also playing the role of separating the pedestrian walkway from the flowing traffic. The number of trees should be increased in the central area, and more importantly, the location needs to be researched so that it is placed in areas where the need for shade is highest. The types and

selection of trees should be taken into account to ensure that it will deliver enough shade for pedestrians.

The findings indicate that the large street width and limited pedestrian space reduces the opportunity to provide shade and does not encourage the visitors or locals to walk in the area. Also, the use of the sidewalk may be affected by its width. Furthermore, it might be argued that wide streets have numerous consequences, including discouraging users from using streets with more pedestrian space and reducing the sidewalk's function as a pedestrian area to walk. Therefore, this supports similar results such as Samarasekara et al. (2011) who found that walkability was primarily determined by the existence of a clear safe (i.e. implying safe from automobile traffic) walking area. The evidence shows that with wide sidewalks, people tend to walk more comfortably than with narrow sidewalks that cannot be accessed.

The findings revealed that the paths had not been improved with the needs of all users in mind. Some of the most affected groups were the elderly who used wheelchairs, because the sidewalks were poorly maintained and had bumps, making it hard to use electric wheelchairs, and because they were not levelled. The findings concur with Cain et al. (2017) and Belon et al. (2014), who stressed that the pavement is the part of the path that people walk on, and its quality is important for a smooth walking experience. It was shown that regarding the Makkah central area, the needs of users leaned more to physical factors than functional ones.

9.3.3 ***Social factors***

The social attributes play the leading role in encouraging walkability in the present study. Under safety aspects, the level of congestion, being free of accidents, safe crossing devices, the need for an inclusive environment for all and free from barriers and obstacles, and security of place are the most critical attributes based on perceptions of users of what adds to the street's walkability. The findings indicate that safety attributes influence walking decisions, where certain feelings, experiences, and behaviour occur in response to the physical environment in the Central Makkah area.

Under safety considerations, the level of congestion, the absence of accidents, the presence of safe crossing devices, the need for an inclusive environment free of barriers and obstacles, and

security of place are one of the most substantial attributes, according to users' perceptions of what contributes to street's walkability.

While people should never be pushed or feel uneasy while walking, the current sidewalks compel certain behaviours that may endanger pedestrians. Walking to the Grand Mosque is the sole means for able-bodied people to enter, as well as the only way to reach the mosque's gates. Because each pilgrim and resident of the central area has the freedom and choice to walk, undesirable behaviour may occur as a result of coercive interaction in which there is no choice or freedom to behave appropriately. Krupat (1985) discovered similar findings in that, when walking, the quantity of people on the street had an impact on one's feeling of safety. Crowding is a subjective or psychological feeling based on the realisation of having less space than intended. In other words, if the space becomes too congested, that may discourage people from using it, which is a result of their feeling unsafe. However, the findings in this research identify that the crowd can be a positive spiritual experience for some, where pilgrims have the sense of belonging within the crowd.

The interface between cars and pedestrians was found to be an important issue to maintain safety on the street and encourage walking. Furthermore, two factors led to this interface, which were the width of the sidewalk and the presence of street merchants on the sidewalks. This confirms the findings by Yatmo (2008), who emphasised that the positive impact of street vendors is that they provide liveliness and aesthetics to the street environment, whereas the negative impact occurs when merchants operate on narrow sidewalks, posing a threat to pedestrians.

Pedestrian crossing methods are part of the accessibility and connectivity features that support walkability. The streets in the centre of Makkah city prioritise automobiles over pedestrians and the majority of urban streets fail to convey a sensation of safety, especially for people with mobility issues. Therefore, crossing methods are an essential feature and most needed in the study area. This supports the findings by Tulu et al. (2013), who stressed that crossings are an important element and poor crossing conditions have an effect on pedestrians' safety and create an unsafe environment.

9.4 Contributions of the research

The present study makes a contribution to the body of knowledge on walkable streets in urban areas settings by addressing a knowledge gap. The idea of a walkability has been examined in other contexts, including neighbourhoods, commercial streets, and resident-neighbourhood connections (Montemurro et al., 2011; Azmi et al., 2013; Johansson et al., 2016; Ernawati et al., 2016) . However, it has not been investigated in the setting of places that witness religious tourism (i.e. pilgrimage) such as Makkah. This research contributes to the body of knowledge on urban settings by focusing on the walkability of a city centre. Furthermore, this research determines the users' needs in a particular setting and kind of public space. Considering that the climates in distinct places differ as are cultures, public consciousness, lifestyles, and climate, this is important. As a result, this study's findings on the relative significance of factors and qualities vary from earlier studies. According to Reeves (2005,p 29), our residence defines us, where we live has an impact on "how we live, who we interact with, and what we eat"; it also has an effect on our feelings and moods, as well as our well-being and health.

Numerous researches have focused on precise users with regards to a walkable street and focused on precise groups of users, like individuals with disabilities or older adults in the outdoor built environment (Burton & Mitchell, 2006). The present study's findings have established the demands of street users as a whole, rather than the needs of individuals with disabilities, who constitute a tiny proportion of the overall population. There are several activities that people engage in on a daily basis that have an effect on their mobility, including people who carry large bags, women with children, and the elderly; the current study went beyond such activities.

This research has helped to improve the knowledge of pedestrian needs, experiences, and preferences, with the goal of identifying ways in which often overlooked space of the street can be used to support walking climatic conditions that are hot and arid, as well as in a community with specific socio-cultural requirements. The analysis supports decision-making by recommending that the present pavement width be increased in order to create improved street design and thereby restore walking opportunities. Involving physical design measures as suitable streetscape elements and the amalgamation of numerous urban microclimate strategies, primarily founded on the combined impact of shade, is vital for two reasons. The first

incorporated interventions linked to physical design (to lower the solar radiation impact). The second is related to meeting the average personal comfort needs between pedestrians.

“Rightsizing streets”, which is the concept of redesigning streets toward the pedestrians away from the automobiles, has the potential to create more space for this new spatial arrangement. Moreover, the exploration of spatial characteristics, done in Chapter seven (the street’s physical feature), shows that the actual lane widths of vehicles range between 3.6 metres and 4.0 metres in width. According to the American Association of State Highway and Transportation Officials (2011) standards, which Saudi Arabia uses when designing urban streets, the general width of a traffic lane ranges between 3.0 and 3.6 metres, with 3.6 being the most preferable where free traffic flow and high speed are important.

Given the evidence mentioned above, it is quite easy to refute any argument made in opposition to narrowing lane widths in the vehicle zone in the future. Therefore, if accommodating pedestrians is considered to be a serious social, environmental, and health issue in urban streets (as is the case), a lane width of three metres for traffic in urban streets should be seen as the most desirable. Consequently, the idea of street space redistribution comes across as a practical and reasonable design approach for encouraging pedestrians into this area. For this reason, rightsizing streets, which incorporate the pavement space, helps accomplish three primary goals. The first is that it provides adequate space to allow for any needed climate-friendly architectural design measures that assist in adjusting the microclimate and in the process improving thermal conditions for pedestrians. The second is that it plays a profound role in adding streetscape components to facilitate the movement of pedestrians, increase the time people spend in the space, and make the walking experience functionally and visually appealing. This is the conclusion that is in keeping with the results of previous studies like the one done by Alexander et al. (1987), which illustrated that narrowing the street space’s width by making both parking and vehicle lanes narrower, making the pavement space wider, and planting trees helps separate vehicular from pedestrian traffic, reduces the speeds of vehicles, and more equitable distribution of street space.

The research examines the differences in street users’ socio-demographic backgrounds and between different groups of people (visitors and residents). As a result, this research contributes to the variety of users' demands and perceptions regarding the characteristics and attributes that contribute to the walkability of a street, depending on the age group, background, and user type, as some of these factors have been overlooked in earlier studies. This current study adds to

existing knowledge regarding more particular user needs in relation to user categories and sociocultural groupings. While previous research has deal with the issues of the needs in open urban spaces (Mehta, 2009; Carmona et al., 2010), the precise demands were linked to a different kind of user, which means that they did not specifically target the Saudi Arabian walker's context.

In conclusion, this research demonstrates that a walkable street is essential to the success of a street, whether in Makkah or elsewhere; it should be liveable, walkable, useable, and sustainable, as well as sensitive to its surrounding environment. In this way, the findings cover a present gap in the existing knowledge by defining the leading needs and perceptions of users regarding the walkable street in Saudi Arabia, which has a distinct environment in regarding climate, cultural context, and social activities, from the rest of the world. The user's perceptions regarding a walkable street will have an effect on the techniques and processes of designing a walkable street.

Finally, the study contributes to the current knowledge on the topic of walkability in countries with hot temperature climates more clearly, because no specific attempt has previously been made to examine walkability difficulties related to such hot, arid weather during a religious event in this manner. This study evaluated the walkability of people from various climates in a unique urban setting such as Makkah city centre area. In addition, the research focused on one of the religious sites that is regularly frequented by the general public. The study also highlighted the effects of the weather on walkability in such a situation, as well as the effectiveness of walking facilities and physical characteristics of the street and how people respond to them, among other things.

9.5 Significance of the research and its implication

The present study is important and opportune in light of the proliferation in the size of urban areas, particularly in the developing countries like Saudi Arabia. The majority of urban development projects in such countries replicate designs from other parts of the world, specifically from the West and Europe, without regard for the physical and social context of street users or the local environment. Creating walkable and liveable urban environments that

can be used for a variety of uses, not only fleeting ones, but plus to fulfil the need for additional social activities, is crucial for developing urban environments that are usable for all purposes.

At the moment, there is a strong need for public spaces in Makkah's central area, and walkable streets must play a vital role. More importantly, building a walkable environment is critical to make the area feel more enjoyable while also creating a distinctively comfortable environment for people to walk in. Moreover, according to the urban design strategy outlined in the Comprehensive Plan for Makkah and Mashaer (2011), the streets will be further developed as continuous and wide walkways, offering street furniture and landmarks as well as landscaping, lighting, and signs, in addition to creating a pedestrian environment by reducing traffic congestion, among other things. In the context of Makkah city centre, which is multiracial and serves millions of people on religious visits, to accomplish this it is necessary to consider the aspects, attributes, and demands of a diverse range of user types and socio-demographic backgrounds.

The present research's outcomes are based on the variables impacting the use of streets. The physical features and qualities revealed, which are based on observation on-site and users' experiences and perceptions of the current condition of the streets, will be used to improve the design of walkable streets, which will help in the development of policies that encourage more people to walk rather than drive in Makkah's city centre. Additionally, these insights may support the government in identifying and prioritising future growth and developing appropriate plans depending on local needs. Rapoport (1986) emphasises the importance of user-centred research when it comes to designing space, stating that designers must start looking at the problem from a different point of view depending on the users' desires, and that actions need to be taken in order to establish supporting features for these intended uses and activities, respectively.

It is intended that by examining the key aspects and attributes that influence walkable streets, urban designers and planners would gain a better knowledge of the issue and adopt a more contextual approach rather than relying on a general design solution to address it. At this point in time, the regulations and guidelines governing the development of Makkah's central area are not based on urban users' needs. The conclusion drawn from the present research will assist in generating more comprehensive and improved guidelines that are not just focused on the perspectives of policymakers and designers but, perhaps more crucially, on the perspectives of those that use the streets.

Additionally, the findings of this study identified five critical factors affecting the walkability of streets for users in the central area of Makkah: comfort; safety; a sense of crowding and congestion; accessibility; and connectivity. As such, these are the primary criteria that must be considered in order to increase the walkability of urban streets in Saudi Arabia. Urban designers and planners in cities should account for these factors when attempting to enrich the life of the city and reintroduce a sense of quality of life.

This present study is unique in that it focuses on urban walkable streets in Makkah's city centre. Such a study is essential when one considers differences in climate, geographical location, the quantity of traffic, number of people visiting annually/occasionally, and culture. For obvious reasons, different solutions are necessary for various conditions and locations. In this research, the findings on user perceptions of street quality (Chapter 7) demonstrate that contextualised rules are required detailing the design of characteristics in urban walkable streets in particular, and other streets in general.

A walkable environment can be established in the city centre by increasing shade and reducing motorised traffic. Additionally, as one of the findings above indicates, increasing pedestrian accessibility will considerably increase pedestrian speed (see Chapter 6). Improving the public transportation infrastructure will help to enhance accessibility and encourage walkability.

At the end, it would be desirable that the conclusions and insights of this study would serve as a knowledge foundation for governments, both local and national, and interest groups in order to solve, avoid, and prioritise existing and future demands of pedestrians in establishing walkable streets in urban environments. Additionally, the findings could contribute to a better knowledge of walkable streets in a particular setting, culminating in the creation of an essential implement for stakeholders (i.e. decision-makers, government officials) for implementing improved conditions for the users quality of life in the future.

The present study’s findings may have connotations for the implementation of urban design in the context of walkable streets in urban centres. Despite the fact that the implications addressed are specific to the context of unique urban streets in the central area of Makkah city, they may also have concerns for comparable sorts of streets and other urban settings in other city centres with the same contextual factors. When the following criteria are examined, the findings may have significant implications for urban design of sites in the local environment.

According to the Comprehensive Plan for Makkah and Mashaer (2011), the proposal to enhance and highlight pedestrian corridors is one of the major objectives in future plans to develop the central area to provide pleasant walking settings and to guarantee that the streets of Makkah's central area are available to all users; the urban street environment should be user-friendly, particularly for pedestrians. This is in accordance with the national vision for 2030, which seeks to enhance and improve walkability as one of the associated attributes that supports the liveability and quality of life in Saudi Arabia.

The findings show that in order to create appealing and desirable walking environments for all users, variables and attributes associated with walkability have to be incorporated into interventions related to urban design and planning. Consequently, within the framework of this research, to enhance a walkable street, the aspects and attributes that are most important to the users may be recognised from their most considered needs and perceptions. The outcomes of this study highlight the needs and perceptions of users, which might be used to generate strategies and guidelines for future development.

9.6 Limitations of the research (reflections)

This research has some limitations, most notably those related to the data collection process and analysis. The following are some of the research's limitations.

The study focused on a few significant streets in Makkah Al-Mukaramah's city centre, including Jabal Al-Kaabah, Ajjyad, Ibrahim Alkhalil, King Abdulaziz, and Al-Haram. Obviously, a multi-case research study would provide more detailed data. This has no bearing on the statistics, as the streets themselves encompass the area surrounding the Grand Mosque.

The focus of this research was to explore and examine the walkability of central Makkah from experience, behaviour, and evaluation of pedestrians, which were narrowed down to four important factors of streets: the physical qualities of the street; and user perception of regarding the streets, their activities, and the socio-demographic background of the street users. Therefore, there are other additional variables that may have a substantial impact on the outcome of this research, including governance, economy, and financial provision, which are not addressed in this study. Because of limitations in terms of manpower and time, some aspects were not included in the scope of this investigation.

When conducting this type of study, it is critical to have an awareness of the actual behaviour of participants on the site to gain a better understanding of the users' actual needs and their interactions with their physical surroundings. However, due to time constraints, the scope of this research was limited to examining the site's activity pattern.

Obviously, there may be additional aspects and characteristics that determine the creation of walkable streets. The observations, feedback from the interviews, and questionnaires were all used to gather the information for this investigation. Other strategies might be used to obtain further information, which could lead to future discoveries. Some alternative strategies such as focus groups, social media analysis, the use of video analysis of street movement, etc. could be more beneficial for future studies.

The findings of this study were derived entirely from a single case study (Central Makkah city, Saudi Arabia), yet in light of the same socio-cultural values and environmental circumstances of Gulf countries, they may be relevant to other situations as well, especially those situated within those countries. But it is highly recommended that future researchers that are interested in carrying out similar studies, especially those taking place in hot and arid climates, carefully assess, or at the very least think carefully about, the results' applicability and transferability to their environments. This is due to the fact that the conclusions of the study were highly impacted by local circumstances, particularly socio-cultural components, whether at the level of religious belief or otherwise, or at the level of behaviour, which largely govern and guide interpersonal interactions as a result of the influence of Islamic teachings.

To build and validate a body of evidence, researchers have observed and recorded specific variables and discoveries using the mixed methods approach. However, it is vital to interpret the findings of both statistical and descriptive methods. In the case of the present study, this is because the face-to-face questionnaire and the sample sizes were small. In light of the foregoing, it is probable that larger samples would lead to more robust and relevant evidentiary research; as a result, generalisations have been made with caution. Consequently, because of the character of the collected data, it can be recommended that the results should be read with the understanding that they represent the individuals investigated at the time of the study.

Since 2019 there have been projects in central Makkah that are on-going, however the pandemic has greatly slowed down development process. Lately, it has not been difficult to observe that economics plays a decisive role in accelerating the development of the area. To accommodate pilgrims, the central Makkah area has been entirely commercialised and is now home to large

hotel brands and office buildings from all over the world. The old urban fabric has been completely replaced by the sterile, vast, and disjointed monotony of the repeated commercial tower blocks, which lack the vibrant and compact variety of urban uses and activities that were present in it. The actual threat in this situation is the erosion of the physical urban environment and the disregard for pedestrians and the urban environment around them. There is no doubt that the urban environment in the central area needs to focus more on walkability and pedestrians, which are of the main goals of the 2030 Vision of the Kingdom of Saudi Arabia, as well as the comprehensive plan for the development of central Makkah in particular. In conclusion, it is anticipated that the results of this study would provide feasible guidelines and recommendations that, if followed by the appropriate municipal authorities, would serve to ease the difficulties encountered and needs that are required by city residents and pilgrims to accommodate walking with more comfort and safety.

9.7 Areas of further research

This research specifies the aspects and factors of influence that contribute to a street's walkability and the perceptions of users of a walkable street. Regardless of the present research's contributions to the exploration of user needs and experiences and perceptions of a walkable street, several findings require further consideration. This suggestion is given since the focus of the research is important to our aim of implementing successful cities. The research can be expanded through conducting additional investigations of certain users' behaviour related to the street's physical environment. The present study may link up to the behaviour of individuals on the street in the Saudi Arabia context and how they use and interact with the street facilities provided.

The social qualities, additionally to the environmental and physical aspects, were highlighted as one of the primary variables that contributed to the creation of a walkable street environment. The social qualities, however, were not thoroughly investigated due to the limits of this research, and it is recommended that additional research be conducted in this area. The justification for this limitation was given in the research methodology chapter (section 4.8). In addition, the investigation of the particular sociological characteristics of a street that help the creation of a walkable street in the Saudi Arabian context is an area that might be explored further.

In this research, respondents in Makkah's city centre were given questionnaires to gather more information about topics that were not covered in the qualitative research and to seek other prospective issues. It is proposed that in future studies, the focus group technique should be used in the future to obtain more detailed data from groups of respondents with varying socio-demographic backgrounds, particularly those with different cultural, racial, gender, and age backgrounds (Pain et al., 2002).

The research examines streets based on the users of the city of Makkah who are able-bodied and able to walk. Subsequent studies could include individuals with restricted movement and impairments, such as those using wheelchairs, with visual impairments, and are hard of hearing. The previous recommendations will provide further comprehensive results that may be used to produce guidelines for enhancing the quality of urban streets and urban settings, both of which contribute to the high standard of life in urban areas.

Additional research should be conducted to ascertain the frequency with which pedestrian behaviour, movements, and activity patterns are observed, as well as the most frequently used areas within the street space. It is strongly recommended to capture and analyse pedestrians' movement/behaviour using a video camera equipped with time-lapse capabilities. This requires a comprehensive examination of the streets selected for this purpose.

9.8 Conclusion

This chapter summarised the major research findings, the research's contributions, and made recommendations and proposals for further research. This research has added to our understanding of urban design and can help to guide policy by addressing a knowledge gap regarding walkable streets in the city of Makkah in particular, and more broadly in Saudi Arabia. Ultimately, that will help the government achieve its goal, as outlined in the recently released Comprehensive Plan for Makkah and Mashaer, which is to encourage growth and enhance the quality of life in the city. Hence, the national vision, which is set to be achieved in 2030, will additionally have as one of its goals the establishment of a policy framework and recommendations to bring about required urban living environments, with a particular emphasis on walkability as one of the most significant characteristics.

It is evident that a city's vibrancy is represented by the willingness of people to use the outdoors, where they may go about their day to day lives with a relatively high degree of freedom and

ease at any hour of the day or night. Streets, without a doubt, are the best public urban environment in which to experience this vitality. Streets in cities are not only arteries linking various areas of the city, nor are they merely pathways for movement. Streets are public spaces that are intended to accommodate a variety of people's needs, preferences, and expectations. Therefore, when the design of streets serves one purpose only, orientated around automobile traffic, and prioritises driving over pedestrian spaces and walking, they become deficient and lose much, if not all, of their user-friendliness for walking and street life in general. This concern with the requirements of automobiles results in a reduction of designated pedestrian space and a failure to appreciate the components essential to support walking. Eventually, people are pushed out of street space.

It is vital to comprehend the basic attributes and elements characterise a walkable street based on the needs and perceptions of users in a specific context. By applying the main attributes and features identified in the present study, urban design and development of the future can get guidance, averting the mistakes of the past and putting the users' needs in s particular environment on the forefront.

Some important principles/factors were identified throughout the research that contribute to the walkability of urban streets for their users: comfort; safety; a sense of crowding and congestion; accessibility; and connectivity. Additionally, the research identified three additional supportive factors for a pedestrian street in the Makkah city context: greenery/trees; public amenities; and maintenance. This distinguishes the issues that should be thoroughly considered when defining future guidelines and regulations for creating walkable streets in Makkah's central area.

Additionally, this research examined the streets' characteristics through the lens of what users perceive makes them walkable. The outcomes indicate that the most important elements in determining a street's walkability are comfort, safety, accessibility, and connectivity, of which the most significant factors are its comfort attributes. Covered walkways/shade and other forms of protection from the sun, as well as appropriate temperatures, are the major elements which contribute to a walkable street's feeling of comfort. Meanwhile, concerning safety, users identified the presence of police or security surveillance; the absence of accidents; the presence of safe crossing methods; and the presence of a safe environment for the elderly and disabled as the major factors that contribute to a street's feeling of safety.

These characteristics and qualities, which are often absent in existing urban streets, are desirable and should be considered by those responsible for urban design guidelines in order to establish

a walkable street environment for both visitors (pilgrims) and locals. Most of these features have been identified as primary determinants of walkable urban streets in Makkah’s central area. It is expected that they would be taken into consideration significantly in the practise of planning and designing streets, not just for exact urban streets, but also for various sorts of streets with comparable contexts.

Finally, the present study proposes that, although the qualities and factors identified are important to local challenges and settings, certain of its outcomes may apply to the global urban street environment. This may be applicable in other parts of the world with similar climate, user behaviour, and culture. The present study adds to existing knowledge by investigating and studying the walkability of an urban street in Makkah's city centre based on the users' perceptions and experiences concerning the social, functional, and physical street aspects. In prior studies, this had been left unaddressed. Hence, it was found significant explanations in terms of characteristics and qualities, as well as differences in perceptions of walkable streets in region across different types of users and socio-demographic groups.

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Appendices

Appendix A: Direct Observation Notes from the field work

Street name	Date/time	Weather con	Types of activity	Notes
Jabal Bakkah	July,1 10am-12pm	Sunny 39-41 Humidity 15% Nnw 11mph	Walking Standing	People look tired because of the heat Some tried to walk beside the wall to get shad Old women with husband or brother stop many times to get rest **60 ppl after 15minutes** Few pilgrims**,** some people cover their head from the sun 2 old women could not complete their walking and took rest for few minutes before continuing. No place to set or relax. 70 ppl at 11:15 am Mostly men above 20, non-Saudi **652 ppl**

	July,1 5:30-7:30pm	Partly sunny 40-38 Humidity 15% Nw 14 mph	Walking Standing	More comfortable walking but still hot. Easy walking **160ppl first 15 minutes** **477ppl after 30 minutes** Some still sweating from walking, wearing light clothes Warm wind to 13 mph makes people walk slowly and enjoying their walk especially kids playing with birds. **1211ppl after one hr.** The sun almost gone but some still sweating The number is increasing 30 **minutes** before Maghrib prayer. The walking speed is increasing too to catch the prayer. People going to the mosque more away than going. Mostly family Different ages Few pilgrims **4,021 ppl**
				Kids and families enjoy playing with birds on the white spaces of the

	July,2 6-8am	Sunny 29-32 before sunrise Humidity 26% N 6mph	Walking Photographing	mosque Bit cool wind **290 ppl after 15minutes** **590 ppl after 30minutes** Most people going from the mosque homes to hotels Few pilgrims after 45 **minutes** People are taking pictures of the crowd of the birds and some selfies with the hour bridge **1068 ppl after 1st hour** Some individual going to work With sun rise and getting hot the number of pedestrians decreased at 7:30 Mostly families Adult individuals **2082 ppl**
Jabal Bakkah	July, 2 1-3pm	Sunny 40 Humidity 17 Nw 12 mph	Walking Standing	Looks tired The heat makes walking difficult and slow People sweating The heat has apparently had its influence on the people movement and speed **138 ppl after 15 minutes** More going than coming An old woman stopped

				looking for some shade Because of the heat many families took a taxi instead of walking under the sun Lunch break many workers going **261 ppl after 30 minutes** Man pushing his mother in wheelchair A man dragging his suitcase stopped many times to clean his sweating from the forehead Some put their small bags or belonging for protection from the sun 440ppl after 1 hr. Few kids More individuals Few pilgrims **682 ppl**
Ibrahim Alkhalil Dar al tawhid Hotel	July, 3 4-7pm	Sunny 39-35 Humidity 22% WNW 13 mph	Walking Shopping Setting Eating/ drinking	There are shades from buildings **600 ppl after 15 minutes** People using street because there is not enough space on the sidewalk with 2 meters **3011 ppl first hr.** People still suffering from the heat a bit No places for people to sit with better sidewalk (7m width)

Bukhari restaurant				With the shades and a bit warm wind decrease in the temperature more people walking More families going out from the residents or hotels There is an increasing number of people so fast 30 **minutes** before maghrib prayer Big group of people eating food on the stairs Mostly couples above 30-50y Women Families **9,035 ppl**
	July, 7 1-4pm	Sunny 42-43 Humidity 14% Nw 10mph	Walking eating/ drinking Shopping Talking Setting Standing	Mostly coming from Dhuhr prayer Groups and families Some using umbrellas and bottle of water **500 ppl after 15 minutes** Old women pushing another on wheelchair on street could not use the sidewalk because there is not enough space Most people are walking on the right side of the street under the building shades People get lost their way to hotel asking me the directions Old people especially find difficulties using

Opposite buk electricity generator				sidewalks (gaps, dawn and up) because of unstable connection, so use street which is dangerous The number started decreasing after 1 hr. after prayer 3426ppl after 1hr 2:15 221 ppl 2:30 372 ppl 500 pilgrims from 1-3 30 **minutes** before Asr prayer the number again is increasing More number going to the mosque and more groups Mostly old people above 40-70y **6,733 ppl**
	July, 22 6-9am	Sunny 32-35 Humidity 25% Wn 7 mph	Walking Setting Standing Shopping eating /drinking	Crowdy Uneven street making difficulties for old people to fall From walking a long-distance people gave up and take a taxi Some look tired/sweating from walking The width of the sidewalk and shops goods force people to walk on the street People still look lost and having difficulties finding their hotels Number started

				decreasing from 7am Group mostly above 30y Could not count
Near umbrellas	September, 9 1-2pm	Sunny 41 Humidity 21%	Walking Setting Shopping eating /drinking	Calm It's getting hot Most of pilgrims have left after al hajj season Uneven pavement makes walking difficult, so some people prefer to walk on streets Only 10% present comparing before
Ajyad street	July, 8 4-7pm	Sunny 42-39 Humidity 13% Wnw 13mph	Walking Setting Standing Shopping	Asr prayer time Hundreds of people coming to the mosque (groups, families, individuals) More people going than coming after the prayer The temperature goes down to 39 and more people coming to the mosque Wider sidewalks (9m) people walk more on No cars get to this point except authorized cars only No place to set people setting on the stairs or stand More people talking to each other Eating ice cream/drinking water

				Could not count
Ajyad st	July, 21 6-9am	Sunny 35-37 Humidity 18% Ne 7 mph	Walking Shopping Setting Eating/drinking	Much more people come in groups illegal merchants on some part of the sidewalk have been chased by police and that narrowing the walking space for people Weather still good people have a pleasant walking experience Mostly old people Big groups coming and going
	September , 9 11:20am-12:20pm	Cloudy 34 Humidity 25% Wnw 9 mph	Walking Talking Setting Shopping	1 hr. before the prayer Its clam few prayer walking Mostly families enjoying their walk with sun absent Women make people uncomfortable No chair to set Number people is increasing 15 **minutes** before prayer Mostly families few kids
King Abdulaziz st	July, 9 4-7pm	Sunny 42-39 Humidity 13% Wnw 13mph	Walking Setting Standing Shopping	King Abdelaziz street has sidewalks on both sides but the right one has no space for two people to walk on More families coming 1hr before maghrib prayer Different ethnicity and races The number is increasing more 30

				minutes before prayer With a bit cool wind NW 12 mph people walk slowly and enjoying their walking more Eating ice cream/drinking water East Asia is the big number **Could not count**
Reasa alharam ain	July 22, 6-9am	Sunny 34-36 Humidity 16% Nw 18mph	Walking Shopping Setting Standing	Mostly families More groups coming and going People setting on stairs talking to each other Disabled people using street rather than sidewalks More people taking taxi than walking after sunrise **Could not count**
	9 September 1:30-2:30pm	Sun partly cloudy 41 Humidity 21% WNW 21 mph	Walking Shopping Setting Standing	Few people walking Many people prefer to take taxi than walking because of the sun Using street more than sidewalk especially for disabled The number decreased More people going than coming More families
Masjid al haram Rd Near to	July, 10 1-4pm	Sunny 39-42 humidity 12% Nw 12mph	Walking shopping eating / drinking Standing	After Duhur prayer people going out of the mosque to eat, rest..etc... 1800 ppl 1:15pm Some using umbrella to protect themselves from

shops The opposite				sun 1393 ppl 1:30 pm The number of people started to decrease They stop under bridge and the kids watch and paly with birds before getting under the sun again passing the bridge People feel more comfortable under the bridge Some feed the birds More going than coming Lost people again asking for direction to hotel 42 degree at 1:30pm 1080 ppl at 2:30 pm Number is increasing 30min before Asr prayer Mostly families Groups **7599 ppl**
	July, 10 4-7pm	Sunny 40-38 Humidity 12% WNW 14 mph	Walking Shopping	People going out for the mosque the number is doubled Huge number of employees going out after work People walk more comfortable A bit warm sun 40degree nw14mph

Dimension	Parameters	Jabal Bakkah/Khalid bin Waleed St.		Ibrahim Alkhalil St.		Ajyad St.		King Abdulaziz St.		Masjid Al-haram St.	
		ZONE 1	ZONE 2	ZONE 1	ZONE 2	ZONE 1	ZONE 2	ZONE 1	ZONE 1	ZONE 2	ZONE 1
Building height		Above 25	1–3 stories	Above 25	3–20 stories	Above 25	6–20 stories	**Building height**	Above 25	1–3 stories	Above 25
Block length		300 m	320 m	400 m	1= 450 m 2= 336 m	373 m	512 m	**Block length**	300 m	320 m	400 m
Street width		13 m	25 m	20 m	20 m	30 m	25 m	**Street width**	13 m	25 m	20 m
Sidewalk width		5 m	None	6 m	2 m	6 m	2 m	**Sidewalk width**	5 m	None	6 m
Road crossings		None	None	Near Dar Altawheed hotel; no signals	None	Controlled by police	None	**Road crossings**	None	None	Near Dar Altawheed hotel; no signals
Pavement	Material	Asphalt	Asphalt	Concrete bricks/ interlock	Interlock / Concrete bricks	Granite slab/ interlock	**Pavement**	Material	Asphalt	Asphalt	Concrete bricks/ interlock
	Condition	Fair	Fair	Bad	Bad	Fair	Bad	Condition	Fair	Fair	Bad
	Clutter	Shops good	-	Streetlights / palm trees	Shops good	Streetlights	Waste Bin	Clutter	Shops good	-	Streetlights / palm trees
	Ramp	-	-	Few	Few	Few	Rare	Ramp	-	-	Few
Canopy	Natural (tree)	Few trees	None	Few palm trees	None	None	**Canopy**	Natural (tree)	Few trees	None	Few palm trees
	Industrial	None	None	None	165 m of 900 m	None	None	Industrial	None	None	None

Appendix B: Physical Feature of Central City of Makkah

Street zones:

Appendix C: Interview Questions and Codes

Public interviews questions

- **How relevant, in general, is the concept of walkability in a hot, arid climate?**

  - Can you tell me how you got here today?
  - If you walk or intend to, what might be your purposes/motives to do so?
  - How far can you walk to get your daily needs?
  - How often do you walk to get to the store? Would you rather live further away from it?
  - Can you do most of your shopping within a 5–10 minute walk from your home? Why? Why not?
  - Do you think providing connected, accessible, and comfortable sidewalks would increase walking to the store? Why? Why not?
  - Have you faced any difficulties reaching any of your commercial activities by walking?
  - What else did you do besides shopping today?
  - Anything else you would like to tell me about walking in Makkah?

- **How do locals perceive their everyday experience as pedestrians in central Makkah?**
  - How often do you walk?
  - How do you describe reaching your daily needs by foot?
  - What would be the safe time to walk in central Makkah?
  - Is the area friendly and encouraging you to talk to people? If yes, how? If not, why?
  - How would you evaluate the streets/sidewalks within central Makkah area?
  - Anything else you would like to tell me about walking in Makkah?

Elite interview:

- What is your role or position?
- Does the current physical environment encourage people to walk? Explain?
- What needs to be improved in the street environment to make it more attractive and sociable to people?
- What is the main problem with the planning and design of streets in central Makkah?
- In your authority, what are the main steps that will be undertaken to provide a comfortable and safe environment for people to walk?

- What are the major goals that your authority wants to achieve through streets and sidewalks?
- What are the most major problems facing those who are responsible for streets and sidewalks in central Makkah?
- What can other departments/authorities do to collaborate with you to solve this issue?
- Anything else we should have discussed

Themes/Issues	**Sub-theme (Feeling & Experience)**	**Quote-Code**
Environmental Climate Topography Air pollution	Exhausting Tire Difficult Major problem Not easy Change clothes	It's **hot** and difficult with the current environment and pavements to walk on. Walking is closer but with this **sun** and **heat** is almost harder. I shop from 5-10 minutes, but the **temperatures** force me to drive the car. The difficulties from the **temperatures** and the number of pilgrims make my journey long. I chose this path because there is a large shadow along to stay away from the **sun's** rays and **heat**. Another thing is the **topography** is making walking more difficult in some areas to go up and down. Walking in this **temperature** is difficult and needs a lot of water. The sidewalks are good, but the **temperature** and the crowd are the problem. The environment is not encouraging to walk, and the **temperature** is exhausting. I can walk half an hour for shopping and my daily needs, which is a tiring experience due to the **sun**. I usually shop at night because it is **hot** during the day. The **heat** and crowded are the difficulties that I'm facing while walking especially during the hajj season. The sun is **hot,** and the crowd is beautiful and encouraging to walk because you can see and feel comfort and atmosphere of faith and spirituality. If there are trees people walking more and encourages them because some of them rest between noon and afternoon because of the **heat** of the sun. Shopping cannot be in 5-10 minutes because the **heat/sun** and crowd because I cannot do anything while in crowd. The difficulties of the **temperature** and the traffic that I faced in central area of Makkah. The access to the Al haram is convenient but only the **temperature**.

		People can walk all the time praying but it is possible that there is **sun** at noon. Irregular vendors, congestion and **temperature** affecting pedestrian movements as well as cleanliness. Sun is **hot**, trees on the sidewalks and Water spray are important for walking softly on the sidewalk and encouraging. Traffic and **climate** are the major problem prevent me to walk in certain times. We need trees and more Water spray to reduce the **heat**. The **heat** of the sun is high, and the wind is a little **hot** and a little tired. Walking unsafe sometimes because of the cars, and there is a lot of **smoke** coming from taxis or buses. I have difficulties in walking in traffic and the **temperature**. The congestions are difficult, and the weather is **hot**, which force me usually to take a taxi to work. Walking is not easy because of the **temperature** and **humidity** always I need to change my clothes more than once a day.
Safety Crowed Car entry allowance Conflicts Barrier from car Crossroad intersection Movement organization/ crowed management Illegal merchants Obstacles	Very difficult Difficulty walking Dangerous Full Prefer separated from cars Unsafe from car Pushing Affecting movement Taxi annoyance Better experience now	The difficulties from the temperatures and the **number** of pilgrims make my journey long. Hajj affects walking from the rest of the year in which there is **congestion**. Sidewalks are **full** and you need use the street for walking which is dangerous with **cars** and **buses**. The **number** of **buses** has increased, and the entry of small **cars** not **allowed** and the problem of **buses** long waiting. Sidewalks will be better and away from **cars**. I faced problems with the overlap of **buses** and the many **traffic jams** with pedestrians. **Intersections** do not exist here and there is a danger with the number of **buses** and must give priority to pedestrians to cross the street which is the most needed. **Pedestrian movement** needs organization for the coming and going. Getting to the Al haram by **car** is very difficult. Sidewalks are workable but there are **bumps**. Mina needs vertical buildings such as towers because there is a **crowd** in it from other feelings and the presence of many pilgrims sleeping on streets. It is difficult to walk here in Umrah and in Hajj seasons, especially during Ramadan because of the **crowed**. There must be understanding with people and people with other languages and not push each other. The sidewalks are good, but the temperature and the **crowd** are the problem. Shopping takes more than 10 minutes because of the **crowed** and poor connection of streets, for

		example if you want to get to the other side to this block you need to walk around. The heat and **crowded** are the difficulties that I'm facing while walking especially during the hajj season. **Illegal merchants** and people **asking for money** are making walking difficult for people. Some sidewalks need to be developed need umbrellas and need maintenance there is a **hole** in it. Shopping cannot be in 5-10 minutes because the heat/sun and **crowd** because I cannot do anything while in crowd. The difficulties of the temperature and the **traffic** that I faced in central area of Makkah. There are no trees that need trees as well as **separation** from **cars**. I prefer the sidewalks to be **separated** from **cars**. Walking difficulties are the **interference** of pedestrians in some of the inside or outside. **Irregular vendors**, **congestion** and temperature affecting pedestrian movements as well as cleanliness. My evaluation is 3 out of 5, because **separating** the **cars** from the pedestrians is necessary. I can't shop within 10-15mintues because of the **crowed** of people. **Traffic** and climate are the major problem prevent me to walk in certain times. Sidewalks and **car interference** hinder pedestrian Movement. We need to do **separation** between **cars** and pedestrians. I have difficulties in walking in **traffic** and the temperature. There must be some act on the presence of **irregular people** for sitting places and make sidewalks a residence for them. The most harassing and difficult ones are from the **owners of the taxi** while walking so that it is close to attracting your attention because he thinks you are looking for a **taxi**. The hajj season affects the movement of the walk greatly as if you were walking in front of a **wave of sea**. Some of the municipal run the hajj season, causing the **crowd** to block going to Al haram. The **congestions** are difficult, and the weather is hot, which force me usually to take a **taxi** to work. I prefer to live outside the central area because it is **crowded**. Walking is better before than now because of the **crowed**. Walking unsafe sometimes because of the **cars**, and there is a lot of smoke coming from **taxis** or **buses**.

		There are difficulties while walking, including **traffic jams** and **car interference** with pedestrians. There is a **risk of crossing** from street to another. The walking experience is currently better than before because currently cars are fewer.
Social Talking	Area not encouraging Is encouraging Encouraging Cannot set No place	The area needs places to sit and relax and to **talk** to each other. We need chairs to set and get some rest and from a **social point of view** the existing chairs are very few and almost non-exist and uncomfortable. The area needs chairs for sitting and **talking**. The current environment is kind of **social** and needs chairs and is not ready to sit because people are all walking. The sidewalk is encouraging to talk to people, you can stop and **talk** but **cannot** set because there is no place to set. The area is **not friendly** and **do not encouraging people socially**, also we need to wider sidewalks and places to sit. The area is encouraging to **communicate** and needs chairs. The area **is not socially** encouraging and narrow, we need chairs and umbrellas, and it is possible to create an **intellectual and cultural** forum where cultures are exchanged among Muslims from all countries of the world. The area is not encouraging to **communicate**, and exchange cultures and needs chairs and it will be crowded but there is cooperation between the pilgrims so that some can leaves their place and gives others. The area **is not encouraging**, but if it has chairs, it is better to leave it inside a building where people can talk to each other as groups. The area **is not encouraging**, and people walk anyways.
Physical Pavement Natural Shading/ industrial Street Furniture Signage Routes Amenities or services	Pavements quality Needs for street furniture No enough space to walk Lack of guidance Difficult	It's hot and difficult with the current environment and **pavements** to walk on. The current environment is not helping **dust** and **asphalt**. Sidewalks are full and you **need** use the street for walking which is dangerous with cars and buses. The area is not covered by **Water spray**. My wife was tired walking here and there is **no place to set or relax**, so walk for short distance and stop to take rest, doing that many times along her journey. The area needs **chairs** for sitting and talking. The available environment or sidewalks are **narrow** and **not wide**. Make sidewalks **wider**, **shaded**, and put **fountains**. The sidewalk is encouraging to talk to people, you can stop and talk but can set because there is no place to **set**.

		Some sidewalks **need** to be developed **need shade** and **need maintenance** there is a hole in it. The area is not friendly and do not encouraging people socially, also we **need** to **wider** sidewalks and places to **sit**. **Trees**, places to **set**, and the **width** of the sidewalks are the important things to consider. The area is encouraging to communicate and **needs chairs**. There are **no trees** that **need trees** as well as separation from cars. Elder people **need chairs** and **shade**. The elderly **need** attention to use sidewalks with their **wheelchair** or even walking. The area is not socially encouraging and narrow, we **need chairs** and **shade**. The current sidewalks **width** is not enough and serve the merchants more than pedestrian **Water spray** should be for pedestrians not streets! The sidewalk **needs tools** to encourage people to connect by creating the place such as comfortable chairs to a place dedicated to **rest**, wait and not to sit on the sidewalks or stairs. For getting people out of the taxi is difficult and it is difficult to ride and there are no specific and **clear layout/signs** showing where the taxi and the riding areas and the drop-off. The area is not encouraging to communicate, and exchange cultures and **needs chairs** and it will be crowded but there is cooperation between the pilgrims so that some can leaves their place and gives others. We **need trees** and more **Water spray** to reduce the heat. **Trees** and **water spray** are not enough, and fans **need** to be more affective for the sidewalks to encourage people to walk. Most of the place is for cars and few pedestrians and there is nothing **special for pedestrians.** There should be some **trees** and **water spray** to make it easy to walk. The use of disabled wheelchair is very **difficult** here and necessary to allocate a special route to them because we are forced to use the bridge and cannot enter Al haram with the gates in the ground floor. Providing amenities for pedestrian like **trees** or **canopies** and other services on sidewalks will encourages people to walk.
Commercial		I usually **shop** at night because it is hot during the day. Illegal merchants and people asking for money are making walking difficult for people. I can't easily **shop** because of the crowed. I prefer to do my **shopping** out of the central area because of the crowed and traffic. I need more than 10 minutes for **shopping** due to overcrowding.

Comfort Shade Water Width	Softly Easy Difficult Encourage Easy walking	The sidewalk needs to be **shaded** and has trees. We need **shade** to encourage people to walk comfortably. Illegal merchants and people asking for money are making walking **difficult** for people. The heat and crowded are the difficulties that I'm facing while walking especially during the hajj season. Make sidewalks wider, **shaded**, and put **fountains**. The sun it hot and the crowd is beautiful and encouraging to walk because you can see and feel **comfortable** and atmosphere of faith and spirituality. Some sidewalks need to be developed need trees and need maintenance there is a hole in it. If there are trees people walking more and **encourages** them because some of them rest between noon and afternoon because of the heat of the sun. The place needs **fans**, **water pumps** and **shade**. I will walk more comfortably if the sidewalks are wider. **Water spray** should be for pedestrians not streets! Sun is hot, trees on the sidewalks and **water spray** are important for walking **softly** on the sidewalk and encouraging. There should be some trees and water spray to make it **easy** to walk.
Access Easy reach Walking distance	Difficult Tired Hard	The difficulties from the temperatures and the number of pilgrims make my **journey long**. I usually walk to work from **25-30 minutes** because the cars are not allowed to enter in some places close to the mosque and the buses are delayed. Most of the sidewalks have been **occupied** by merchants. Walking here is very **difficult** for elderly. I need **20 minutes** walks to the grocery store because can't go to a specific place to buy something easily and fast. No, the shops about **10-15 minutes** away, sometimes it's **a long distance** to walk from the place I'm staying in. Before the days of hajj there were traffic points that taxies are **not allowed** to be skipped and were far away from al haram and me and my father had to **walk 2 kilometres** to get to the central area and were tired. They **let** people into the mosque during the day (noon and afternoon) and they didn't let us in. The elderly need attention to **use sidewalks** with their wheelchair or even walking. I arrived by **taxi and I'm tired** and it was easier than a bus and walking away.

		Irregular vendors, congestion and temperature affecting pedestrian **movements** as well as cleanliness. I chose this route because it is the **closet** way to my workplace. **Difficulties** in using the sidewalks especially for the elderly before the start of the hajj. Walking here is **hard** especially for the elderly. After Isha prayer is crowded and make **access** to central area more difficult. I need more than **10 minutes** for daily needs due to overcrowding. The chosen route is the best and **easiest** route for restaurants than other services. I **can't easily** shop because of the crowed. My walking better and easy to access, **easy to reach certain places.**
Connection Continuity Directions	Block the continuity Critical barriers Long distance Difficult using by old people	Most of the sidewalks have been **occupied** by merchants. It's hard to **reach** everyday needs, because it far to some places. I need **20** minutes walks to the grocery store because can't go to a specific place to buy something **easily** and **fast**. I chose this path because it is **closer** to my work. Shopping takes **more** than 10 minutes because of the crowed and poor connection of streets, for example if you want to get to the other side to this block you need to walk around. The current sidewalks width is not enough and serve the **merchants** more than pedestrian. The place is socially encouraging the sidewalks are for walking and chairs/benches can **hold** the pedestrian. **Irregular vendors**, congestion and temperature affecting pedestrian movements as well as cleanliness. Difficulties in using the sidewalks especially for the **elderly** before the start of the hajj. Walking here is hard especially for the **elderly**. Sometimes I need to stop my car far away about **2kilometre** come to work by foot. I chose this path because my route is **closer** to my place of work and is depend to the use of my car. The chosen route is the best and **easiest** route for restaurants than other services. I need more than **20 minutes** to do shopping or reach the shopping areas. I chose this path because it is **closer** to my work.

(P) refers to Participant
(E) refers to Elite

Appendix D: Face-to-Face Questionnaire

Transforming the City towards Walkability: the Case Study of Central Makkah, Saudi Arabia

Dear Respondent,
This questionnaire is part of academic research for a PhD degree in urban design. The researcher attempts to collect information from both the residents of Central Makkah and the visitors for Hajj (pilgrimage) and Umrah. The questionnaire investigates peoples' satisfaction towards the quality of streets and sidewalks in Central Makkah and their needs and desires to develop the area in order to become more pedestrian-friendly.

The outcomes of this questionnaire will be beneficial to the residents who live around Al-Masjid Al-Haram (the Great Mosque), and those who visit Makkah to perform the rites of Pilgrimage during the Hajj season or to perform the rites of Umrah all the year-round. By finding out what people think of the current urban settings of Central Makkah, it will help to understand how to improve these settings and how to fulfil peoples' needs and desires in order to offer a better walking experience. However, the impact of this questionnaire depends on peoples' consent to participate and how cooperative, responsive and accurate they are in their answers.

You have been selected randomly to take part in this survey and it would be really appreciated if you could spare some time to answer these questions (A maximum of 7 minutes). There are no right or wrong answers, we only want your opinions, and everything you tell us will be kept strictly confidential.

Researcher name: Abdulrahman Almajadiah
Postgraduate Research Student
Newcastle University
You can contact the researcher if there is any query related to the questionnaire through:
Mobile:+966558555141
Email: A.Almajadiah2@newcastle.ac.uk

* Required

Part 1. User's information

1. **1- Gender** *
Mark only one oval.
- ◯ Male
- ◯ Female

2. **2- What is your nationality?** *
Mark only one oval.
- ◯ Saudi
- ◯ Non- Saudi

3. **3- Age group:** *
Mark only one oval.

- ◯ 20-30
- ◯ 41-50
- ◯ Above 50
- ◯ Under 20
- ◯ 31-40

4. **4- What type of user are you?** *
Mark only one oval.

- ◯ Resident in central Makkah
- ◯ Visitor

Part 2. User's Evaluation

5. **5- In your opinion which of the following are the most limiting factors on walking within Central Makkah area or Al-Haram? (select all that apply)** *
Check all that apply.

- ☐ The climate of Makkah
- ☐ Topography
- ☐ Traffic congestion
- ☐ The condition of the available sidewalk
- ☐ The lack of pedestrian corridors
- ☐ Other: _____

6. **6- Please rate your satisfaction level about the streets, sidewalks and pedestrian corridors for each of the following** *

Mark only one oval per row.

	Strongly agree	Agree	Neuter	Disagree	Strongly disagree
There are sidewalks on most of the streets in Al-Masjid Al-Haram area					
There are wide sidewalks along most of the streets of the Haram area					
There are appropriate corridors adjacent or separate from the public streets around the Haram area					
There is a place to sit, to rest along the sidewalks					
There are enough shaded sidewalks					
There are enough trees along sidewalks					
There is enough lighting at night along the sidewalks					
I feel safe when the sidewalk is separated from the streets and traffic.					
I feel safe to walk on sidewalks during the day					
I feel safe to walk on sidewalks at night					
The current sidewalks around the Haram area help me to reach my daily destinations easily					
There are crosswalks for pedestrians on intersections.					
The current sidewalks are suitable for disabled people with wheelchairs					
There are enough guidance signs on sidewalks					

Part 3: User's Perception

7. **7- Purpose of your visit to Central area of Makkah or Al-Haram (select all that apply)** *

Check all that apply.

- [ ] Praying
- [ ] Performing Hajj or Umrah
- [ ] Shopping
- [ ] Socialising
- [ ] Working
- [ ] Other: _____

8. **8- What is the main transportation used to reach Central Makkah or Al-Haram** *
Mark only one oval.

- ◯ Walking
- ◯ Private Car
- ◯ Taxi
- ◯ Bus
- ◯ Bicycle
- ◯ Motorcycle
- ◯ Other: _____

9. **9- If you go to Central Makkah on foot, how long does it take you to reach Al-Haram?**
Check all that apply.

- ☐ Less than 5 min
- ☐ 6-10 min
- ☐ 10-20 min
- ☐ More than 20 min

10. **10- When do you often visit the Central Makkah or Al-Haram during the day? (select all that apply)** *
Mark only one oval.

- ◯ Morning
- ◯ Between noon and afternoon
- ◯ Afternoon to sunset
- ◯ After sunset
- ◯ On Every prayer
- ◯ On Some prayers
- ◯ During working hours
- ◯ Other: _____

11. **11- Frequency of visits to the Central Makkah or Al-Haram** *
Check all that apply.

- ☐ Every day
- ☐ Work days
- ☐ Every other day
- ☐ Once a week
- ☐ Twice a week
- ☐ Weekend
- ☐ Once a month
- ☐ Once a year
- ☐ Other: _____

12. **12- Duration of the visit to the central Makkah or Al-Haram** *
Mark only one oval.

- ◯ Less than 1 hour
- ◯ 1-3 hours
- ◯ 4-8 hours
- ◯ 9-12 hours
- ◯ More than 12 hours

13. **13- In your opinion, what will make your walking experience more attractive, enjoyable and comfortable in Central Makkah or Al-Haram area? (select all that apply)** *
Check all that apply.

- ☐ Trees
- ☐ Canopies
- ☐ Fountains
- ☐ Sidewalk width
- ☐ Places to sit and relax
- ☐ Other: _____

14. **Note: Please use the space below to add anything you would like to add about streets, sidewalks in Central Makkah or Al-Haram, which can improve and create a better environment to walk**

_____

_____

_____

_____

_____

Appendix E: Official letters of consent to collect data of the field

Newcastle University

School of Architecture, Planning and Landscape

Claremont Tower
Claremont Road
Newcastle upon Tyne
NE1 7RU United Kingdom

Royal Embassy of Saudi Arabia
Cultural Bureau in London
630 Chiswick High Road
London W4 5RY
United Kingdom

Friday, 5th April, 2019.

To whom it may concern,

This is Professor Tim Townshend, Professor of Urban Design for Health and leader of the Global Urban Research Unit at the School of Architecture, Planning and Landscape of the Newcastle University. I am the PhD supervisor for Mr Abdulrahman Almajadiah, who started his full-time PhD programme with me from 1 Feb 2018. Abdulrahman's project which focusses on walkability and improving the pedestrian experience in Makkah, Kingdom of Saudi Arabia. As part of his work, Abdulrahman needs to collect data regarding the research from the selected city of his research. It would be vital for him to gather some statistics, documents about the city. Also, Interview and observation people will part of his data collection as well. It is envisaged that he will travel back to Saudi Arabia from 25th June to 25th September 2019.

Faithfully

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matrix

The Queen's Anniversary Prizes 2013

KINGDOM OF SAUDI ARABIA
Ministry of Education
Najran University
(044)
Vice president of Postgraduate and Research

جامعة نجران
NAJRAN UNIVERSITY

المملكة العربية السعودية
وزارة التعليم
جامعة نجران
(٠٤٤)
وكالة الجامعة للدراسات العليا والبحث العلمي

الرقم: ص خ-2593-16-440 التاريخ: 19/08/1440

سعادة وكيل إمارة منطقة مكة المكرمة

الأمين العام لهيئة تطوير منطقة مكة المكرمة **سلمه الله**

السلام عليكم ورحمة الله وبركاته . . وبعد

نفيد سعادتكم بأن المحاضر **عبدالرحمن مبارك محبوب المجادعة**، أحد أعضاء هيئة التدريس بكلية الهندسة، قسم الهندسة المعمارية والمبتعث حالياً لجامعة نيوكاسل بالمملكة المتحدة لنيل درجة الدكتوراه وعنوان بحثه هو "مدى قابلية تطوير البيئة العمرانية في المنطقة المركزية بمكة المكرمة وجعلها قابلة للمشي" وحيث أن هذه الدراسة تتطلب القيام بزيارة منطقة الدراسة وجمع المعلومات وتصويرها وإجراء مقابلات شخصية مع بعض زوار الحرم المكي وكذلك المسئولين بالجهات ذات العلاقة بموضوع الدراسة. أيضاً، سيتم توزيع استبانات لعينة عشوائية من مستخدمي ممرات المشاة بالمنطقة المحيطة بالحرم المكي؛

لذا آمل من سعادتكم التكرم والإيعاز للجهات المختصة بمساعدة وتسهيل المهمة البحثية للمبتعث والتي نرجوا من الله أن تسهم في خدمة الوطن والحد من الآثار السلبية التي قد يتعرض لها زائر الحرم المكي وسكان مدينة مكة المكرمة.

وتقبلوا تحياتي وتقديري،،،

وكيل الجامعة

للدراسات العليا والبحث العلمي

أ. د. محمد بن سلطان العسيري

المملكة العربية السعودية - نجران - طريق الملك عبد العزيز ١٣٠١ ص.ب ١٩٨٨ - الهاتف: ٠٧٤٢٨٧٧٦ ٠٧ ٩٦٦ - الفاكس: ٠٧٤٢٨٧٧٩ ٠٧ ٩٦٦
Kingdom of Saudi Arabia - Najran . King Abdulaziz Rd. Post Code 11001 P.O. Box 1988 - Tel. +966 17 542 8776- Fax: +966 17 542 8779 www.nu.edu.sa
E-mail: vphsr@nu.edu.sa

المملكة العربية السعودية
هيئة تطوير منطقة مكة المكرمة
الإدارة العامة للتخطيط والدراسات
إدارة الدراسات الحضرية

الرقم: ٤٠١١٧٤٢٣
بتاريخ: ١٤٤٠/٠٩/١٨
المرفقات: ٢ لفة
40117423

الموضوع: بشأن تسهيل المهمة البحثية للمبتعث.

سعادة وكيل جامعة نجران للدراسات العليا والبحث العلمي **المحترم**

السلام عليكم ورحمة الله وبركاته

إشارة إلى خطاب سعادتكم رقم ص خ - ٢٥٩٣- ١٦- ٤٤٠ وتاريخ ١٤٤٠/٠٨/١٩هـ، بشأن دراسة "بحث مدى قابلية تطوير البيئة العمرانية في المنطقة المركزية بمكة المكرمة وجعلها قابلة للمشي " للمحاضر / عبد الرحمن مبارك محبوب المجادعة، أحد أعضاء هيئة التدريس بكلية الهندسة بجامعة نجران وطلبكم تسهيل مهمته في الحصول على بعض البيانات والمعلومات من خلال الزيارات الميدانية.

أفيد سعادتكم بالموافقة على تسهيل المهمة البحثية للطالب المبتعث لدراسة الدكتوراه، وأن يتم تزويد هيئة تطوير منطقة مكة المكرمة بنسخة من الدارسة بعد انتهائها.

آمل من سعادتكم الاطلاع والإحاطة.

ولسعادتكم تحياتي ؛؛ ؛

مساعد الرئيس التنفيذي للتخطيط والبرامج

(بالنيابة)

م. عباس بن عبد الغني قطان

الخالدية (٢) الطريق الدائري الثالث مكة المكرمة - هاتف : ٥٤٠٤٠٤٠ / ٠١٢ فاكس : ٥٤٠٢٧٤٠ / ٠١٢ - www.mrda.gov.sa

Appendix F: The time preference to visit the central area

When do you often visit the Al-Haram during the day?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Early Morning	86	21.5	21.5	21.5
	Between Morning and noon	4	1.0	1.0	22.5
	Afternoon to sunset	34	8.5	8.5	31.0
	Afte sunset	207	51.7	51.7	82.8
	On every prayer	20	5.0	5.0	87.8
	On some prayers	48	12.0	12.0	99.8
	During work hours	1	.3	.3	100.0
	Total	400	100.0	100.0	

Appendix G: Users' perceptions on the degree of satisfaction about the suitability of current sidewalks for pedestrians with special needs and mobility issues based on age group

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
The current sidewalks are suitable for disabled people with wheelchairs * Age	400	100.0%	0	0.0%	400	100.0%

			Age				
			20-30	31-40	41-50	Above 50	Total
The current sidewalks are suitable for disabled	Strongly Disagree	Count	12	23	21	18	74
		% within Age	13.6%	18.5%	20.6%	20.9%	18.5%

people with wheelchairs	Disagree	Count	26	57	48	34	165
		% within Age	29.5%	46.0%	47.1%	39.5%	41.3%
	Neuter	Count	22	28	16	22	88
		% within Age	25.0%	22.6%	15.7%	25.6%	22.0%
	Agree	Count	19	14	17	7	57
		% within Age	21.6%	11.3%	16.7%	8.1%	14.2%
	Strongly agree	Count	9	2	0	5	16
		% within Age	10.2%	1.6%	0.0%	5.8%	4.0%
Total		Count	88	124	102	86	400
		% within Age	100.0%	100.0%	100.0%	100.0%	100.0%

Appendix H: The association between most limiting factors on walking within Central Makkah area and the respondents age

Post Hoc Tests

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Age	(J) Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
most limiting factors on walking within Central Makkah area (climate)	20-30	31-40	-.054	.065	.839	-.22	.11
		41-50	-.068	.068	.746	-.24	.11
		Above 50	-.035	.071	.961	-.22	.15

	31-40	20-30	.054	.065	.839	-.11	.22
		41-50	-.014	.062	.996	-.17	.15
		Above 50	.019	.065	.991	-.15	.19
	41-50	20-30	.068	.068	.746	-.11	.24
		31-40	.014	.062	.996	-.15	.17
		Above 50	.033	.068	.962	-.14	.21
	Above 50	20-30	.035	.071	.961	-.15	.22
		31-40	-.019	.065	.991	-.19	.15
		41-50	-.033	.068	.962	-.21	.14
most limiting factors on walking within Central Makkah area (traffic congestions)	20-30	31-40	-.165	.069	.078	-.34	.01
		41-50	-.196*	.072	.033	-.38	-.01
		Above 50	-.173	.075	.096	-.37	.02
	31-40	20-30	.165	.069	.078	-.01	.34
		41-50	-.031	.066	.966	-.20	.14
		Above 50	-.008	.069	.999	-.19	.17
	41-50	20-30	.196*	.072	.033	.01	.38
		31-40	.031	.066	.966	-.14	.20
		Above 50	.023	.072	.989	-.16	.21
	Above 50	20-30	.173	.075	.096	-.02	.37
		31-40	.008	.069	.999	-.17	.19
		41-50	-.023	.072	.989	-.21	.16
most limiting factors on walking within	20-30	31-40	-.130	.061	.143	-.29	.03
		41-50	-.177*	.063	.027	-.34	-.01

Central Makkah area (topography)		Above 50	-.178*	.066	.037	-.35	-.01
	31-40	20-30	.130	.061	.143	-.03	.29
		41-50	-.048	.058	.846	-.20	.10
		Above 50	-.048	.061	.862	-.21	.11
	41-50	20-30	.177*	.063	.027	.01	.34
		31-40	.048	.058	.846	-.10	.20
		Above 50	.000	.064	1.000	-.16	.16
	Above 50	20-30	.178*	.066	.037	.01	.35
		31-40	.048	.061	.862	-.11	.21
		41-50	.000	.064	1.000	-.16	.16
most limiting factors on walking within Central Makkah area (The condition of the available sidewalks)	20-30	31-40	-.157	.066	.086	-.33	.01
		41-50	-.066	.069	.777	-.24	.11
		Above 50	.063	.072	.820	-.12	.25
	31-40	20-30	.157	.066	.086	-.01	.33
		41-50	.091	.064	.482	-.07	.25
		Above 50	.219*	.067	.006	.05	.39
	41-50	20-30	.066	.069	.777	-.11	.24
		31-40	-.091	.064	.482	-.25	.07
		Above 50	.128	.069	.253	-.05	.31
	Above 50	20-30	-.063	.072	.820	-.25	.12
		31-40	-.219*	.067	.006	-.39	-.05

		41-50	-.128	.069	.253	-.31	.05
most limiting factors on walking within Central Makkah area (The lack of pedestrian corridor)	20-30	31-40	-.179*	.069	.048	-.36	.00
		41-50	-.054	.072	.879	-.24	.13
		Above 50	-.057	.075	.871	-.25	.14
	31-40	20-30	.179*	.069	.048	.00	.36
		41-50	.126	.066	.231	-.05	.30
		Above 50	.122	.070	.298	-.06	.30
	41-50	20-30	.054	.072	.879	-.13	.24
		31-40	-.126	.066	.231	-.30	.05
		Above 50	-.004	.073	1.000	-.19	.18
	Above 50	20-30	.057	.075	.871	-.14	.25
		31-40	-.122	.070	.298	-.30	.06
		41-50	.004	.073	1.000	-.18	.19

*. The mean difference is significant at the 0.05 level.

Appendix K:

Post Hoc Tests

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Age	(J) Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
walking experience more attractive, enjoyable and comfortable (trees)	20-30	31-40	-.102	.060	.319	-.26	.05
		41-50	-.070	.062	.674	-.23	.09
		Above 50	-.028	.065	.973	-.20	.14
	31-40	20-30	.102	.060	.319	-.05	.26
		41-50	.032	.057	.944	-.12	.18
		Above 50	.074	.060	.607	-.08	.23
	41-50	20-30	.070	.062	.674	-.09	.23
		31-40	-.032	.057	.944	-.18	.12
		Above 50	.042	.063	.908	-.12	.20
	Above 50	20-30	.028	.065	.973	-.14	.20
		31-40	-.074	.060	.607	-.23	.08
		41-50	-.042	.063	.908	-.20	.12
walking experience more attractive, enjoyable and comfortable in (Canopies)	20-30	31-40	-.029	.065	.969	-.20	.14
		41-50	.038	.067	.943	-.14	.21
		Above 50	.065	.070	.791	-.12	.25
	31-40	20-30	.029	.065	.969	-.14	.20
		41-50	.067	.062	.699	-.09	.23
		Above 50	.094	.065	.468	-.07	.26
	41-50	20-30	-.038	.067	.943	-.21	.14
		31-40	-.067	.062	.699	-.23	.09
		Above 50	.027	.068	.978	-.15	.20

	Above 50	20-30	-.065	.070	.791	-.25	.12
		31-40	-.094	.065	.468	-.26	.07
		41-50	-.027	.068	.978	-.20	.15
walking experience more attractive, enjoyable and comfortable in (Fountains)	20-30	31-40	-.075	.070	.705	-.25	.10
		41-50	-.140	.073	.219	-.33	.05
		Above 50	-.033	.076	.973	-.23	.16
	31-40	20-30	.075	.070	.705	-.10	.25
		41-50	-.065	.067	.763	-.24	.11
		Above 50	.042	.070	.932	-.14	.22
	41-50	20-30	.140	.073	.219	-.05	.33
		31-40	.065	.067	.763	-.11	.24
		Above 50	.107	.073	.459	-.08	.30
	Above 50	20-30	.033	.076	.973	-.16	.23
		31-40	-.042	.070	.932	-.22	.14
		41-50	-.107	.073	.459	-.30	.08
walking experience more attractive, enjoyable and comfortable in (sidewalks width)	20-30	31-40	-.070	.068	.728	-.25	.10
		41-50	-.037	.071	.955	-.22	.15
		Above 50	.172	.074	.092	-.02	.36
	31-40	20-30	.070	.068	.728	-.10	.25
		41-50	.034	.065	.954	-.13	.20
		Above 50	.243*	.068	.002	.07	.42
	41-50	20-30	.037	.071	.955	-.15	.22
		31-40	-.034	.065	.954	-.20	.13
		Above 50	.209*	.071	.019	.03	.39
	Above 50	20-30	-.172	.074	.092	-.36	.02
		31-40	-.243*	.068	.002	-.42	-.07
		41-50	-.209*	.071	.019	-.39	-.03
walking experience more attractive, enjoyable and	20-30	31-40	.092	.068	.533	-.08	.27
		41-50	.146	.071	.171	-.04	.33
		Above 50	.181	.074	.070	-.01	.37

comfortable in (Places to sit and relax)	31-40	20-30	-.092	.068	.533	-.27	.08
		41-50	.054	.065	.841	-.11	.22
		Above 50	.090	.068	.558	-.09	.27
	41-50	20-30	-.146	.071	.171	-.33	.04
		31-40	-.054	.065	.841	-.22	.11
		Above 50	.036	.071	.960	-.15	.22
	Above 50	20-30	-.181	.074	.070	-.37	.01
		31-40	-.090	.068	.558	-.27	.09
		41-50	-.036	.071	.960	-.22	.15

*. The mean difference is significant at the 0.05 level.