An investigation of the driving factors affecting children's Water, Sanitation and Hygiene (WASH) behaviours in East New Delhi primary schools

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Abstract

Sustainable Development Goal 6 (Clean Water and Sanitation) addresses gaps that persist in Water, Sanitation and Hygiene (WASH) access worldwide, particularly affecting poor communities' opportunity to live healthy, hygienic lives.

According to the 'Capability, Opportunity, Motivation Behaviour Model', these three domains must be addressed for WASH interventions to achieve sustained adoption of targeted behaviours. Numerous factors pertaining to these three domains enable or obstruct East New Delhi primary school children's WASH behaviours and therefore progress towards SDG 6. This thesis investigates these driving factors, analysing mixed methods data gathered in three government schools and one low-fee private (LFP) school, as well as in the communities surrounding them. The main findings indicate that:

- Children attending the LFP school practise positive WASH behaviours more frequently than government school children and have access to superior school WASH provision. Children at schools with higher-quality WASH facilities are more likely to practise positive WASH behaviours.
- School principals face challenges in providing adequate school WASH facilities and ensuring that children have the capability, opportunity and motivation to practise positive WASH behaviours. These include insufficient funding, teachers' obligatory non-school commitments, unexplained teacher absenteeism and a high turnover of students. Schools-based WASH interventions can mitigate these, particularly by motivating school staff.
- Socio-economic status affects children's opportunity to adopt positive WASH behaviours. Children from lower-income backgrounds practise positive WASH behaviours less often. Schools-based WASH interventions could mitigate this through outreach to parents and children transferring learning into the household.

These findings reveal the driving factors affecting children's capability, opportunity and motivation to practise positive WASH behaviours in East New Delhi primary schools. Secondly, they highlight action which could be taken to support children's sustained adoption of these behaviours, securing progress towards SDG 6 for the next generation.

Acknowledgement

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Glossary of Terms

AAP – Aam Aadmi Party
ANOVA – Analysis of Variance
BBC – British Broadcasting Corporation
BCC – Behaviour Change Communication
BERA – British Educational Research Association
BJP – Bharatiya Janata Party
CD – Coefficient of Determination
CFI – Comparative Fit Index
CI – Confidence Interval
CLTS – Community-Led Total Sanitation
COM-B – Capability, Opportunity, Motivation - Behaviour
CURE – Centre for Urban and Regional Excellence
EDMC – East Delhi Municipal Corporation
EWS – Economically Weaker Section
GBV – Gender-Based Violence
GISA – Government Intervention GISA
GISB – Government Intervention GISB
GNIS – Government Non-Intervention School
GDP – Gross Domestic Product
HWISE – Household Water Insecurity Experiences
HWWS – Hand Washing With Soap
IBM-WASH – Integrated Behavioural Model for Water, Sanitation, and Hygiene
IEC – Information, Education and Communication
IQ – Intelligence Quotient
LFP – Low-Fee Private
LFPS – Low-Fee Private School
LSHTM – London School of Hygiene and Tropical Medicine
MDGs – Millennium Development Goals
MHM – Menstrual Hygiene Management
NCT – National Capital Territory
NISA – National Independent Schools Alliance
NGO – Non-Governmental Organisation
OD – Open Defecation
PTA – Parent-Teacher Association
RCT – Randomised Controlled Trial
RMSEA – Root Mean Square Error of Approximation
RO – Reverse-Osmosis
RQ – Research Question
SBA – *Swachh Bharat Abhiyan* (Clean India Mission)
SDGs – Sustainable Development Goals
SD – Standard Deviation
SE – Standard Error
SEM – Structural Equation Modelling
SLTS – School-Led Total Sanitation
SPSS – Statistical Package for the Social Sciences

SRMR – Standardised Root Mean Square Residual
STH – Soil-Transmitted Helminth
TLI – Tucker-Lewis Index
TSC – Total Sanitation Campaign
UNDP – United Nations Development Programme
UNGA – United Nations General Assembly
UNICEF – United Nations Children's Fund
WASH – Water, Sanitation and Hygiene
WHO – World Health Organization

Chapter One: Introduction

1.1 Introduction

During data collection for this doctoral thesis at a government primary school in which comprehensive infrastructural and educational work on Water, Sanitation and Hygiene (WASH) was implemented by a local NGO in 2018, two interpreters and I (the researcher) observed the children's breaktime. We watched as two children planted a cutting from a tree branch in the ground. The children left and returned with a plateful of water with which they watered their cutting. One of the interpreters asked them why they had planted it and one replied:

> So that it can give us some shade in summer and some fruits as well.
>
> (Government Intervention School A male student, 20th January 2020)

It was encouraging to see children taking responsibility for their school environment and recognising the benefits that can arise from doing so. However, their enthusiasm stood in contrast to the attitude presented by some school staff, as indicated by a senior teacher during an interview:

> These children are from the backward and very poor class families. So definitely what they see here, they don't see at home…more than half of the time they are with their parents, so whatever the things we teach here, whatever we do with them, they don't follow at home. If their families were quite healthy and very much comfortable to afford everything, definitely the change would have been better, it would have come earlier.
>
> (Male teacher at Government Intervention School A, 17th January 2020)

This teacher's connection of children's socio-economic status to their adoption of positive WASH-related behaviours illustrates the rationale of this thesis research. Certain driving factors enable or impede children's WASH behaviours and one of these could be socio-economic status. This research investigates these driving factors, exploring how to accelerate progress towards the United Nations' Sustainable Development Goal 6: Clean Water and Sanitation (United Nations General Assembly, 2015) in the context of East New Delhi primary schools.

One such driving factor particularly prominent in the literature is schools-based WASH intervention programmes similar to the one implemented by an Indian non-governmental organisation (NGO), the Centre for Urban and Regional Excellence (CURE), which serves as the setting for this research. Many programmes such as this take place in schools attended by children from a low-income background with the aim of addressing the WASH-related inequalities investigated in this research (Hetherington et al., 2017; Chard and Freeman, 2018; Vally et al., 2019). It was clear that the small cutting planted by the children during that breaktime would not take root in the long term and the same is true of many schools-based WASH programmes. Humphrey (2019) highlights this, arguing that 'One reason for the poor efficacy of low-cost WASH interventions is their requirement for high user adherence to consistent behaviour change' (p1158). In other words, programme outcomes are often not sustained because, although extensive infrastructural improvements (WASH hardware) have taken place, these are not necessarily accompanied by the adoption of sustained positive behaviour change (WASH software). This phenomenon is particularly visible on a national scale in India through the *Swachh Bharat Abhiyan* (SBA, Clean India Mission), an accelerated nationwide campaign to build latrines which is explored further later in this introductory chapter (section 1.8.2). It is also seen at a local level in the Economic Survey of Delhi 2019-2020 (Government of National Capital Territory (NCT) of Delhi, 2020) which states that all schools in Delhi have gender-separate toilets and drinking water facilities. This implies that each school is equipped to offer this safe environment to its students but provides no comment on whether it is adequately maintained, functioning or used correctly. This focus on the WASH hardware aspect (infrastructure improvements) at the expense of WASH software (behaviour change activities) presents barriers to the continuation of long-term positive outcomes from schools-based WASH interventions. These have adverse effects on the extent to which children access 'safe, non-violent, inclusive and effective learning environments' (SDG Target 4.a, United Nations General Assembly, 2015, p19) and on their capability, opportunity and motivation to adopt positive WASH behaviours long-term.

The Capability, Opportunity, Motivation Behaviour (COM-B) model (Michie et al., 2011) is a theoretical framework useful for designing programmes such as schools-based WASH

interventions, as well as for identifying how behaviour change can be sustained post-implementation. The COM-B model states that the three domains of capability, opportunity and motivation must be explicitly addressed to bring about successful, long-term behaviour change. Michie et al. (2011) explain the model:

> Capability is defined as the individual's psychological and physical capacity to engage in the activity concerned...Motivation is defined as all those brain processes that energize and direct behaviour...It includes habitual processes, emotional responding, as well as analytical decision-making. Opportunity is defined as all the factors that lie outside the individual that make the behaviour possible or prompt it.

> (p4)

The broader concept of capability in the context of international development was explored by the economist Amartya Sen in his book *Development as Freedom* (2001). For Sen, poverty is more multifaceted than a simple measurement of income and he structures his argument around the notion of freedom:

> ...there is a strong case for judging individual advantage in terms of the capabilities that a person has, that is, the substantive freedoms he or she enjoys to lead the kind of life he or she has reason to value...poverty must be seen as the deprivation of basic capabilities rather than merely as lowness of incomes

> (p87)

Sen defines capability as the mixture of 'functionings' (ibid., p75) that a person is capable of attaining to achieve these 'substantive freedoms' (ibid., p87). He gives the example of adequate nutrition and avoiding disease. In the context of WASH, these may be as simple as accessing clean water or on a more abstract level, living life with dignity. It follows that these 'functionings' (ibid. p75) are dictated by both internal and external factors and Nussbaum builds on Sen's concept of the capability approach by differentiating between 'internal capabilities' and 'combined capabilities' (2011, p21). The former includes 'trained or developed traits and abilities' (ibid.), such as handwashing with soap, while the latter refers to these internal abilities in conjunction with the external circumstances which facilitate a given functioning. Thus, the three domains of the COM-B model interact to produce these 'combined capabilities' (ibid.).

As presented in Figure 1, one example of this pertinent to the current research could be how a child being taught how to use a toilet block (capability in the COM-B model sense) combines with their understanding that open defecation is harmful (motivation) and the provision of a clean toilet facility (opportunity) to facilitate hygienic toilet use.

Figure 1 Example application of the COM-B model and capability approach

Potential driving factors

School WASH provision

COM-B

Capability - teaching
Opportunity - facilities
Motivation - understanding

Combined capabilities

- Taught to use a toilet block
- School provision of clean toilet facility
- Understanding that OD is harmful

Functionings

- Live life free of disease
- Access a clean and safe school environment
- Practise WASH-related activities in a dignified way

(Sen, 2001; Michie et al, 2011; Nussbaum, 2011)

The 'functionings' (Sen, 2001, p75) that people are capable of attaining relating to WASH include living lives free of disease, accessing a clean and safe school environment and practising WASH-related activities in a dignified way. This research investigates the factors that drive children's 'internal capabilities' (Nussbaum, 2011, p21) which in turn ultimately dictate these 'functionings' (Sen, 2011, p75), such as their WASH behaviours like handwashing with soap before eating and after using the toilet. These 'internal capabilities' (Nussbaum, 2011, p21) join with potential external factors such as school WASH facilities and socio-economic status to form 'combined capabilities' (ibid.) which govern children's 'functionings' (Sen, 2011, p75).

The COM-B model (explained in more detail in section 1.8.3) is applied during this research to consider the driving factors affecting children's WASH behaviours. These two areas of children's WASH behaviours and the factors affecting them join to form children's 'combined capabilities' (Nussbaum, 2011, p21) to attain 'functionings' (Sen, 2011, p75) relating to WASH, thus contributing towards 'substantive freedoms' (ibid., p87) to live a life that they value. The three research questions (RQs), listed in section 3.1.1, focus on the effect of school WASH provision on children's WASH behaviours, barriers and enablers to school management's provision of school WASH facilities and the effect of socio-economic status on children's WASH behaviours.

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This introduction chapter presents the concept of WASH, clarifying its definition and that of associated terms. A brief history is given of WASH in the development sector, with a focus on the Millennium Development Goals (MDGs, 2000) and the Sustainable Development Goals (SDGs, 2015). An argument for the importance of WASH is presented with insights regarding human rights, women's experiences and water security. Finally, key WASH initiatives in India and the application of the COM-B model in the context of WASH are examined before the thesis's core contribution to knowledge and an outline of the thesis structure are detailed.

1.2 The case for researching WASH

Access to WASH and a deep understanding of its importance are vital for human health, development and wellbeing; this is particularly true for low-income households and is particularly true in light of the COVID-19 pandemic. WASH access and behaviours are affected by socio-economic status and are one integral pillar upon which success in achieving the SDGs will be built across the world's poorest communities, as explained by Hutton and Chase (2017):

> Safe drinking water, sanitation, and hygiene (WASH) are fundamental to improving standards of living for people. The improved standards made possible by WASH include, among others, better physical health, protection of the environment, better educational outcomes, convenience time savings, assurance of lives lived with dignity, and equal treatment for both men and women. Poor and vulnerable populations have lower access to improved WASH services and have poorer associated behaviors. Improved WASH is therefore central to reducing poverty, promoting equality, and supporting socio-economic development.

(p171)

Worldwide, vast inequalities in WASH access persist; a significant proportion of the global population remains without adequate WASH access, particularly sanitation, and this is skewed towards the Global South. Furthermore, India is the only country in the world where more than 500 million people live without access to improved sanitation (Figure 2).

Figure 2 Number of people without access to improved sanitation, 2015
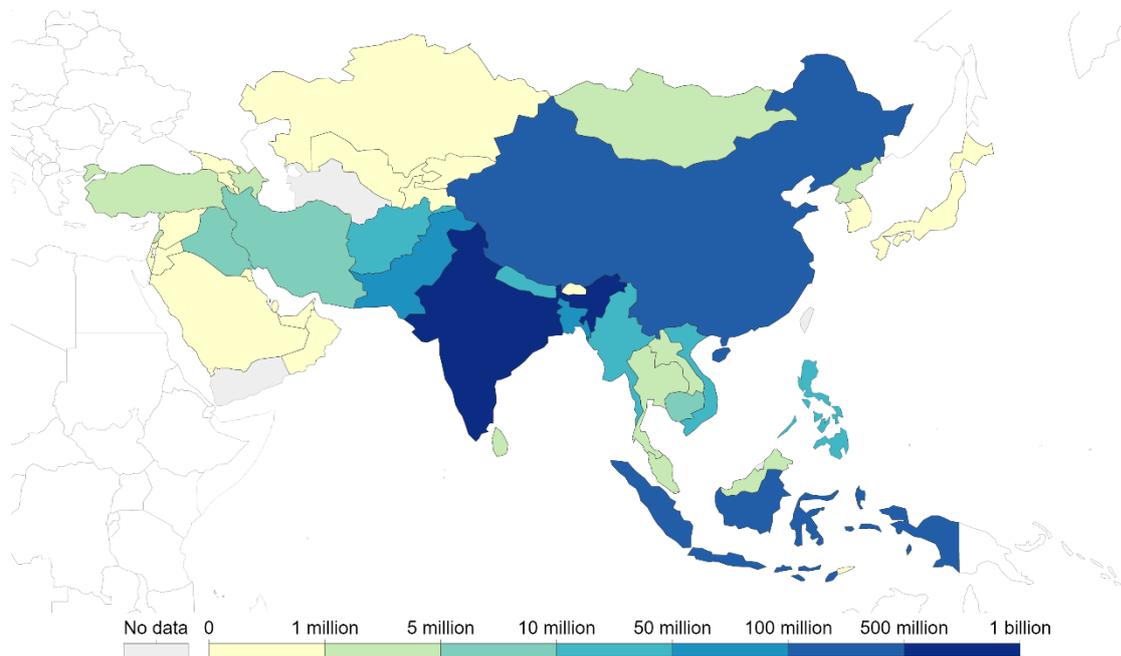
Source: Our World in Data based on the World Bank, World Development Indicators   OurWorldInData.org/sanitation • CC BY
Note: Improved sanitation facilities include flush/pour flush (to piped sewer system, septic tank, pit latrine), ventilated improved pit (VIP) latrine,
pit latrine with slab, and composting toilet.

(Ritchie and Roser, 2019)

It is important here to set out a clear meaning of the term WASH and the phraseology associated with it. At its most basic level, WASH (Water, Sanitation and Hygiene) can be described as 'Access to clean water, basic toilets, and good hygiene practices' (UNICEF, 2021, para. 1). However, each of its components contain nuances which are not captured by the acronym.

First, with regards to water, the WHO and UNICEF Joint Monitoring Programme uses several different categories to define levels of water access: surface water, unimproved, limited, basic and safely managed (Table 1). The term 'improved' is defined as 'piped water, boreholes or tubewells, protected dug wells, protected springs, and packaged or delivered water' (WHO/UNICEF, 2017b, p8). As of 2017, water delivered by tankers or local carts and packaged water (e.g. bottles and sachets) are now defined as improved whereas previously they were recorded as an unimproved source due to insufficient data. Table 1 denotes the water sources classified as 'unimproved' or 'no service'. 144 million people worldwide relied on surface water in 2017 (ibid.). The WHO and UNICEF Joint Monitoring Programme report that in 2017, 641 million people worldwide only accessed a water source for drinking classified as 'limited' (2019). In 2015, less than half

of the population of India accessed a safely managed source of drinking water (WHO/UNICEF, 2017a) and the continued, unsustainable exploitation of groundwater is a major concern in Delhi, the setting of this thesis study (Das, 2020). In 2017, the maximum level of groundwater withdrawal considered to be sustainable was exceeded by 20% (National Statistical Office of India, 2020). In 2018, piped water into the home was the principal source of drinking water for 63% of households in Delhi. 14.1% of households depended on bottled water (National Statistical Office of India, 2019).

Table 1 The WHO and UNICEF Joint Monitoring Programme ladder for household drinking water services

Service level	Definition
Safely managed	Drinking water from an improved water source that is located on premises, available when needed and free from faecal and priority chemical contamination
Basic	Drinking water from an improved source, provided collection time is not more than 30 minutes for a roundtrip, including queuing
Limited	Drinking water from an improved source for which collection time exceeds 30 minutes for a roundtrip, including queuing
Unimproved	Drinking water from an unprotected dug well or unprotected spring
Surface water	Drinking water directly from a river, dam, lake, pond, stream, canal or irrigation channel

(WHO/UNICEF, 2017b, p8)

Whether or not the WHO and UNICEF Joint Monitoring Programme's definitions are adequate is debated. Over ten years ago, Biswas (2010) drew attention to this:

> In my view, if an example of "improved sources" of water can be considered to be a standpipe one kilometer or more from households that delivers water of poor quality, the world has made only limited progress in terms of achieving the goal of providing access to clean water.

(p160)

One criticism is that water quality is not considered in the criteria for an improved source (Cronk et al., 2015). This is problematic; Bain et al. (2014) found that 'over a quarter of samples from improved sources contained fecal contamination in 38% of 191 studies' (p1). More recent research shows that this has not changed; Headey and Palloni (2019) argue that 'the official definition of "improved water" may need to be revisited' (p732) based on their finding from research in 59 countries that there is no statistically significant relationship between increased access to improved water sources and improvements in children's nutrition or health. On the contrary, they found that piped

water in the home, which is better quality than other purportedly improved sources, is positively associated with improvement in children's growth.

Secondly, regarding sanitation, the Water Supply and Sanitation Collaborative Council offers a comprehensive definition: 'the collection, transport, treatment and disposal or reuse of human excreta, domestic waste water and solid waste, and associated hygiene promotion' (Evans et al., 2009, p6). 1.3 billion people used 'limited' or 'unimproved' sanitation facilities in 2017 (WHO/UNICEF, 2019). Table 2 shows the definitions of different sanitation provision levels. The category of 'improved facilities' comprises 'flush/pour flush to piped sewer systems, septic tanks or pit latrines; ventilated improved pit latrines, composting toilets or pit latrines with slabs' (WHO/UNICEF, 2017b, p8). Globally, 673 million continued to practise open defecation (OD) in 2017 (WHO/UNICEF, 2019), approximately half of which were in India (World Bank, 2020a). That said, the practice of OD has greatly reduced in Delhi in recent years (Rahman et al., 2020). According to the National Statistical Office of India (2019), 99.5% of households in Delhi accessed a latrine in 2018 and 99.2% of people belonging to those households used their latrine regularly.

Table 2 The WHO and UNICEF Joint Monitoring Programme ladder for household sanitation services

Service level	Definition
Safely managed	Use of improved facilities that are not shared with other households and where excreta are safely disposed of in situ or transported and treated offsite
Basic	Use of improved facilities that are not shared with other households
Limited	Use of improved facilities shared between two or more households
Unimproved	Use of pit latrines without a slab or platform, hanging latrines or bucket latrines
Open defecation	Disposal of human faeces in fields, forests, bushes, open bodies or water, beaches or other open spaces, or with solid waste

(WHO/UNICEF, 2017b, p8)

Jenkins et al. (2014) provide evidence to question these definitions. More than half of the households they surveyed in Tanzania used a toilet that aligned with the 'improved' status criteria but just 8% used a facility that was considered by the authors to count as 'hygienically safe and sustainable sanitation' (p131). Headey and Palloni (2019) build on this, finding that replacing OD with sanitation provision classified as 'unimproved', such as a public shared latrine, leads to greater health improvements than upgrading 'unimproved' facilities to 'improved' status. In fact, Buckley and Kallergis (2019) contend

that shared sanitation facilities should be classified as 'improved'. Under current measures, there is no indicator to take into account progress towards SDG 6 sanitation targets through the proliferation of communal toilet facilities. Mara (2016) agrees with their assessment, citing the Indian community-led approach to shared sanitation as an example for other developing countries to follow in urban areas.

Finally, hygiene can be defined broadly in the development context as 'conditions and practices that help maintain health and prevent spread of disease including handwashing, menstrual hygiene management and food hygiene' (WHO/UNICEF, 2021, para.1). This thesis study aligns with this definition with hygiene, focusing largely on the WASH-related hygiene behaviour of handwashing. The WHO and UNICEF Joint Monitoring Programme (2019) reports that 60% of the population of India had basic handwashing facilities in the household in 2017. With specific regards to Delhi, the National Statistical Office of India (2019) alleges that in 2018, 73.5% of households in Delhi washed their hands with water and soap before a meal and 97.6% did so after defecating.

This thesis refers to WASH as set out in the above definitions and follows the literature in separating WASH interventions into the two domains of 'hardware' – the installation of infrastructure including toilets, handwashing facilities and water treatment equipment – and 'software' – the implementation of behaviour change communication (BCC) and hygiene promotion activities (Darteh et al., 2019; Dey et al., 2019). This section of the introductory chapter has set out the global problem of unequal access to WASH as well as the definitions of some key terms. The following section recounts the evolution of WASH as a key indicator of progress in the development sector.

1.3 WASH in the development sector

The consideration of WASH in the development sector can be traced to the adoption of the Universal Declaration of Human Rights in 1948, when water and sanitation were excluded from the text (de Albuquerque, 2014). It is theorised that this was because it was drafted largely by Western governments while 'Many countries whose populations suffered from a lack of access to water and sanitation were not directly represented at

the negotiating table.' (de Albuquerque, 2014, p23). Therefore, the inequalities presented starkly by Figure 2 above can be traced to the first global discourses on human rights (see section 1.5). Biswas (2010) notes that, despite the inaugural UN Water Conference in 1977, water continued to be omitted from humanitarian dialogue into the 1980s and 1990s and it is significant that this remains the only UN conference on water to be attended by a large majority of member states. Furthermore, he draws attention to the fact that the issue of sanitation has received even less focus than water:

> …whereas the United Nations proclaimed a World Water Day that has been regularly observed on March 22 since 1993, there has not been a corresponding day for sanitation. At previous count, the UN system has designated 65 issues worthy enough of a World Day. These currently include issues like television, mountains, and South-South Cooperation, but sanitation has not been considered important enough to have a World Day…The fact that the sanitation goal was added as an afterthought in the MDGs, and that there has been a day devoted to water but not to sanitation, clearly indicates that sanitation has not received the same level of attention from the national and international institutions and policy makers as water has.

(ibid., p159-160)

Around the turn of the millennium, WASH became more prominent in the human rights discourse with various human rights treaties mentioning it explicitly, including the Convention on the Rights of the Child (1990) and the Convention on the Rights of Persons with Disabilities (2006) (de Albuquerque, 2014). In 2002, the United Nations established the MDGs, eight global targets to be achieved by 2015 agreed upon at the Millennium Summit in 2000. 'Goal 7: Ensure environmental sustainability' included the target to 'Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation' (UNDP, 2020, para. 3). This was progressed further in 2013 when the Human Rights Council and the UN General Assembly joined together in reiterating their recognition of water and sanitation as human rights (de Albuquerque, 2014) before the publication of the SDGs in 2015. Goal 6 aims to 'Ensure availability and sustainable management of water and sanitation for all' (UNGA, 2015, p20) – thus the international perspective on WASH transformed from omission in 1948 to forefront focus in 2015.

In 2006, the United Nations Development Programme warned that, with the rate of progress at that time, the MDG target of halving the proportion of people without access to sanitation by 2015 would not be achieved globally and would not be attained in sub-Saharan Africa until 2076. Cumming (2009) attributed this to 'political neglect', lamenting that 'sanitation remains largely absent in national development plans and donor aid strategies' and claiming that the 'Lack of investment in sanitation reveals a blind spot in development policy: a failure to recognise sanitation's integral role in reducing poverty' (p9). More recent literature suggests that this problem still persists; Mariwah (2018) refers to sanitation as 'the neglected Siamese twin of water' (p223) and in their large-scale cross-disciplinary review, Hyun et al. (2019) also mention this inattention to sanitation, particularly in urban contexts.

It is clear then that in consideration of the driving factors securing children's WASH behaviours, addressing sanitation must be considered in conjunction with safe water access. The following presents an overview of the MDGs and SDGs that strengthens the claim that WASH is indispensable in the fight against poverty, situating the research in the wider field of contemporary global development.

The final MDG report claims that the objective of halving the number of people across the world without safe drinking water was achieved (UNDP, 2015). However, before this announcement, Clasen (2012) pointed to the problematic nature of the target, explaining that it is undermined by the inadequate definition provided in the MDGs of 'sustainable access to safe drinking water' (p1178). The MDG target did not sufficiently take into account specific challenges relating to water access, quantity and quality and instead relied on information about households' type of water supply – this is a concern raised in other studies also (James, 2006; Dar and Khan, 2011; Smiley, 2017). Clasen (2012) also notes that the WHO and UNICEF Joint Monitoring Programme's MDG progress evaluation studies in six countries showed that allegedly 'improved' supply types 'were often microbiologically and chemically contaminated' (p1179). In short, a household may have a consistent supply of piped water that is designated as safe but if it is contaminated, it is unsafe. This criticism of the alleged progress during the MDGs

corresponds with one of the main motivations behind this thesis research; it may be true that all schools have WASH facilities but if these are not maintained, they are unsafe.

The issues of access to clean water and sanitation are addressed in significantly more detail in the SDGs with an entire goal dedicated to WASH and specific, quantifiable targets (United Nations, 2015). Furthermore, SDG 6: Clean Water and Sanitation is intrinsically linked to many of the other SDGs (Milan, 2017). For example, poverty alleviation (SDG 1) in the Global South is not possible without ensuring access to clean, potable water (Adams et al., 2020). Poor health (SDG 3) can be mitigated to a great extent if people are able to stay hydrated and avoid diarrhoea-related diseases (Dos Santos et al., 2015). Finally, access to education (SDG 4) can be improved significantly by providing WASH infrastructure in schools, resulting in a supportive environment for girls in managing menstrual hygiene (Ellis et al., 2016). In fact, 'SDG 4 (Quality Education) target 4.a includes an explicit reference to WASH in the school-setting, as a key component of a 'safe, non-violent, inclusive and effective learning environment' (Chatterley et al., 2018, p595).

Cavill et al. (2016) join with Clasen (2012) in commenting on the variable degree of success of the MDGs, stating that

> Over the lifetime of the MDGs, 2.1 billion people gained access to improved sanitation between 1990 and 2015. However, 2.4 billion people still use unimproved sanitation facilities, of which 1 billion practise open defecation

(2016, p245)

They also express concern at a potential similar outcome for the SDGs in predicting that without considerable acceleration, OD, the eradication of which is a principal target of SDG 6, will still be practised in the poorest rural areas of the world in 2030 (ibid.). This is why the United Nations General Assembly (UNGA) launched the 'Decade of Action' for 2018-2028 (United Nations, 2020b) to accelerate progress in the SDGs. Thus, it is paramount to establish frameworks for monitoring WASH progress globally, especially in locations such as urban India where it is inadequate. Furthermore, Chatterley et al. (2018) indicate the importance of matching national targets with SDG targets. When data are collected in schools, an opportunity for useful analysis is lost if there is no

universal evaluation criteria. With current progress, it is improbable that the challenge to eliminate OD worldwide will be successful (Mara, 2017). A sea change in global perception of the importance of WASH is required; investment in WASH hardware and software in schools, such as the initiative that acts as the backdrop to this current study, is vital.

An overview of the SDG targets and indicators relevant to WASH in schools and this current study is presented in Table 3. The most applicable of these are found in SDG 6 (Clean Water and Sanitation) but some from SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-Being) and SDG 4 (Quality Education) are also pertinent. The subsequent paragraphs set out how each of these is linked with SDG 6.

Table 3 Sustainable Development Goals: Targets and Indicators

	SDG Global Targets	SDG Global Indicators
SDG 6	6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all	6.1.1 Proportion of population using safely managed drinking water services
	6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations	6.2.1 Proportion of population using a) safely managed sanitation services and b) a hand-washing facility with soap and water
SDG 1	1.4 By 2030, ensure all men and women, in particular the poor and vulnerable, have equal rights to economic resources as well as access to basic services…	1.4.1 Proportion of population living in households with access to basic services (including access to basic drinking water, basic sanitation and basic handwashing facilities)
SDG 2	2.2 By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls…	2.2.1 Prevalence of stunting…among children under 5 years of age
SDG 3	3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.	3.9.2 Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene…
SDG 4	4.1 By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes	4.1.1 Proportion of children and young people: (a) in grades 2/3; (b) at the end of primary; and (c) at the end of lower secondary achieving at least a minimum proficiency level in (i) reading and (ii) mathematics, by sex
	4.a Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all	4.a.1 Proportion of schools with access to…(e) basic drinking water, (f) single-sex basic sanitation facilities, and (g) basic handwashing facilities

(UNGA, 2015)

- SDG 6

Targets 6.1 and 6.2, which pertain to drinking water, sanitation and hygiene access, are selected as the SDG 6 objectives which most resonate with the current research project. According to the WHO and UNICEF Joint Monitoring Programme, India has seen considerable progress on these targets since the turn of the millennium. Between 2000 and 2017, the proportion of the population practising OD reduced by 47%, accounting for the majority of the world's reduction in this harmful practice. From 2000 to 2014, the rate of OD in rural India declined by around 3% per annum but data between 2015 and 2019 reveal a decrease of more than 12% per annum (WHO/UNICEF, 2019). This is attributed to the Indian government's *Swachh Bharat Abhiyan* (SBA) campaign but as is explored later in this chapter (section 1.8.2), there are considerable questions around reported figures and the reality across India, especially in rural areas. Open defecation is explored more fully in section 2.2.1.

Nationwide use of basic sanitation services increased by 43% between 2000 and 2017, with 486 million people gaining access (ibid.). In 2017, 92.7% of India's population accessed basic drinking water provision as a minimum. However, the remaining 7.3% using limited and unimproved sources or surface water amounts to 98.8 million people in such a heavily populated country so there is still much progress to be made (UNICEF, 2020). Furthermore, just 60% of the population had a handwashing facility at home with soap and water available in 2017 and 37 million people had no handwashing facility at all (WHO/UNICEF, 2019).

- SDG 1

Target 1.4, which refers to equitable access to economic resources and basic services, relates to the inequalities at play in access to WASH services in communities such as East New Delhi. In many countries, there are inequalities in water access between rural and urban communities and between the rich and poor. In India, there is a disparity in access to (at least) basic water provision of approximately 18% between rich and poor households (WHO/UNICEF, 2019). Data on basic handwashing facilities also point to inequalities with a gap of around 40% between the urban rich and the urban poor (ibid.). These indicate that progress towards SDG targets relating to inequality (SDG 1, as well as

SDG 10 which focuses specifically on this) in India does not align with the 2030 deadline (Roy and Roy, 2019).

- SDG 2

At first glance, Target 2.2, which aims to end malnutrition, appears to apply to food and not WASH. However, there is much evidence that the prevalence of diarrhoeal infections, particularly in low-income communities resulting in part from unequal WASH coverage, is a direct cause of stunting, defined as 'the impaired growth and development that children experience from poor nutrition, repeated infection, and inadequate psychosocial stimulation' (WHO, 2015, para. 1). Acute diarrhoea results in dehydration, inhibiting the body's absorption of nutrients (Cumming and Cairncross, 2016; Shrestha et al., 2020a). The literature relating to how stunting, a particular problem in India, is attributed to inadequate WASH is explored in more detail in section 2.2.3.

- SDG 3

If progress is to be made in improving health and reducing the number of WASH-related deaths in India, particularly among children, unsafe WASH services in schools should be highlighted. Diarrhoea is the third most common cause of child deaths in India (Jeyakumar et al., 2020) and there is much effort to reduce this through schools-based WASH improvements such as safer sanitation facilities and improved water quality, with varying success (Saboori et al., 2013; Chard et al., 2018; Gitore et al., 2020). For example, it should not be assumed that increasing latrine coverage specifically decreases the prevalence of diarrhoeal diseases (Clasen et al., 2014). More attention is given to associations between WASH and health in Chapter Two (section 2.2.2), including a discrete focus on COVID-19 in the context of India and schooling (section 2.2.4).

- SDG 4

The part of Target 4.1 (free and high-quality education) relevant to the current study is the specific differentiation between girls and boys. The 2019 Global Education Monitoring report indicates that since the turn of the millennium, steady progress has been made on gender parity in education but in 2017, only 57% of countries were at

parity for school enrolment (UNESCO, 2018). That said, school enrolment does not equate to school attendance. Inadequate WASH provision can have a detrimental impact upon gender parity in education as girls feel unsafe and do not receive sufficient support in MHM. As a result, the rate of their school absenteeism can increase (Jewitt and Ryley, 2014; Sivakami et al., 2019). Progress towards Target 4.a (school WASH facilities) will drive progress towards Target 4.1 as improvements in the safety and quality of learning environments will enable children, and particularly girls, to complete their education safely without interruption (WHO, 2019a).

1.4 The importance of WASH

The World Health Organization (2017) highlights sufficient WASH as the principal factor in the reduction of diarrhoeal disease. According to Moharana et al. (2019), diarrhoea leads to the deaths of approximately 300,000 children annually in India, accounting for 22% of deaths in 0-6 year-olds. Working to change perceptions of the importance of WASH, thereby decreasing OD and the dangerous diseases it facilitates, can have a profound impact on human health, development and wellbeing. This is explored further in Chapter Two with a review of the literature relating to OD and its damaging consequences including infectious diseases and child stunting. Furthermore, the spread of COVID-19 globally brings WASH into renewed focus. As of August 2021, India has the third-highest number of deaths in the world and various approaches to improving knowledge, attitudes and practices around WASH could have profound implications for how COVID-19 is managed in the future. These are explored later in Chapter Two (section 2.5) and include community-led total sanitation (CLTS), 'nudge' theory and sanitation marketing, and WASH-related literature emerging in light of the pandemic is also presented. Evidence also points to the benefits of WASH stretching beyond health to improved educational outcomes, increased convenience, dignity and equality (Hutton and Chase, 2017) and these themes are also explored (section 2.2.5).

It is worth highlighting the fact that sanitation is, globally-speaking, more problematic than water. The WHO and UNICEF (2017b) state that, at the time of publication, 844 million people remained without basic drinking water provision compared to 2.3 billion without basic sanitation. Agol and Harvey (2018) reinforce this point with a focus on

gender equality, finding that girls are more likely to drop out of school owing to a lack of toilets than a lack of water. Using a large sample of secondary data collected through Zambia's Education Management Information System, they conclude that 'Although both water and toilets are important resources in schools, the latter is a much more important determinant in girls' educational outcomes than the former' (p292).

In fact, the introduction to *Realising the Human Rights to Water and Sanitation: A Handbook* by former United Nations' Special Rapporteur on the human rights to safe drinking water, Catarina de Albuquerque, contends that 'water and sanitation should be treated as two distinct human rights with equal status, both included within the human right to an adequate standard of living' (2014, p19). The concern is highlighted that when water and sanitation are grouped together, there is a 'political and cultural preference' (p19) to focus on water. Maintaining them as two distinct areas of focus ensures that sanitation is not neglected when arguably, this is more dangerous than neglecting access to water. De Albuquerque (2014) explains that if a household does not possess safe sanitation, this can induce negative effects for neighbouring households through the spread of disease. However, this is not the case when a household lacks access to safe water as this problem does not exacerbate the spread of disease in the same way. If progress towards achieving SDG 6 is to be accelerated, due attention must be given to both water and sanitation. However, treating them as separate and distinct as de Albuquerque suggests could be problematic as it is important to acknowledge their symbiotic nature. For example, inadequate sanitation leads to the contamination of clean water sources (Kayembe et al., 2018). The following section discusses the recognition of water and sanitation as distinct human rights in greater detail.

1.5 Human rights

The United Nations General Assembly's Resolution 64/292 (2010) recognises water and sanitation as human rights, obligating states to make WASH provisions for all citizens indiscriminately (Cavill et al., 2016). Hall et al. (2014) describe the 2010 Resolution as a 'milestone' and point to the integral role that water plays in the realisation of other human rights such as 'the right to food and livelihoods' and 'the Convention on the Elimination of All Forms of Discrimination against Women' (p849). Heller (2015)

reiterates this, highlighting the fact that in adopting water and sanitation as a human right in 2010, the United Nations General Assembly (2010, p2) states that they are 'essential for the full enjoyment of life and all human rights' and are inter-linked with other human rights such as gender equality and the right to health. States are obligated to provide these rights for their citizens, who can hold their government to account to receive that to which they are entitled. However, a decade on, the fact that severe WASH-based inequalities still persist across the globe calls into question the efficacy of the 2010 Resolution.

Gupta et al. (2010) and Murthy (2013) argue that the 2010 Resolution is not sufficiently far-reaching, expressing concern regarding the extent of its legal reach. Murthy (ibid.) criticises the water industry's focus on financial stability and efficiency brought about by privatisation and optimistically champions the framing of water and sanitation as a human right, pointing to the 2010 Resolution's role in highlighting the problem of inequitable access across the globe. However, she explains that while it can be argued that the human right to water is enshrined in law internationally through the International Covenant on Economic, Social and Cultural Rights (1966), the same is not necessarily true of the human right to sanitation. Focusing on the human right to water, Tiboris (2019) also questions the strength of the Resolution, suggesting that although its official recognition by the UNGA is encouraging, 'its normative grounding remains obscure' (p916). He argues that regarding the human right to water, there are clear commitments for states which are not being met and points to the concept of progressive realisation. This is a human rights term which means that states which are included in a covenant are obliged to provide the human right in question but can work towards its full realisation gradually through national legislation. This provides some flexibility for states in meeting the requirements of the Resolution while pressuring them to make progress in doing so. In fact, India (and Delhi in particular), due to urban inequalities and groundwater depletion, still has considerable progress to make in effectuating the human right to water and sanitation (Mehta et al., 2014; Ghosh et al., 2019).

In reference to how the 2010 Resolution and SDG 6 fit together, the concept of progressive realisation aligns with the WHO/UNICEF Joint Monitoring Programme's frameworks of gradually implemented 'water and sanitation ladders which build on established indicators and establish new rungs with additional criteria relating to service levels' (2017b, p2). The human right to water and sanitation and this gradual improvement approach has the potential to recalibrate WASH-related public policies so that they prioritise inclusion and ensure equitable outcomes (Brown et al., 2016). Within the implementation of the human right to water and sanitation at the institutional level though, there is an interdependence between individual rights and the rights of the whole community. Someone may prefer to defecate in the open. However, this choice could have a detrimental impact on the rights of their fellow community members (Cavill et al., 2016).

Just as clean water and sanitation (SDG 6) is integral to progress on many other SDGs, it is impossible to ensure other human rights if the human right to water and sanitation is compromised. Catarina de Albuquerque (2014) explains that the right to education is not secure if students do not have access to water in school and the right to nutrition is more difficult to uphold without water for agriculture. Giné-Garriga et al. (2017) analyse to what extent the human right to sanitation is integrated into each aspect of SDG 6, concluding that the SDGs offer a better framework for realising the human right to sanitation than the MDGs. However, they point out that the SDGs do not offer guidance on monitoring how the needs of vulnerable groups are being addressed in order to reduce inequalities. Therefore, according to Giné-Garriga et al. (2017), in relation to human rights, the SDGs represent a movement in the right direction but require further thought.

According to de Albuquerque, community participation is vital in realising the human right to water and sanitation: 'Participation ensures better implementation and enhances the effectiveness and sustainability of interventions, offering the possibility of social transformation' (2014, p31). When people are involved in solutions for water and sanitation access in their own communities, progress is accelerated. Community-Led Total Sanitation (CLTS) is a behaviour change programme aiming to eradicate OD

through such community engagement. It relies on a 'triggering' process whereby people are led to experience shame and disgust at the realisation that 'we are eating each other's shit' (Cavill et al., 2016, p249). CLTS is relevant to any discussion of the human rights to water and sanitation at the individual and community level (Musembi and Musyoki, 2016) but such a participatory approach must be implemented with care. CLTS has received accusations of compromising human rights (Engel and Susilo, 2014). Cavill et al. (2016) point to some of the controversy that has surrounded the implementation of CLTS, citing reports of community members throwing rocks at others practising OD, threatening to withhold promised government grants or failing to take into account gender considerations, thus further burdening women. More focus is given to CLTS in Chapter Two (section 2.5.1) in an exploration of the literature pertaining to common WASH interventions.

A failure to enact the human right to water and sanitation particularly affects women, thus further entrenching WASH-based inequalities. Exploring this in the context of India, Koonan (2019) contends that interventions aiming to improve sanitation have been blind to patriarchal structures and gender inequalities, and raises particular concerns that, although legal structures take into account women's needs, this is not reflected in local implementation. As a result, women and girls eat and drink less to avoid practising OD during the day (see section 2.2.1). A lack of privacy means that many women wait until after dark to defecate, which presents a significant security risk. It is clear that the human right to water and sanitation is even more challenging to realise for women, who are particularly vulnerable to WASH-based inequalities as compared to men. Consequently, the following section explores the role of WASH in women's health and social well-being in greater detail.

1.6 WASH and women

Girls and women are particularly vulnerable to the negative consequences of WASH-based inequalities. In their large-scale study across 10,000 schools in Zambia and South Africa, Agol and Harvey (2018) state that

> Experiences across the world show that the lack of water and sanitation has far-reaching impacts on women's health and livelihoods; access to clean potable water and good sanitation can make a difference for mothers and babies…

> (p292)

In fact, such is the importance of satisfactory WASH services in schools that Agol and Harvey (ibid.) suggest that gender differences in the two focus countries may not be significant in schools with sufficient WASH facilities due to improvement in attendance across both genders. Hirve et al. (2014) also uncover psychosocial concerns for women in India who are unable to access toilets . These include embarrassment, shame and a lack of dignity. Clearly, the detrimental impacts of inadequate WASH provision for women are not limited to those associated with health and income. The following section outlines two of the major factors requiring attention in planning and implementing WASH interventions with girls' and women's needs in mind: menstrual hygiene management (MHM) and gender-based violence (GBV).

1.6.1 *Menstrual hygiene management (MHM)*

MHM is a major factor in the importance of realising the human right to water and sanitation, with major implications for gender equality, the focus of SDG 5. In essence, 'Given the impacts of inadequate resources and support for MHM, addressing these needs for women and girls is a public health priority' (MacRae et al., 2019, p2).

Conducting research in Ghana, Cambodia, Tanzania and Ethiopia, Sommer et al. (2015a) highlight the numerous challenges faced in MHM by school-age girls including unpredictable water access, inadequate sanitation infrastructure and a lack of options for disposal of menstrual products. These three barriers are also identified by Ellis et al. (2016) in a study based in the Philippines. Sommer et al. (2015a) show that a number of environmental factors affect girls' abilities to address these challenges such as the extent of their puberty education, their understanding of the socio-cultural implications surrounding MHM, their participation in school and how they interact with teachers, parents and each other. Common experiences across the four focus countries include

the role of culture in propagating stigma surrounding the menstrual cycle, inadequate access to knowledge on the matter and sub-standard sanitation facilities in schools.

In the Global South, school WASH facilities broadly do not make adequate provision for girls' MHM needs. Sommer et al. (2020) highlight the burgeoning worldwide focus on equipping girls to manage menstrual hygiene effectively. However, investigating the adequacy of sanitation provision in schools in Malawi to meet girls' MHM needs, Mchenga et al. (2020) find that there is much improvement required to ensure that these facilities are able to cater for adolescent girls. This includes guaranteeing gender-separate facilities at a distance from boys' facilities, functioning locks on doors, connected piped water, availability of handwashing facilities and access to disposal for menstrual hygiene products. These findings add to those of previous studies (Ellis et al., 2016; Ndlovu and Bhala, 2016) conducted in other countries, illustrating a growing concern that worldwide, school WASH facilities are failing to meet the needs of adolescent girls.

It is vital that schoolgirls have a voice in planning interventions which aim to improve MHM provision. Sommer (2010) points out that many interventions take place worldwide attempting to ensure that education is more gender-equitable but also laments that these do not give sufficient focus to the way in which school buildings themselves can contribute to gender-based discrimination. She advocates more community participation in research, arguing that including schoolgirls' preferences and ideas in the process of planning interventions is vital for ensuring that they continue to attend during monthly menstruation. Sahin (2015) adds that this should not just take into account the practical management of the menstrual cycle but also social beliefs and stigma surrounding it.

Cementing a link between SDG 6 (Clean Water and Sanitation) and SDG 5 (Gender Equality), Jewitt and Ryley (2014) reinforce this view that more attention must be paid to the everyday experiences of schoolgirls in designing interventions aimed at reducing gender inequalities. They undertook qualitative research with girls in Kenya attending nine schools, revealing 'a re-patterning of schoolgirls' everyday spatial movements when they reached puberty...as their access to social capital assets - especially education - was

curtailed' (p144-145). A lack of access to facilities and equipment to manage menstrual hygiene results in girls' absenteeism and increased gender inequality. This is a finding shared by Nielsen and Plan India (2010), who state that substandard menstrual hygiene provision results in pubescent girls missing five school days per month on average. The issue of MHM must be at the forefront when planning and implementing WASH interventions in schools so that postmenarcheal girls access the facilities they need to feel comfortable in continuing to attend school. Thus, their opportunities, not just for further education but future income and participation in society as well, will not be under threat (Cavill et al., 2016).

Crofts and Fisher (2012) reinforce this conclusion, criticising the WASH sector for neglecting the issue of MHM. They investigate whether low-cost, reusable sanitary pads can form part of a solution for schoolgirls in Uganda. Following Sommer's (2010) call to involve girls in research around this issue, they employ a participatory approach 'designed to foster inductive reasoning whereby ideas emerging during the research process could be explored further' (p51-52). They discover a strong demand for low-cost sanitary pads and find that a lack of MHM education and pain relief are just as problematic for participating girls as inadequate access to appropriate, affordable sanitary equipment.

Adding perspective from the home environment to these school-based insights, Muralidharan (2019) researches MHM practices among women living in low-income settlements in Mumbai, India. She shares a quotation from a 15-year old who does not attend school, exemplifying the injustices and stigma faced by adolescent girls:

> I don't think it is easy to use pads in this slum. You have to throw used pads in the gutter outside the house. And when we do that, everyone will come to know that we have our period. People will shout that pads are being thrown in the gutter for everyone to see…If someone sees our used pad—we have committed a sin! People will abuse you.

(p22)

Clearly, this stigma is a psychosocial form of GBV, an urgent issue worldwide which is ostensibly linked to WASH provision. The following section clarifies this link with evidence particularly focused on India and Delhi.

1.6.2 *Gender-based violence (GBV)*

GBV affects women worldwide and is particularly prevalent in low-income communities (Muluneh et al., 2020). This is inter-linked with MHM as the limited provision of WASH resources and facilities to practise MHM safely facilitates instances of GBV (Muralidharan et al., 2015). As such, GBV is a particularly damaging symptom of WASH-based inequalities. SDG 5 aims to 'Achieve gender equality and empower all women and girls' (UNGA, 2015, p20). The targets refer to ending discrimination, eliminating violence and harmful practices such as female genital mutilation and ensuring equal opportunities in all areas of life. This is a hugely important focus in the SDGs as one does not need to look very far to find numerous accounts of sexual violence resulting from inadequate WASH provision (Pommells et al., 2018). One mother from Delhi recounts her experience: 'We have had had one-on-one fights with thugs in order to save our daughters from getting raped. It then becomes a fight that either you kill me to get to my daughter or you back off' (Gosling, 2014).

Reuters reported in 2014 that two adolescent girls in Uttar Pradesh had been raped and murdered while travelling to defecate together in the evening; this case was widely reported across the globe (Bhalla, 2014). This tragic crime demonstrates that a lack of appropriate WASH provision for girls provides opportunities for perpetrators of GBV to commit offences that might have otherwise been prevented through access to WASH infrastructure. Although it is not uncommon for boys and men to be targeted in instances of GBV (House, 2013; Malik and Nadda, 2019), the following discussion will focus on its impact upon women in the context of WASH.

The existing literature reveals the prevalence of GBV in developing countries, which is facilitated in part by substandard WASH provision and damaging WASH knowledge, attitudes and practices (Wali et al., 2020). Sommer et al. (2015b) criticise the WASH research community for failing to pay sufficient attention to this issue. In their review of 275 existing articles relevant to the topic, they outline four types of violence as relevant to WASH – sexual, psychological, physical and socio-cultural. They cite communal toilet facilities as a particular danger area, as well as women adopting traditionally masculine roles such as repairing WASH facilities. House and Cavill (2015) highlight the threat of

those in positions of responsibility for WASH provision who 'may demand favours from community members for their services' (p4), suggesting that GBV is a problem at the institutional level as well as the community level. They outline a number of approaches that can be taken to reduce GBV, such as the use of promotional posters (Figure 3) and the increased participation of women in Community-Led Total Sanitation (CLTS) meetings, ensuring peer support for women involved in increasing WASH provision and thereby reducing the risk of harassment.

Figure 3 Poster addressing GBV in the context of WASH access in Sri Lanka
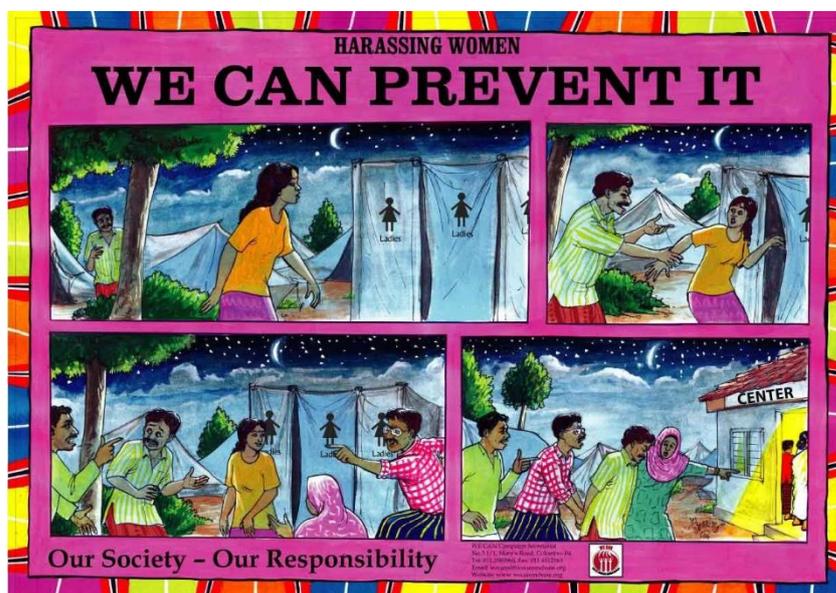
(House and Cavill, 2015, p16)

Looking at the issue on a wider scale, Gonsalves et al. (2015) underscore sexual violence as a critical worldwide public health issue that, according to a WHO (2013a) estimate, impacts 35% of women across the globe. They acknowledge a number of reasons to treat their data with caution such as their assumption that the frequency of instances of sexual violence remained constant across different times of day. Nevertheless, they state that from 2003 to 2012 in Kahayelitsha township in Cape Town, 635 sexual assaults of women were reported that occurred on the way to and from toilet visits. Lennon (2011) further demonstrates that this is a global issue, drawing attention to the fact that women are particularly at risk when travelling to use public toilets. In this study based in low-income areas of Delhi (including one area where one of the schools participating in CURE's schools-based WASH project is located), women marked on a map the areas of

their community where they would be most vulnerable to GBV facilitated by insufficient WASH provision (Figure 4). Areas used for OD were often associated with instances of GBV. Lennon highlights three common themes emerging from focus group interviews held with women residing in these areas: fear of sexual violence, anger at the dearth of protection from institutional actors such as the police and disgust at the dirtiness of their respective neighbourhoods.

Figure 4 Translated version of map drawn by local women of GBV danger areas in Delhi
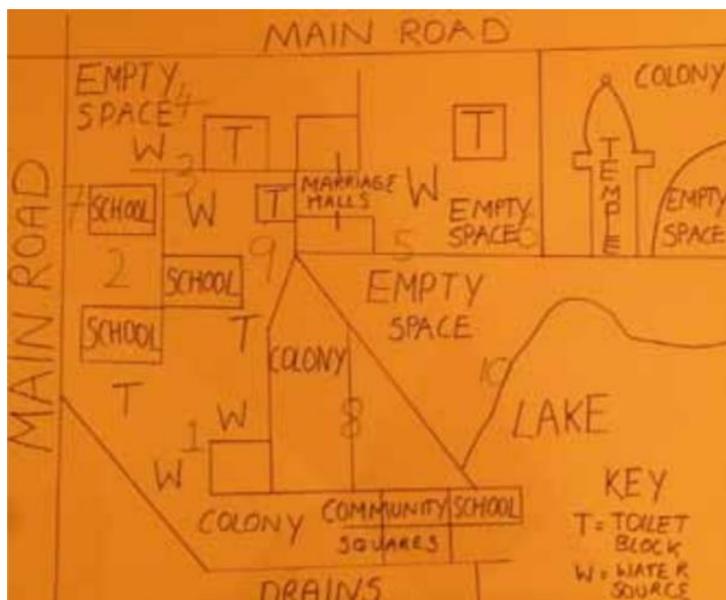
(Lennon, 2011, p8)

Patriarchal structures driving the continued practice of OD (see section 2.2.1) contribute to GBV. While men may prefer OD for practical and social reasons, they do not experience the same dangers or social anxieties resulting from it as women (Hussain, 2018). Building on Lennon's (2011) research, Azeez et al. (2019) consider the effects of inadequate sanitation provision in Rajasthan and share the accounts of women related to GBV while practising OD. Some participants recounted experiences of humiliation: 'men used to hide and watch while we were defecating and then talk about it in public–just for fun. This often put my husband to shame and even led to quarrels' (p162). Others explain that community relations and collective OD protect women from GBV: 'I think no one dares to do such things as from every home women go for open defecation and most of the time we go together' (ibid.). However, the authors point out that often,

victims of GBV are hesitant to share their experiences so the actual extent of WASH-related GBV may be worse than reported.

Cavill et al. (2016) indicate that there exists some solutions that could at least partially address the issue of WASH-related GBV in the absence of sufficient institutional protection and remedy. Increasing the number of toilets built in close proximity to women's homes mitigates the risk and anxiety faced by women who are no longer required to frequent, often at night, areas commonly used for OD where the risk of GBV is heightened. Most significantly for this research, safe, hygienic and private sanitation facilities in schools provide girls with a non-public, secure space and in so doing, greatly reduce the threat of GBV. However, provision of such a space is not possible without a secure supply of clean water. The following section details the issue of water security, as groundwater depletion is a significant and current danger in Delhi.

1.7 Water security

The United Nations provides this definition for water security:

> The capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability.

(2013, para. 4)

A common indicator for the occurrence of water stress is when availability decreases to below $1000m^3$ per capita per annum (Falkenmark et al., 1989) but this measure receives criticism because it does not sufficiently account for social factors such as economic inequalities and only applies to water reserves, rather than agricultural, industrial and domestic consumption (Gain et al., 2016; Drissia, 2019). Some studies propose an alternative framework for measuring water security; Gain et al. (2016) advocate a more nuanced 'global water security index' (p5) to monitor water security worldwide. This takes into account issues which aggravate WASH-based inequalities such as drought, the depletion of groundwater, access to sanitation facilities, the quality of water, governance and legislation. For Romero-Lankao and Gnatz (2016), water security is

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dictated by five components - governance, ecology, economic factors, technology and socio-demographic factors. Indicators include rate of diarrhoea per 100,000 people, the Gini index measurement of inequality, the development of water infrastructure, river water quality and legal frameworks for regulation. They offer a framework comprising these five components that could be used to bridge the gap between academia and practice and contribute towards more effectively targeted policy reforms in ensuring water security in urban areas. Wutich et al. (2017) also call for a wider definition of water security for households encompassing issues of water politics, governance and socio-cultural processes. For example, a more detailed analysis of differences within households is required to understand different individuals' roles.

On the theme of communal efforts to mitigate water security, Brewis et al. (2019b) investigate the phenomenon of households sharing water across eight countries in sub-Saharan Africa. They find that in the main, water is shared between neighbours, that the practice is more common when water is more scarce and more expensive, and that generally, those who share their water do not expect recompense. The authors identify water sharing as a community-based, short-term solution to water insecurity. However, Wutich et al. (2017) also highlight that water management schemes such as community members nominated to monitor quality or to form maintenance committees are sometimes influenced by existing inequalities around gender or ethnicity, thus benefiting some groups more than others. Therefore, there is an inherent danger in both formal and informal community initiatives to mitigate water insecurity that negative reciprocity (e.g. theft and fraud) can occur (Wutich et al., 2018).

The issue of increasing water security in India, and particularly Delhi, is widely reported both in academia (Chalisgaonkar et al., 2018; Ghosh et al., 2019) and the media (Del Bello, 2018; Rajendran, 2019). According to an Indian government think-tank, 600 million people in the country live with critical water stress and with nearly 70% of the water supply contaminated, close to 200,000 people die annually from water-related conditions (NITI Aayog, 2018). In fact, the city of Delhi was forecast to run out of groundwater by 2020 (Das, 2020). Water insecurity in India is caused mainly by the exhaustion of groundwater reserves, poor water quality, drought and mismanagement

in the form of a lack of governance and deeply embedded corruption (Gain et al., 2016; Dubey et al., 2020). In Delhi, groundwater depletion is significantly higher than the rate at which it is recharged, resulting in accelerated decrease in groundwater. Increased usage of wastewater and reducing the number of impermeable surfaces in the city through which rain cannot penetrate are two viable methods for addressing this (Ghosh et al., 2019). This is particularly concerning as it is low-income communities who are most vulnerable to the devastating impacts of water insecurity (Mukherjee et al., 2020).

Narain and Singh (2017) offer the case study of peri-urban Gurgaon, a suburb of Delhi, as an example of water insecurity particularly impacting low-income communities. They explore the effects of three canals in Gurgaon which provide water for the city, remove its wastewater and intersect a number of villages which do not actually benefit from the canals. The paper explores the different techniques that inhabitants of these villages have designed to take advantage of this water access from which they have been excluded, such as diverting the course of the canal to irrigate their crops. The authors recommend that interventions aiming to improve water security in such communities should engage with such informal techniques for gaining water access that communities have devised, rather than assume that unequitable access to water inevitably breeds conflict.

In another case study, Sarkar (2019) evaluates the current use of vending machines known as 'water ATMs' in Delhi. They are 'a market-based solution...to provide safe drinking water to the urban poor in Delhi who are inadequately served by the public utility network' (p166). Sarkar comments that these vending machines could dramatically decrease instances of water-related diseases and plastic pollution caused by the single-use water package industry. However, she also raises some ethical concerns that low-income communities are obliged to pay for water in this system when households which benefit from municipal water provision have the added benefit of their costs being subsidised. Thus, the use of water ATMs further marginalises those who are already marginalised. Sarkar argues that water ATMs cannot be viewed as a long-term alternative to piped connections.

Water insecurity can also impact upon mental health. Shrestha et al. (2018) developed an objective measurement of water security in Nepal, finding positive and significant associations between quality of life (mental health, physical health and social relationship cohesion) and water security. At the household level, Brewis et al. (2019a) acknowledge that food insecurity increases the risk of common mental health conditions and investigate if water insecurity has a similar impact. They explore the effect of household water insecurity (in terms of the extent of reliable access to a high-quality water source) on symptoms of depression and anxiety in Haiti. They conclude that a lower level of household water security leads to increased anxiety and depression, even when controlling for socio-economic status and food security. Water security also has a further indirect impact on these mental health conditions through its link to access to food and sanitation facilities. This study provides evidence that household water security is a key factor in causing mental health conditions in low-income areas. In a large-scale study across 20 countries, Stoler et al. (2019) investigate the link between the amount of households' income spent on water and their perception of their stress level, their water security and food security. Expenditure on water was positively related to water insecurity while there was a negative relationship between water insecurity and income. The authors also found positive relationships between expenditure on water and participants' perception of their stress and their food insecurity. They conclude that any sort of intervention designed to improve water infrastructure which involves increasing households' water expenditure should be accompanied by schemes designed to generate income.

Water security also feeds into the discussion around girls' access to education (see section 2.3.1). Kookana et al. (2016) explore the responses of students at eight secondary schools in semi-arid parts of Rajasthan and Gujarat to a questionnaire on water issues. Close to 90% of respondents stated that groundwater depletion was a significant issue which resulted in increased absenteeism – this was a particular problem for female students. The scarcity of groundwater resulted in more demand on school students on their time for retrieving water rather than attending school. Therefore, the depletion of groundwater reserves can exacerbate exclusion from education, particularly

for girls. The following section explores two nationwide WASH initiatives in India which aimed to address the issues set out in this introductory chapter.

1.8 Key WASH initiatives in India and ensuring sustained behaviour change

Cumming (2009) cautions governments against neglecting sanitation:

> Political neglect characterises the sanitation sector at the international and national levels…sanitation remains largely absent in national development plans and donor aid strategies. Low political priority plays out in chronic underinvestment and weak institutional capacity…The failure to increase access to sanitation acts as a brake on development and makes the realisation of broader development outcomes both unlikely and unsustainable.

(p9)

Substandard sanitation is a barrier to low-income communities emerging from poverty and a significant contributing factor to social inequalities. In the twenty-first century, Indian governments have responded to this through two nationwide initiatives aiming to build sanitation capacity across India. In fact, WASH has long been on the agenda for Indian governments. A nationwide water and sanitation initiative was introduced as early as 1954 with the 'National Water Supply and Sanitation programme'. This was followed by the global programme of the 'International Drinking Water Supply and Sanitation Decade (1981-1990)' (Majra and Gur, 2008, p143). The two major, nationwide, government-led WASH initiatives in India this century are the Total Sanitation Campaign (TSC) and its successor, the SBA (Clean India Mission).

1.8.1 *Total Sanitation Campaign (TSC)*

Launched by the Bharatiya Janata Party-led coalition government of Atal Bihari Vajpayee, the TSC arrived in 1999. Particularly targeting rural regions, it 'focused on information and education to generate public demand for sanitation facilities, particularly in schools…but it suffered from its relatively low priority and its ineffective deployment of resources' (Irigoyen, 2017, para. 1). As a result, its impact was limited. A randomised controlled trial based in Madhya Pradesh showed that the TSC led to a slight increase in the proportion of households with access to improved sanitation facilities and a small reduction in OD. Despite these promising findings, there was no

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improvement in children's health, taking a number of outcomes into account including helminth infection, diarrhoea and anaemia (Patil et al., 2014). This further cements Humphrey's (2019) point that for WASH interventions to be successful, sustained behaviour change is required in addition to infrastructure (see section 1.1). In fact, another TSC impact study based in Orissa attributes this lack of significant health improvements to a public reluctance to use new sanitation infrastructure. Considerable gains in latrine coverage did not equate to widespread usage, resulting in the persistence of OD and the health dangers that accompany it (Barnard et al., 2013). Hueso and Bell (2013) describe the TSC's outcomes as 'remarkably poor' (p1001) with a mismatch between reported sanitation provision in 2011 national census data (31%) and government figures (68%). They allege that in the first decade of the century, the number of households owning latrines actually decreased by 8.3 million. An evaluation of the TSC led by WaterAid India (2008) revealed that outcomes varied greatly between states; this was particularly true of states where the TSC was implemented broadly rather than with a specific, community-focused approach (Mara, 2017). In fact, it seems that lessons from the TSC were not learned during the implementation of the SBA which was criticised for the same reason (Menon, 2015).

1.8.2 *Swachh Bharat Abhiyan (SBA)*

With a multi-billion US dollar budget, the SBA was initiated by Prime Minister Narendra Modi in 2014 with its primary objective to eliminate OD entirely by 2019, marking the 150th birthday of Mahatma Gandhi (Biswas and Jamwal, 2017). Described as 'the largest behavioural change programme in the world' (Mohapatra, 2019, p451), this was to be accomplished through WASH hardware interventions (the provision of household latrines and toilets for community use). However, referring to SBA at the beginning of its implementation, Manisha (2015) insists that 'sanitation and hygiene should be emphasized as a paramount piece of the school educational program from primary level' (p67), pointing to the fact that a successful nationwide sanitation programme in India should reach beyond households into institutional settings. Furthermore, the SBA will not have a positive impact long-term unless software intervention components (such as

community-based behaviour change activities) are given equal priority with government-centralised latrine construction (Jain et al., 2018).

Mohapatra (2019) offers a reason for why behaviour adoption does not correspond with infrastructure provision in the SBA: 'not all members of the household use the toilets simply because they do not know their benefits…illustrating the need for more community-level information about sanitation' (p470). He recommends that, rather than the government construct thousands of toilets, responsibility should be given to communities for moving away from OD practice and proposes CLTS as a viable method for achieving this. He explains that, in contrast with the SBA, no financial subsidy is provided to communities during CLTS. Rather, behaviour change is produced through 'triggering exercises' (p460-461) which provoke a sense of disgust and shame. However, Mohapatra does not draw attention to the ethical concerns that accompany CLTS and does not review any literature which challenges the efficacy of the approach. Both are explored further in section 2.5.1.

With the government stating that all 36 states of India are OD-free and claiming to have built approximately 103 million household toilets during SBA, it is perceived by some to have been a success (Indian Department of Drinking Water and Sanitation, 2020). However, as with the Economic Survey of Delhi's partial statistics on school WASH coverage (Government of NCT of Delhi, 2020), there is a mismatch between what the government alleges regarding the rate of OD and what is happening in reality. Gupta et al. (2019) refute the government's claims, revealing that 44% of those over the age of two continue to practise OD in the rural states of Bihar, Rajasthan, Madhya Pradesh and Uttar Pradesh. They recognise that progress has been made but oppose the BJP government's declarations of universal victory against OD. Furthermore, a BBC investigation (2019) highlighted a report from the National Statistical Office of India (2019) which claimed that the percentage of households with toilet access was 96.2% and 71.3% for urban and rural areas respectively, just one month after Prime Minister Modi's assertion that rural India had become OD-free (Langa, 2019). As will be discussed in greater detail in Chapter Two (section 2.2.1), ownership of a toilet through hardware interventions is not a guarantee that the household does not practise OD (Coffey et al.,

2014; Routray et al., 2015; Caruso et al., 2019). Sustained behaviour change brought about by stakeholders' adherence to recommendations from the software components of WASH interventions is required.

1.8.3 *Identifying the gaps in behaviour adoption using the COM-B model*

The Capability, Opportunity, Motivation Behaviour (COM-B) model (Michie et al., 2011) is a useful theoretical framework to employ in such situations. In the theoretical basis of this current research, the three domains of the COM-B model interact to form children's 'combined capabilities' (Nussbaum, 2011, p21) which in turn govern the 'functionings' (Sen, 2011, p75) that they attain to achieve 'substantive freedoms' (ibid., p87). The COM-B model is a suitable model to apply in this case as the literature shows that its use is widespread in the Global South but not in the context of schools-based WASH interventions based in India. Staniford and Schmidtke (2020) conduct a systematic review of hygiene interventions which took place in child-focused settings such as schools and hospitals, focusing on the COM-B model. They only include two interventions based in India (Biran et al., 2014; Lewis et al., 2018) and neither of these applied the COM-B model to investigate WASH behaviour adoption. Thus, the current research addresses a gap in the existing literature by applying the COM-B model in the context of schools-based WASH in India. The core contribution to knowledge provided by this research is detailed further in the following section (1.9).

Michie et al. (2011) explain the three different domains of the COM-B model:

> Capability is defined as the individual's psychological and physical capacity to engage in the activity concerned...Motivation is defined as all those brain processes that energize and direct behaviour...It includes habitual processes, emotional responding, as well as analytical decision-making. Opportunity is defined as all the factors that lie outside the individual that make the behaviour possible or prompt it.

<div align="right">(p4)</div>

Staniford and Schmidtke (2020) find that interventions in their review which focus on these three elements are more effective. This demonstrates that behaviour change

for WASH in schools requires a multi-factor approach, taking into account children's abilities to practise positive WASH behaviours while considering structural and physical barriers to them doing so, as well as what motivates them to do so.

For example, in order for children to adopt positive WASH behaviours long-term, they need both the infrastructure (opportunity) and support (capability and motivation) to facilitate this at school and at home. Inadequate WASH provision in schools means children are unable to adopt adequate hand-washing behaviours, rendering health education initiatives less effective. As Mooijman (2012, p9) states, 'Promoting hand washing without a supply of soap and water is like having a bowl without food in it.' Students will not put learning into practice if they do not have access to the necessary facilities. In fact, one solution for schools in low-income areas with precarious water access could be the provision of waterless hand sanitiser (Pickering et al., 2013). This is particularly pertinent during the COVID-19 pandemic as HWWS has taken on renewed significance (see section 2.2.4).

Some recent literature demonstrates how the COM-B model can be employed to design and evaluate programmes focused on WASH-related behaviour change. Aiming to devise a programme to improve the WASH and nutrition-related behaviours of pregnant women and those caring for children under the age of two years in Kenya, Arriola et al. (2020) use the COM-B model to produce a systematic, meticulous programme founded upon theory. Their intervention addressed particular behaviours but was wide-reaching and comprehensive. The study advocates the integration of knowledge based on stakeholders' experiences with behaviour change theoretical frameworks such as the COM-B model when designing interventions focused on tackling stunting.

Following a cluster randomised trial (McGuinness et al., 2020a) which investigated the application of riverbank filtration methods to increase access to potable water in Karnataka, India, McGuinness et al. (2020b) reinforce findings with qualitative research, using focus group discussions and semi-structured interviews. Applying the COM-B model, they identify factors which impede or enable the adoption of WASH behaviours (more frequent health reporting and usage of filtered, potable water).

They establish several factors affecting stakeholders' capability, opportunity and motivation to adopt these behaviours. These include hesitation in sharing health information with enumerators, inconsistent understanding of survey questions, the perceived inconvenience of using filtered water and varying attitudes towards and understanding of the relationship between health and water usage. The authors recommend use of the COM-B model and these methods to identify the factors enabling and impeding WASH behaviours during future research on WASH interventions.

Ellis et al. (2020) also seek to clarify the determinants of WASH and nutrition-related behaviours, in this case amongst households with children under two years of age. Focus behaviours in the research included latrine use, safe disposal of children's faeces and provision of hygienic play environments for infants. The authors employ the COM-B model in analysing mixed-methods data, integrating household observations with key informant interviews and focus group discussions. They identify a number of factors interfering with stakeholders' capability, opportunity and motivation in adopting these behaviours. The perceived limiting cost of lasting construction materials (see section 2.2.5) and ubiquitous acceptance of open defecation arose as barriers to latrine use. The main elements disrupting the safe disposal of children's faeces were the widespread belief that children's faeces are safe to handle and the shortage of latrines, owing to the apparently prohibitive price of building supplies. Lastly, the authors identified impeding factors in providing hygienic play environments for children: living spaces were shared with animals, and regular maintenance and cleaning were required. As with McGuinness et al. (2020b), the authors recommend the COM-B model as a valuable framework in devising interventions, informed by theory, which take into consideration these factors which impede adoption of WASH-related behaviours.

Okello et al. (2019) employ the COM-B model to investigate the impact of a schools-based WASH intervention in Tanzania which consisted of participatory WASH software activities designed to build children's capability, opportunity and motivation to adopt HWWS behaviour. The authors aimed to identify factors

enabling or impeding this behaviour and discover that as children grasped the relationship between infrequent HWWS and damaging health outcomes, they were more motivated to adopt the behaviour. They also highlight the fact that, although school WASH facilities provided the opportunity for children to practise HWWS, there was often not sufficient soap and running water to do so. In conclusion, Okello et al. advocate 'more theoretically informed research…to unpack the drivers of institutional factors that contribute to behavioural outcomes' (p9).

However, some challenge the legitimacy of the COM-B model. In an opinion piece, Ogden (2016) argues that fitting health psychology research around a wide-reaching framework such as the COM-B model is not necessarily advantageous. According to Ogden (ibid.), if variability is replaced with systematisation, health professionals will be less equipped to diagnose particular problems and address the needs of specific people. However, this researcher believes that 'the health and well-being of a discipline' (p245) should not be the priority. Rather, if a framework is in some way useful in identifying barriers to positive behaviour adoption, it should be employed. Marks (2020 also critiques the COM-B model, separating the motivation domain into 'needing' and 'wanting', arguing that it is incomplete 'because the process of wanting is missing' (p4). For Marks, someone may have a strong motive to adopt a behaviour but if they do not want to, they will not. However, this seems to ignore the connection between the phenomenon of motivation and the process of wanting; if motivation is built in a constructive rather than coercive manner, the desire to practise the targeted behaviour will grow. Secondly, even if Marks' assessment is accurate, that is not to say that the COM-B model is not useful for identifying factors relating to its three domains. Willmott et al. (2021) investigate the model's usefulness in the context of physical activity and healthy eating interventions, noting its 'explanatory potential' (p14) for understanding and clarifying factors causing behaviour change patterns.

Furthermore, during the process of research design for this doctoral thesis, the researcher contacted Prof Robert Dreibelbis from the London School of Hygiene and Tropical Medicine (LSHTM) who has published widely on the topic of schools-based

WASH interventions. Prof Dreibleis reiterated the importance of designing WASH interventions upon a theoretical foundation, specifically recommending the Integrated Behavioural Model for Water, Sanitation, and Hygiene (IBM-WASH) (Dreibelbis et al., 2013a) and the COM-B model as viable frameworks. As the intervention serving as the setting for this research had already taken place, the researcher decided that it would be most appropriate to employ the more versatile COM-B model because it is applicable across contexts, whereas the IBM-WASH framework would be useful for in-depth evaluation of an intervention which was originally designed around it.

Previous researchers recommend that further research be carried out in this area and the existing literature, as well as the approval of Prof Dreibelbis from LSHTM, demonstrate that the COM-B model is an appropriate theoretical framework to employ in an investigation of the driving factors affecting children's WASH behaviours in the context of schools-based WASH interventions in East New Delhi. The following section sets out the rationale for this research, explaining why it is required and how it adds to the existing literature.

1.9 The core contribution to knowledge

The identification of driving factors affecting primary school children's WASH behaviours in East New Delhi is the core contribution to knowledge in this thesis. Through a comprehensive review of existing research, a gap in the literature is highlighted. Many studies evaluate the effect of certain schools-based WASH interventions on children's health outcomes (Dujister et al., 2017; Gitore et al., 2020) and specific WASH behaviours (La Con et al., 2017; Chard and Freeman, 2018). However, this research is unique in combining quantitative and qualitative methods including structural equation modelling and semi-structured interviews to delineate which factors influence children's WASH behaviours in the participating schools and how. During the literature review, the school environment and socio-economic status were identified as possible key factors affecting children's WASH behaviours. This research contributes to knowledge by considering children's experiences of these two factors, providing valuable insights into whether and how children's WASH behaviours are affected by them.

For example, the school environment could act as a place of WASH-based security for children, providing stable access to water and safe sanitation that they do not receive elsewhere. Education can also play a central role in supporting children in developing hygienic behaviours and socially responsible attitudes to WASH. According to the Economic Survey of Delhi 2019-2020 (Government of NCT of Delhi, 2020), 100% of schools in Delhi have separate toilets for girls and boys, and drinking water facilities. This suggests that every school in Delhi is adequately prepared to offer this safe environment to its students.

However, these statistics do not tell the 'whole' story as it is not necessarily the case that these amenities are functioning, safe or well-maintained. This research contributes knowledge by addressing this partial narrative, investigating Delhi schools' WASH provision to identify the driving factors that propel progress towards SDG 6 and secure children's WASH behaviours. It presents data collected in four schools: two government schools which participated in a schools-based WASH programme implemented by the Centre for Urban and Regional Excellence (CURE), an Indian NGO, and two non-intervention schools (one government and one low-fee private (LFP)). In each of these schools, the research explores the different WASH-related elements encountered by school children in their daily lives and how these affect their WASH behaviours.

This research also considers how children's socio-economic status affects their adoption of positive WASH behaviours. It analyses questionnaire data relating to socio-economic status, reinforced by insightful perspectives from children's parents, to consider how WASH inequalities are mitigated or exacerbated, and whether schools-based WASH programmes can narrow the gap in WASH access between low-income and middle-income households.

Empirically, this research offers unique insight by combining data collected in Delhi primary schools with those collected in the communities surrounding these schools, investigating children's background, behaviours, and the perspectives of school staff and parents. It applies structural equation modelling (SEM) to identify the pathway relationships between key factors. Conceptually, it employs the Capability, Opportunity, Motivation Behaviour (COM-B) Model (Michie et al., 2011) as a theoretical framework for considering impeding and enabling factors affecting children's WASH behaviours.

These form part of their 'combined capabilities' (Nussbaum, 2011, p21) to achieve 'substantive freedoms' (ibid., p87) such as living a healthy life, accessing clean water and practising WASH activities with dignity. This research also presents a far-reaching view by applying the critical realist theories of stratification and emergence (Bhaskar, 2013) to consider how the underlying phenomena at play in Delhi children accessing 'inclusive and effective learning environments' (UNGA, 2015, p19) fit together to reveal the fuller picture.

Ultimately, this thesis presents a unique core contribution to knowledge by investigating the driving factors which affect children's WASH behaviours in the participating East New Delhi primary schools. It identifies both impeding and enabling factors which, if addressed, could build children's capability, opportunity and motivation to practise positive WASH behaviours long-term. Therefore, it contributes applicable knowledge towards the SDG targets of 'universal and equitable access to safe and affordable drinking water for all' (6.1), 'access to adequate and equitable sanitation and hygiene for all' (6.2) and 'safe, non-violent, inclusive and effective learning environments for all' (4.a) (UNGA, 2015, p19).

1.10 Thesis structure

The previous section explained the core contribution to knowledge that the thesis provides. This section will set out the research questions and structure of the thesis, providing an overview of what is to come in the subsequent chapters. The main focus of this thesis is to identify the driving factors affecting progress towards SDG 6 through children's WASH behaviours in East New Delhi primary schools.

Chapter Two presents a review of existing literature, first focusing on the far-reaching impact of WASH-based inequalities which encompass health issues as well as economic and social factors. Focus is given to the neglect of WASH provision and how this can exacerbate inequalities in education. An overview of efforts to address these inequalities, such as WASH initiatives, solutions and their common challenges, is presented. Chapter Three explores different philosophical worldviews (Creswell, 2014) which form the foundation of research, focusing specifically on the ontological position of critical realism and the epistemological position of postpositivism as the

methodological bases of this thesis study. The mixed methods approach is discussed, as well as the setting in which the research took place and the instruments used during data collection. The chapter concludes with an overview of analysis techniques, discussion of efforts to ensure validity and reliability and consideration of processes to ensure high standards of ethical research. Chapter Four presents the findings from the research, starting with descriptive statistics and initial qualitative insights pertaining to the research context before addressing each of the three research questions (listed in section 3.1.1) in turn.

Analysis of differences in children's WASH behaviours and school WASH provision between school types is followed by investigation of the effect of the latter on the former (RQ1). Next, the specific challenges faced by school principals in providing healthy and safe WASH facilities are explored before the potential for schools-based WASH interventions to mitigate these challenges is considered (RQ2). Finally, socio-economic status is compared between school types before parental experiences of WASH access from across the participating schools are presented. The potential impact of socio-economic factors on children's WASH behaviours is investigated, as well as whether schools-based WASH interventions can bring about positive changes in this area (RQ3). In order to shed light on the driving factors affecting children's WASH behaviours, the COM-B model is applied which identifies determinants enabling or impeding children's development of capability, opportunity and motivation to adopt targeted behaviours. Particular focus is given during analysis to the differences between the four participating schools – Government Intervention School A (GISA), Government Intervention School B (GISB), the Government Non-Intervention School (GNIS) and the Low-Fee Private School (LFPS). Throughout the thesis, the four schools are referred to by these initialisms and when referring to both government intervention schools, GISA-B is used.

In Chapter Five, a discussion of the findings is put forward, situating the results in the context of previous literature and the methodological foundation of the research. The chapter focuses on each of the research questions in turn before considering the study's limitations and avenues for possible future research in this area. Finally, Chapter Six

serves as a conclusion to the thesis, considering lessons and implications for WASH in schools in light of the research.

Chapter Two: Literature Review

2.1 Introduction

This chapter offers an overview of previous literature pertinent to the aims of this research to consider the driving factors affecting children's WASH behaviours in East New Delhi primary schools. Cooper (2010) outlines four functions of a literature review: integrating the findings of previous studies, criticism of these previous studies, building links between related aspects of the research topic, and expounding issues central to the field. These four components are integrated into this chapter which presents previous literature around how inadequate WASH impacts children, investigates WASH in the context of education, considers particular challenges in WASH provision and details common solutions implemented during WASH interventions.

Existing evidence revealing the impact of inadequate access to WASH, particularly regarding OD, infectious diseases, stunting and COVID-19 are explored. OD is one of the principal issues causing WASH-related health problems in India and its damaging symptoms are consequences and aggravators of WASH-based inequalities, especially in the domains of children's health and education. In particular, implications emerging from COVID-19 are pertinent as WASH issues will be central to the response to the pandemic in India, one of the most affected countries in the world (Dong et al., 2020).

A section focusing on the relationship between WASH and education follows, including previous literature focusing on schools-based WASH interventions, children's attitudes towards caring for the environment, school absenteeism and LFP schooling. The subsequent section sheds light on further challenges relating to WASH including infrastructure and inequalities, sustainability and the challenge of monitoring progress. Finally, a detailed outline of common responses to WASH challenges is presented in the final section including key approaches such as community-led total sanitation (CLTS), sanitation marketing, BCC and 'nudge' theory.

2.2 The impact of inadequate WASH

This section draws on the previous literature to explore the devastating impact of OD, as well as the issues of stunting, COVID-19 and socio-economic factors. It emphasises the global need to narrow the gap in WASH provision which is an effort that schools-based WASH interventions can assist if their recommendations are upheld in the long term.

2.2.1 *The danger of open defecation*

One of the major root causes of infectious diseases related to inadequate WASH access in low-income communities is OD, described by UN Deputy Secretary General Jan Eliasson as 'one of the clearest manifestations of extreme poverty' (WHO/UNICEF, 2015, foreword). OD is defined as 'the practice of defecating in open fields, waterways and open trenches without any proper disposal of human excreta' (Saleem et al., 2019, p1). The worldwide elimination of OD is at the heart of SDG 6; the second target aims to 'achieve access to adequate and equitable sanitation and hygiene for all and end open defecation' by 2030 (UNGA, 2015, p20). Globally speaking, 673 million people worldwide, more than 8.5% of the global population, practised OD in 2017 (WHO/UNICEF 2019). It remains an incredibly damaging major factor sustaining the types of WASH inequalities investigated in this research, especially in India and still in Delhi, although rates have reduced in recent years (Rahman et al., 2020).

Coffey et al. (2014) open by stating that the majority of the population of India practise OD and that the majority of open defecators worldwide live in India. However, they later quote the WHO and UNICEF (2014) figure of 48% of the population of India practising OD as of 2011, placing the figure at just less than half. Figure 5 shows that India has one of the highest OD rates in the world, as of 2015. Of the 1.31 billion people living in India in 2015, 330 million practised OD, decreasing the 2011 number by approximately 50% (WHO/UNICEF, 2017). The WHO and UNICEF (2019) commend the considerable further progress made in addressing this figure since then, through initiatives such as the SBA, but do not acknowledge concerns raised regarding the accuracy of the Indian government's claims around the success of the SBA (Gupta et al., 2019; Langa, 2019) highlighted in section 1.8.2.

Figure 5 Share of people practising open defecation, 2015
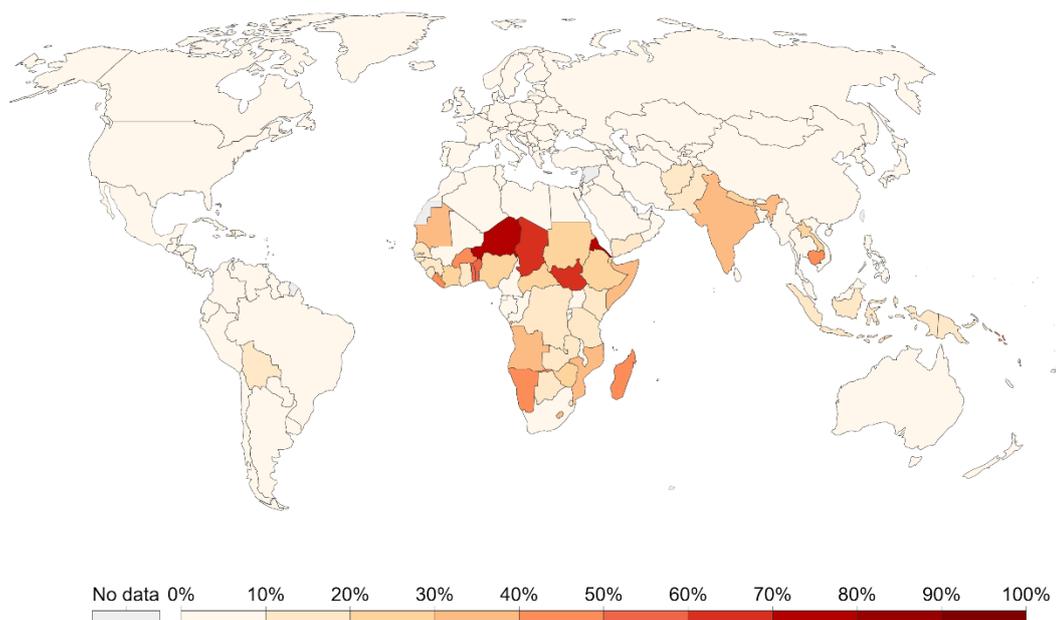
(Ritchie and Roser, 2019)

In some cases, people continue to practise open defecation due to circumstances beyond their control. Ashraf et al. (2020) explore the impact of COVID-19 lockdown on sanitation practices in peri-urban areas of Tamil Nadu. They state that the vast majority of participants (92%) did not alter their toilet practices as a result of COVID-19 lockdown but 29% of participants did not have private or public sanitation access in the first place. Therefore, approximately a third of participants reported a member of their household leaving the home during lockdown to defecate on a daily basis. However, some existing literature provides an answer as to why, despite having access to WASH hardware enabling them to stop, such a high proportion of the global population still practises OD and is reluctant to adapt behaviour to use latrines, even if they own them (Obeng et al., 2015; Alemu et al., 2017; Juran et al., 2019). This underlines the need for WASH interventions achieving sustained behaviour change if they are to be successful; infrastructure provision alone is not sufficient (Humphrey, 2019). Although the following literature largely refers to rural settings, it is nonetheless relevant to the current research because it is a clear example of how WASH hardware improvements (e.g. physical infrastructure) must also be accompanied by successful and long-term WASH software improvements (e.g. sustained behaviour change).

Mara (2017) notes that 'Despite...associated averse health outcomes, OD is often a *preferred practice*, notably in rural India' (p6). He cites Coffey et al. (2014) who uncover a revealed preference for OD through a sample of 3,235 household interviews. They provide evidence that the reason that OD in rural India is more prevalent is not due to household income. Rates of OD are lower in countries with a significantly lower gross domestic product (GDP) per capita than India, such as Kenya with a GDP per capita of USD 2,109 (compared to India's USD 5,050) and an OD rate of 13% (compared to India's 49.8% at the time of the article's publication). However, this is a simplistic comparison and there may be a number of other factors driving the higher rate of OD in India compared with these poorer countries, such as socio-cultural or religious preferences.

Although it appears that household income is not the reason for the higher OD rate in India, 78% of their respondents who do not own latrines point to the cost incurred as a principal reason for continuing to live without a latrine. Coffey et al. (2014) explain this finding by stating that this does not indicate that the cost of constructing a latrine is prohibitive but rather that there is a widely-held perception that this is the case. This aligns with Sinha and Chaudhry's (2019) finding that people living in the state of Bihar consider toilets to be an unrealistically expensive investment amounting to over 20,000 Rs (194 GBP), even if this is not the case. Strengthening the connection between socio-economic status and access to WASH (Hutton and Chase, 2017), this perception of latrine installation as an expensive endeavour further justifies the need for WASH education.

In fact, there is some evidence that OD continues even when households do own latrines, particularly in rural areas. Conducting a qualitative study in rural India, Routray et al. (2015) conclude that government construction of latrines does not guarantee a decrease in OD, due to strong socio-cultural obstacles to the adoption of latrine use. More recently, Caruso et al. (2019) suggest that the number of people worldwide practising OD is underestimated because calculated figures do not include households with toilets that are unused. Conducting research into the motivation behind open defecation in Nepal, Bhatt et al. (2019) cite a number of reasons why OD continues despite the presence of a toilet in the household. Some household members felt that

their latrine was constructed in an inappropriate part of their household such as in close proximity to the kitchen or rooms where religious activities are practised. Others did not appreciate the odour of the latrine in the household and thus preferred OD. This demonstrates the need to include beneficiaries in the design phase of interventions (Sommer, 2010; de Albuquerque, 2014; Jewitt and Ryley (2014).

Other studies also reveal a preference for OD. In the case of men in Indonesia, Devine and Kullmann's (2011) qualitative analysis of perceptions around WASH attribute this preference to enjoying positive social interactions, the normalisation of OD and the increased physical comfort of defecating in the river. Jewitt (2011) highlights the challenging issue of cultural objections to safe sanitation practices, such as in Madagascar where it is taboo to store human waste underground for fear that it could disturb the dead. She also draws attention to the fact that in rural areas of the Global South, 'people often choose open defecation in preference to using a smelly, mosquito-infested toilet that other users have not bothered to clean properly' (p615), citing the effect of the sun and animals in sanitizing and disposing of waste. Furthermore, referring to an account of a case specific to India, Tiwaril (2016) reports in the Times of India that 90 households in rural Uttar Pradesh 'quietly demolished the toilets inside their house that was [sic] built under the *Swachh Bharat Abhiyan* (SBA), preferring to go back to defecating in the open.' He adds that others simply removed the toilet seat and used the space for storage instead.

This evidence of habits and commonly-held beliefs presents a strong argument for focusing WASH interventions on software (e.g. behaviour change) as well as hardware (e.g. installation of sanitation facilities). It is inadequate merely to provide facilities as this does not sufficiently encourage usage so there is much need for research into effective WASH behaviour change strategies such as the Capability-Opportunity-Motivation Behaviour (COM-B) model (see section 1.8.3). Mara (2017) starkly underlines the link between poor WASH access and children's future opportunities, warning that unless OD is fully eradicated in rural areas and informal settlements,

> ...there will be more 'lost generations' of physically-impaired and cognitively-
> challenged children and adults. All Ministry of Health officials and development

professionals need to be aware of the physical and mental outcomes of OD in young children, some of which are irreversible.

However, patriarchal structures also shape gendered experiences of OD, with women trapped by conflicting limitations and facing considerable barriers to stopping OD practice (see section 1.6). Bhatt et al. (2019) give the example of girls and women being forced to practise OD because they are prohibited from using the latrine in the home which is exclusively for male family members. However, at the same time, women can be more susceptible to social repercussions for continuing to practise OD than men (Kuang et al., 2020). Khanna and Das (2016) highlight three socio-cultural barriers to OD eradication particularly affecting women in Uttar Pradesh: household gender dynamics, insufficient application of government sanitation policy and poverty. The health of recently married and pregnant women is threatened by the pressure they feel to eat less so they avoid defecation during the daytime. Toilets constructed by the government do not cater for women's privacy needs and patriarchal control of household finances is a further barrier to toilet ownership. Bhatt et al. (2019) recommend that consideration be given to such factors driving women's practice of OD particularly so that safe sanitation advocacy can be as gender equitable as possible. One way to achieve this is to support women in assuming positions of WASH leadership (e.g. election to local sanitation committees), equipping them to help vulnerable women in their community (Cavill et al., 2016).

It is vital that those in positions of responsibility are attentive to the issue of OD, especially considering the devastating impact it has on infectious disease prevalence and health outcomes. The following section will explore the evidence for this in previous literature, directly linking inadequate WASH access to infectious diseases (including COVID-19) and stunting, and indirectly to socio-economic issues.

2.2.2 *Infectious diseases: The impact on children's health and cognitive development*

There is a significant body of evidence in the existing literature linking inadequate WASH access to serious but avoidable infectious diseases, particularly in school-aged children. This is an important area to address because it demonstrates the key role that school

environments can play in providing stable access to WASH for children, particularly those from low-income backgrounds who live in households facing heightened water insecurity and low sanitation coverage. In this context, the link between SDG 3 (Good Health and Well-Being), 4 (Quality Education) and 6 (Clean Water and Sanitation) is explicit.

In their systematic literature review of educational and health outcomes related to WASH in schools, Jasper et al. (2012) call for more research focus on this area, stating that 'Respiratory and gastrointestinal diseases are one of the leading causes of death for children globally' (p2783). This claim is reinforced in large global studies of mortality (Troeger et al., 2017, Khalil et al., 2018). Humphrey (2009) identifies environmental enteropathy (chronic inflammation of the intestines) as one of the most dangerous such conditions for children, contracted by ingesting faecal bacteria, often as a result of insufficient WASH conditions. She describes it as a leading cause of child undernutrition and naturally recommends safe disposal of faecal waste and handwashing immediately following faecal contact as the most effective means to preventing faecal-oral transmission. Environmental enteropathy is also a major cause of child stunting (Ngure et al., 2014; Arndt et al., 2016), which is explored in detail in the following section.

The question then arises how children worldwide could avoid these dangerous diseases. One example is the Bangladesh-based component of a study conducted by Pickering et al. (2019). They implemented joint WASH and 'infant and young child feeding (IYCF)' (p1140) interventions in Bangladesh, Kenya and Zimbabwe, investigating possible associations between improved nutrition and household WASH access on instances of diarrhoea in children and children's growth. The interventions consisted of seven different groups: 'water chlorination; sanitation; handwashing with soap; combined water chlorination, sanitation, and handwashing with soap (WASH); IYCF…; IYCF combined with WASH; and control' (p1140). In Bangladesh, every group except the water chlorination intervention resulted in decreases in instances of diarrhoea of between 31% and 40%. However, there was no similar reduction in Kenya and Zimbabwe. What is clear is that the efficacy of different WASH intervention designs

varies according to the contrasting approaches used (Pickering et al., 2013; La Con et al., 2017; Pickering et al., 2019)**.**

There is also much previous evidence linking these infectious diseases to negative impacts on cognitive development, particularly in school children (Wierzba and Muhib, 2018). Controlling for nutritional and socio-economic status, Partovi et al. (2007) compared 132 children infected with *Giardia lamblia* with 150 uninfected children in Iran. *Giardia lamblia* is commonly spread through ingesting faecally contaminated water, which is often caused by OD (Agtini et al., 2020). They find that the infection negatively affects short-term and long-term memory and note that the sample area had substandard sanitation conditions. In a large-scale, global study comprising 192 countries, Eppig et al. (2010) hypothesise that 'a developing human will have difficulty building a brain and fighting off infectious diseases at the same time, as both are very metabolically costly tasks' (p3801). They find a statistically significant relationship between infectious disease and intelligence quotient (IQ) at the national level in five of the six world regions, as defined by Murdock (1949). They warn that it is likely that children who contract diarrhoeal diseases before the age of five will suffer lifelong negative effects to cognitive development. More recent studies corroborate these findings. Pinkerton et al. (2016) conducted a longitudinal study in Brazil, finding evidence that both stunting and diarrhoea in early childhood have direct, negative effects on cognitive development. Significantly, Orgill-Meyer and Pattanayak (2020) show that increasing sanitation coverage improves children's scores in cognitive tests a decade later, with a particular impact for girls. As highlighted in the literature above, they recommend 'more research investigating barriers to latrine adoption and sustained use' (p11). This evidence for the devastating impact of WASH-related infectious diseases demonstrates a clear, integral role for narrowing the WASH access gap in securing the educational and socio-economic status of children in the long term.

The Joint Monitoring Programme of the WHO and UNICEF is responding to the above evidence of the danger of inadequate WASH for school children by focusing on monitoring WASH progress not only at the household level but also the institutional level, starting with schools and health facilities. Chatterley et al. (2018) recognise the

importance of this, citing SDG 4 (Quality Education) target 4.a which references WASH as a vital constituent of a safe and impactful learning environment. They call for a spotlight on WASH in the school setting: 'Children spend a significant part of their day at school where WASH services can improve educational opportunities and decrease the potential for disease transmission' (p596). However, this adds weight to the argument that more must be done to improve the quality of WASH provision in schools and to evaluate these improvement efforts. The following section will explore the issue of stunting in more depth, as this is one of the most damaging symptoms of the pervasion of infectious diseases in children in the Global South.

2.2.3 *Stunting: Physical growth and cognitive development*

Stunting is defined by the WHO (2015) as 'the impaired growth and development that children experience from poor nutrition, repeated infection, and inadequate psychosocial stimulation' (para. 1). A child is classified as stunted 'if their height-for-age is more than two standard deviations below the WHO Child Growth Standards median' (ibid.). It is a deep-rooted problem across the developing world, particularly in India where, as of 2017, 34.7% of under-fives were stunted (World Bank, 2020b). In Delhi, the figure is 31.9% as of 2015-2016 (National Statistical Office of India, 2020). It is used as an indicator for severe malnutrition 'as it indicates recurrent episodes or prolonged periods of inadequate food intake, calorie and/or protein deficiency or persistent or recurrent ill health' (UNICEF, 2012, p20). Furthermore, it can be directly attributed to high levels of OD, particularly in India, representing a major argument for improving access to high-quality WASH services in school settings. Rahman et al. (2020) find a statistically significant, positive correlation between OD and stunting in India; children who practise OD are 14% more likely to suffer from stunting than children who use an improved sanitation facility. Chambers and Von Medeazza (2013) highlight the fact that higher population density exacerbates the damage of OD, an issue that is compounding the issue of stunting in India with a population of 1.3 billion. In a worldwide longitudinal study across the period of 1986-2007, including data on 1.1 million children in 70 low-income and middle-income nations, Fink et al. (2011) reveal a decreased risk of stunting when children access improved sanitation (odds ratio = 0.73, 95% confidence interval

0.71 = 0.75), and when they access improved water provision (odds ratio = 0.91, 95% confidence interval 0.89-0.94).

Stunting is recognised as an urgent problem both in India (Spears and Haddad, 2015) and internationally. Sustainable Development Goal 2 which aims to 'End hunger, achieve food security and improved nutrition and promote sustainable agriculture' (UNGA, 2015, p17) looks to achieve 'the internationally agreed targets on stunting and wasting in children under 5 years of age' (ibid.). However, this is only possible if children drink uncontaminated water and use hygienic sanitation facilities, both in the school and home environment. Bacterial diseases and parasitic infections caused by faecal-oral transmission mean that young children are unable to absorb the nutrients they ingest to grow healthily. Instead, these nutrients are expelled during diarrhoea (Yoseph and Beyene, 2020).

Stunting has negative impacts beyond short-term health, such as on economic productivity (Chakravarty et al., 2019). Spears and Haddad (2015) explain that height is an indicator of cognitive development and that average height in a population of children can predict the human capital of that generation in adulthood. Moreover, stunting exacerbates, and is exacerbated by, social inequalities. UNICEF data (2015) reveal that in the least developed nations worldwide, 49% of the poorest children suffer from stunting, compared with 26% of the wealthiest children for reference. Fawzi et al. (2019) consider the link between stunting, mothers' wellbeing and economic impacts in 137 low- and middle-income countries. They find that the main maternal factors linked to stunting are depression and education, with the cost of these amounting to 29.3 billion USD for each birth cohort. Vasquez and Daher (2019) review studies investigating stunting and cash-based or nutritional interventions aiming to reduce it in developing countries. They conclude that conditional cash transfers and supplementing nutrition over several years can reduce stunting and impact on economic progress in developing countries in the long term. Specifically focusing on five countries including India, Victora et al. (2008) explore the link between child undernutrition and human capital. They find a strong association between undernutrition and reduced adult height, schooling and

economic productivity, suggesting height-for-age at 2 years as an ideal predictor of human capital.

The fact that stunting and avoidable infectious diseases are particularly prevalent in low-income areas and further aggravate poverty shows that substandard WASH contributes towards the widening of socio-economic inequalities (Hutton and Chase, 2017; Mosello and Matoso, 2017). The following sections highlight the importance of WASH in the context of COVID-19 and some of the indirect effects of deficient WASH provision.

2.2.4 *WASH and COVID-19*

Since the global outbreak of COVID-19, simple WASH behaviours such as handwashing with soap (HWWS) have taken on renewed significance and it is more imperative than ever before that they are prioritised, particularly in low-income countries (Brauer et al., 2020; Ray, 2020). This is especially true of India where, as of August 2021, there are over 32 million confirmed cases and over 400,000 deaths (the second and third highest in the world respectively), according to the Johns Hopkins University COVID-19 Dashboard (Dong et al., 2020). Higher population density in India increases the damaging consequences of OD (Chambers and Von Medeazza, 2013) and the same is true for COVID-19 in a country where social distancing is unattainable due to overpopulation, particularly in large cities, and HWWS is not practised by a majority of the population (Kamath et al., 2020).

COVID-19 is relevant to this research because it has clear implications both for WASH and education. Schmidt (2020) points to the fact that investing time and funds into increasing HWWS while responding to COVID-19 in low-income countries will also have a significant impact on curbing the spread of other WASH-related infectious diseases such as respiratory conditions and diarrhoeal diseases. There is a real concern during the pandemic though that insufficient WASH provision is facilitating the unchecked spread of COVID-19 throughout poor areas, particularly in megacities such as Delhi (Das et al., 2020). The key to addressing this is prevention through social distancing and HWWS. However, both of these are challenging to accomplish in overcrowded informal settlements. Ray (2020) highlights the social inequalities that create barriers to low-

income communities battling COVID-19. Obviously, handwashing plays a key role, particularly in areas where social distancing is difficult to maintain. However, she underlines the fact that for millions worldwide who retrieve water some distance from their home or rely on sources such as unprotected wells, even the standard handwashing promoted during the pandemic is difficult to achieve (see section 1.7). Even households with water piped into their homes have intermittent access. This means that they have to store standing water in containers and wash hands adequately with this, frequently enough to curb the spread of COVID-19 (ibid.). Ray recommends that there be more guidance available on achieving HWWS effectively in this context where water insecurity is rife. In their review article, Howard et al. (2020) agree that in order to suppress COVID-19 and prevent future pandemics, continuous access to piped water in households and other settings needs to be a focus in countries with inadequate WASH provision. They also recommend that governments looking to bolster defences against COVID-19 and similar future outbreaks invest in WASH behaviour change programmes tailored for those in the vulnerable category.

As with OD, COVID-19 will have far-reaching consequences that extend beyond immediate physical health impacts. The pandemic is exerting a considerable burden on mental health worldwide with the introduction of quarantine and self-isolation exacerbating common mental illnesses such as depression and anxiety (Dong and Bouey, 2020; Kumar and Nayar, 2020; WHO, 2020a). An increase in child abuse and domestic violence has also been reported in India as a result of lockdown (Buckshee, 2020; Chandra, 2020; Graham-Harrison et al., 2020; Unni, 2020). Previously, schools have acted as protective spaces against illegal child marriage as girls have appealed to friends and teachers for help when pressured by their family to marry. However, with COVID-19 forcing school closures, the already high rate of child marriage has risen considerably (Arya, 2020).

As of August 2021, all primary schools in Delhi have remained closed since March 2020 and as a result, these issues compromising children's safety and wellbeing will likely multiply. There is not much existing research on the impact of substantial disease outbreaks on children but Lee (2020) reports on the impact of school closures caused by

COVID-19 worldwide on mental health. Children with existing mental health conditions under control through treatment may suffer relapses while as reported above, child abuse and domestic violence will increase. Azevedo et al. (2020) estimate that COVID-19 school closures will cause children worldwide to lose 0.3-0.9 years of schooling. Furthermore, they suggest that approximately 7 million primary and secondary students could quit their education altogether as a result of the pandemic's economic fallout. With student absenteeism already a major issue in low-income countries, COVID-19 poses a major problem for achieving universal access to education and Azevedo et al. (ibid.) predict that the pandemic will result in a considerable setback in achieving education-related SDG targets by 2030. When schools do reopen, it will be important to prevent transmission of COVID-19 by improving WASH access in schools. The dangers faced by children due to the pandemic further justify this research, necessitating action to improve the standards of WASH provision in schools, particularly those attended by low-income children who have less opportunity to adopt behaviours preventative against COVID-19.

2.2.5 *The indirect implications of inadequate WASH*

Insufficient access to WASH facilities and knowledge can be indirectly linked to non-health factors such as safety and dignity. For example, Hutton et al. (2014) reveal that the perceived economic cost of sanitation can be a considerable barrier to families investing in an appropriate sanitation solution (Coffey et al., 2014; Sinha and Chaudhry, 2019) (see section 1.8.3). This despite the fact that families owning toilets cite a number of benefits. Hutton et al. (2014) investigate perceived economic impacts of sanitation interventions in Southeast Asia. They find that the main reasons why some participants owned toilets included safety, improved environment, source of pride, reduction in anxiety relating to one's children, comfort, convenience, easy installation and decreased embarrassment – all of which can be classified as benefits, unrelated to physical health, that are associated with WASH improvements. Meanwhile, the main reason why other participants did not own a toilet was the alleged high cost. They conclude that 'sanitation should be promoted as a central development priority' (p34), especially in the education sector.

According to Hutton and Chase (2016), WASH inequalities align with socio-economic status on a global level. They find that the impact of substandard sanitation amounts to a decrease in GDP of over 4% in South Asian countries and argue that non-health impacts should be taken into account when evaluating WASH interventions. A less recent study from the Water and Sanitation Program of the World Bank (2011) cites a figure specifically for India of 6.4% reduction in GDP linked to the impact of diarrhoeal infections such as intestinal helminths. According to Chambers and Von Medeazza (2013), this could be an underestimation as it does not take into account environmental enteropathy.

The link between WASH access and socio-economic status is also observable at the household level. UNICEF (2017) offers a positive perspective on this in India, estimating that inhabitants of rural villages free of OD share savings of 50,000 Rs (484 GBP) per year and the value of their property increases by on average 19,000 Rs (184 GBP). However, Perard (2018) states that the estimated figure of 28-33 billion USD per year to achieve universal sanitation provision amounts to just 0.1% of total GDP for developing countries. At this relatively low cost, he argues that the barrier to achieving global sanitation access is not attributed to the overall expense but to a number of factors including whether sanitation investment is sustainable over time and people being unwilling to pay for sanitation improvements.

It is clear from the health and economic impacts faced by communities in low-income countries that substandard WASH provision serves to exacerbate inequalities and compound poverty. The following section explores this in the context of WASH and education, reviewing findings from previous school-based WASH interventions in the literature and considering factors such as school absenteeism, the possibility of students transferring their learning from school-based WASH programmes to their household and LFP schooling (Day Ashley et al., 2014).

2.3 WASH and education

The literature demonstrates that there exist vast inequalities in school WASH provision worldwide and that research is required to ascertain which factors enable or impede

children's WASH behaviours in the school environment. This is particularly true in light of the inclusion of school WASH in the SDGs (Chatterley et al., 2018), the fact that it has an important role to play in the realisation of the human right to water and sanitation (Cronk et al., 2015) and the evidence highlighted above that infectious diseases (section 2.2.2) and stunting (section 2.2.3) negatively impact cognitive ability (Grantham-McGregor et al., 2007; Eppig et al., 2010; Spears and Haddad, 2015).

In their review of the literature surrounding monitoring WASH and the SDGs in the institutional settings of schools and healthcare facilities, Chatterley et al. (2018) explain that 'Children spend a significant part of their day at school where WASH services can improve educational opportunities and decrease the potential for disease transmission between students' (p596). Globally though, the evaluation of WASH in schools is still in the embryonic stages (ibid.), despite explicit reference to it in the SDGs. Sustainable Development Goal 4, which aims to 'Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all' (UNGA, 2015, p19), includes the target to 'Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all' (ibid.) and the indicators for this specify basic drinking water, single-sex sanitation facilities and basic handwashing facilities. However, monitoring these indicators and targets in institutional settings is challenging. Chatterley et al. (2018) highlight the importance of judging WASH provision in non-household settings such as schools and healthcare establishments specifically against the SDG indicators. For this reason, the research questions of this current study are matched with targets and indicators from SDG 6 (Clean Water and Sanitation) as well as SDG 3 (Good Health and Well-Being) and SDG 4 (Quality Education).

Cronk et al. (2015) state that knowledge of WASH in institutional settings (schools, places of work, health facilities) is limited and call for national and international monitoring systems that will play an integral role in improving WASH provision in non-household settings. They cite the considerably positive impact that appropriate WASH provision can have, not just on health but also welfare and productivity. The authors identify a number of existing monitoring tools such as Educational Management

Information Systems (EMIS), Health Management Information Systems (HMIS) and Service Provision Assessments (SPA) but do not provide analytical detail regarding how these existing systems could be adapted to meet this need; more research is required to clarify this. Although their study only evaluates one private sector sanitation provider and does not include government provision, Snyder et al. (2020) recognise that inconsistent school WASH deepens inequalities and call for further research to achieve the SDG targets for WASH in schools:

> There are considerable challenges to achieving the Sustainable Development Goals' target of universal access to basic sanitation in schools. Schools require safe, clean, and sex-segregated facilities for a large number of students. Robust and affordable solutions are needed to address the economic, spatial, social, institutional, and political factors which contribute to poor sanitary conditions in informal settlements.

(p1)

The following section explores previous literature relating to schools-based WASH interventions (similar to that of CURE) which aim to achieve improvements in WASH, including the progress in sanitation that Snyder et al. (2020) recommend, thus working towards the SDG 6 targets in schools. In Chapter Five, this literature is compared to the findings of the current research to clarify the driving factors affecting children's WASH behaviours, and therefore progress towards SDG 6, in East Delhi primary schools.

2.3.1 *Evaluating WASH interventions in schools*

In their review article, Joshi and Amadi (2013) state that previous understanding of positive WASH behaviours, age, gender, socio-economic status, school grade and extent of access to WASH facilities all associate significantly with a number of outcomes. These are school absenteeism, prevalence of infectious diseases and WASH-related knowledge, attitudes and practices. To investigate the driving factors affecting children's WASH behaviours, it is important to investigate which approaches are effective in bringing about changes in school WASH systems. The numerous interventions presented here test the impact of different WASH software and hardware factors such as BCC activities and infrastructure developments on variables including children's hygiene habits, school attendance and prevalence of WASH-related infections. This section will review the

existing evidence from WASH interventions in schools, many of which are similar to the design implemented by CURE. It is separated into two parts – the first examines studies which aim to change school students' behaviour and the second focuses on studies with the objective of improving school students' health, although some of these naturally overlap. This is ordered as such because one hypothesis implicit in this research is that an increase in adoption of WASH behaviours will bring about improvements in health outcomes.

First, there is evidence that WASH interventions bring about desirable changes in students' WASH behaviours such as handwashing and latrine use. McMichael's (2019) review of WASH in schools in low-income countries evidence highlights 13 interventions, all of which contribute evidence of an association between schools-based WASH interventions and improvements in children's WASH behaviours. However, the extent to which this behaviour change is sustained over time, and the extent to which it translates into improved health outcomes, are both unclear.

Boubacar Maïnassara and Tohon (2014) evaluate an intervention in Niger similar to CURE's, incorporating latrine construction, improvements in clean water supply and handwashing stations, alongside health education. Although it is important to note that this study relied on self-reporting with regards to data on WASH behaviours, the intervention reportedly had a positive impact on these with increased usage of piped water, toilets and handwashing after toilet use. However, this was not reflected in health indicators such as parasitic infection, for which the more objective and reliable method of stool sample analysis was used. The authors explain that their intervention had short-term benefits in terms of behaviour change but recommend that monitoring continues over the long term to verify and reinforce these positive effects. WASH education also requires regular repetition to ensure widespread adoption.

Chard and Freeman (2018) also note that intervention outcomes are difficult to sustain over time. Humphrey (2019) states that 'One reason for the poor efficacy of low-cost WASH interventions is their requirement for high user adherence to consistent sustained behaviour change' (p1158). There are not many schools-based WASH interventions which provide detailed reports of post-intervention outcomes; this leads to limited

understanding of what is required to effect this consistent behaviour change. Figure 6 presents results from the WASH in schools programme based in Laos evaluated by Chard and Freeman (2018). It shows the average percentage of students practising five different WASH behaviours at certain intervals after implementation. There were significant increases in toilet use, group toilet cleaning and group handwashing among intervention students in comparison to control groups. The authors recommend group handwashing as an effective activity but this cannot be relied upon – they express the need for a strategy to encourage long-term individual handwashing too. Improvement in the acquirement of handwashing with soap (HWWS) habits is more difficult to sustain long-term, as Humphrey (2019) warns, and this can be seen from the mixed results in this category in Figure 6. The average percentage of students in the intervention groups practising HWWS did increase but remained inconsistent over time.

Figure 6 Project output achievement since project implementation
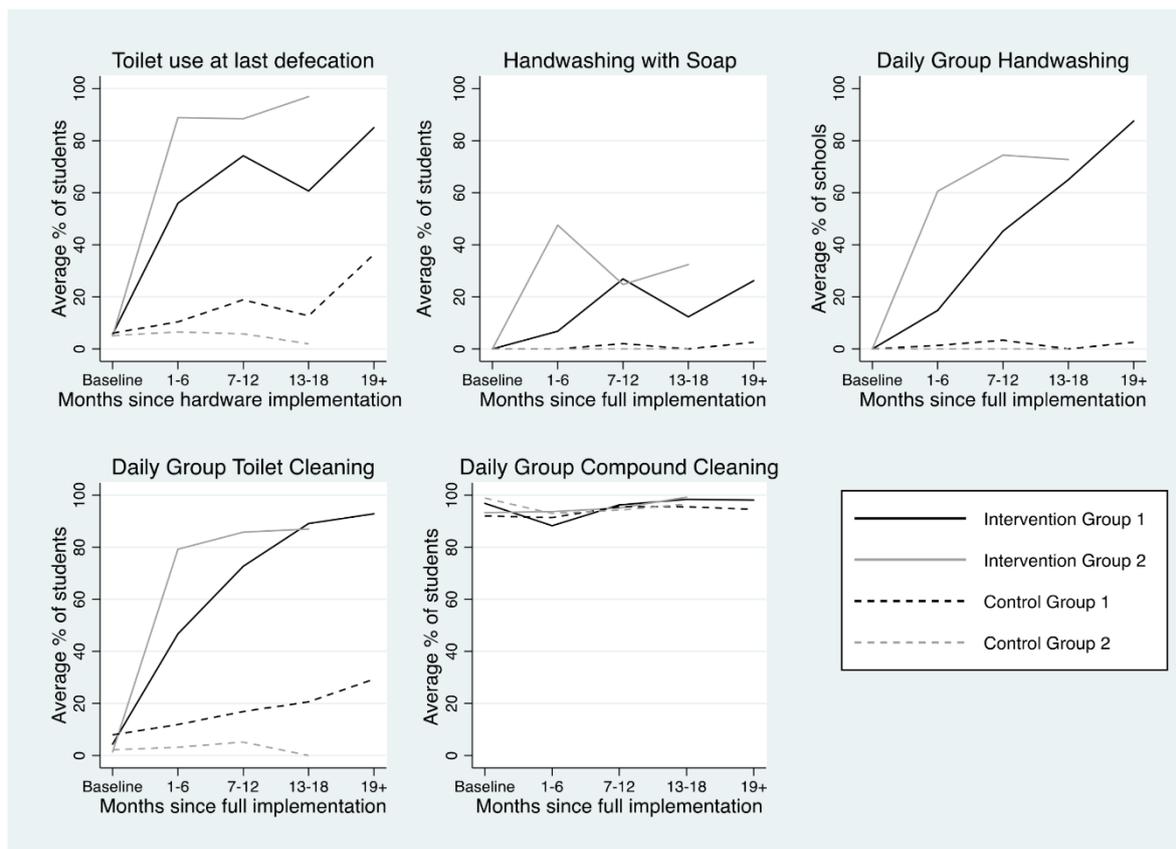
(Chard and Freeman, 2018, p579)

Meanwhile, Karon et al. (2017) include 450 Indonesian schools in their sample and find that the likelihood of having handwashing stations with water and soap available one year after the end of the intervention was higher in intervention schools than in control schools, suggesting that there is some potential for beneficial intervention impacts to be sustained. However, this study does not consider water quality and rightly highlights the fact that the definition of an improved water source does not take this into account (see section 1.2). Thus, the authors cite the need for further research including water quality as a factor to clarify the extent of WASH provision in these schools. The authors also recognise socio-economic status as an important factor, explaining that it is less likely for students who access improved sanitation at home to practise OD at school. Martin et al. (2018) present a systematic review of studies in low- and middle-income countries which focus on the sustainability of WASH interventions. Although not focusing on schools, it offers some insight into why sustainability is inconsistent and considers how sustained adoption of WASH technology is actually defined in the literature. Reporting on findings from 21 articles which focus specifically on sustained adoption, the authors highlight a key issue in the evaluation of WASH interventions; time frames used in the evaluation of such programmes are often insufficient for the accurate investigation of long-term positive behaviour adoption. They recommend the incorporation of direct observation lasting over a longer period of time, like the approach followed by Chard and Freeman (2018) in Figure 6, to ensure accurate measurement of sustained adoption of WASH behaviours.

School staff are also an important factor in sustaining WASH behaviour changes long-term. Saboori et al. (2013) raise the issue of the role played by teachers in ensuring the long-term sustainability of intervention benefits:

> …although hand washing training was conducted with teachers in the two intervention arms before implementation, it is uncertain whether the trained teachers conducted handwashing promotion and education at the schools after training and whether the school health clubs were continuing to conduct hand washing promotion activities. Varying levels of hand washing promotion within the intervention schools may have influenced the proportion of proper hand washing practice events observed among pupils.

(p706)

If the programme relies on school staff to continue providing materials and training sessions post-intervention, it is important that these staff are trained and incentivised to do so, understand the objectives of the intervention and that the intervention outcomes are monitored in the long term. Harahap et al. (2018) also consider the role that teachers play in the sustainability of WASH intervention outcomes. They aim to measure the impact of WASH provision in schools in a mixed methods study which employs SEM to explore the link between the cleanliness of the school environment (although outdoor areas such as playgrounds are excluded without a reason stated) and students' WASH behaviours. The authors include little information regarding the observation instrument and questionnaire used to gather data on school cleanliness, teachers' behaviours and students' behaviours, and do not share the Cronbach's alpha result to demonstrate the scale's internal consistency. They also do not detail the qualitative methods employed so findings should be treated with caution. However, they find that cleanliness, not just of the classroom but that of the entire school compound, is important when considering the impact of the school environment upon students' WASH behaviours. Involving students in taking responsibility for ensuring the cleanliness of the school is an important factor and positively impacts students' habits. Teachers have a central role in influencing students' behaviour; the authors' inclusion of teachers' behaviour in their analysis increased the strength of the positive correlation between the cleanliness of the school environment and students' WASH behaviours. La Con et al. (2017) also identify teachers as having a significant role and apply mixed methods design more transparently, using observation of children's behaviours, a self-reported questionnaire and focus group discussions with teachers recruited from a random sample of schools. In their Kenya-based hygiene programme evaluation, training the teachers on hygiene and installing drinking and handwashing stations led to 'observed improvements in pupils' hygiene' (p121).

Ghanim et al. (2016) advocate more WASH interventions among younger students. They conduct a cross-sectional study with 428 participating primary school-aged children in the United Arab Emirates and find that parents (77%) are the most common source of hygiene knowledge with teachers as the second most common (46%). They conclude that schools providing hygiene training in primary education would ensure equality in

the proliferation of hygiene knowledge at the age when children need it, leading to more widespread positive WASH behaviours in adolescence. Wagner and Samuelsson (2019) go further and advocate WASH input at pre-school level, as well as increased WASH-related training for teachers. These measures could combine to lessen the effect of socio-economic status on the practice of WASH behaviours.

A number of studies note improvements in handwashing behaviour following schools-based WASH interventions. In the Philippines, Vally et al. (2019) use the same approach as the current research of comparing intervention schools and non-intervention schools. Similar to CURE's project, the intervention consisted of the renovation of WASH infrastructure and activities such as interactive games, peer learning and art activities aiming to promote healthy WASH behaviours. Again, this study relies on self-reported data from students. Those attending intervention schools reported higher rates of handwashing with soap (HWWS) (83%) than those attending comparison schools (60%). The authors found an even starker contrast during direct observations of student handwashing after toilet use; 89% of students in intervention schools compared to 31% in comparison schools. In a mixed methods study focusing largely on qualitative data, Hetherington et al. (2017) review a participatory youth programme in Tanzania called Project SHINE (Sanitation and Hygiene Innovation in Education). It consisted of workshops for teachers, lessons, an extra-curricular timetable, events in the community and a science fair all with the objective of increasing awareness of WASH and health. With a design similar to this thesis, impact was explored through interviews, focus group discussions and a questionnaire on WASH knowledge, attitudes and practices. Post-intervention questionnaire results compared to baseline revealed improvements in key areas relating to WASH including increased numbers of participants considering handwashing to be important, reduced unhygienic behaviours but no increase in knowledge associated with sanitation. Authors report themes from the qualitative data including youth leadership skills, teachers' enthusiasm for the participatory approach and strong participation from the community.

Bieri et al. (2013) evaluate a health education intervention in China aiming to build understanding of soil-transmitted helminths (STHs) and offer strong evidence supporting

schools-based programmes. At post-intervention assessment, the percentage of intervention group children washing hands after toilet use was close to twice that of the control group (98.9% and 54.2% respectively, $p < 0.001$) and the percentage infected with STHs was half that of the control group (4.1% and 9.4% respectively, $p < 0.001$). This is an example of how behavioural and health impacts can overlap (Patel et al., 2012; Erismann et al., 2017; Palmeirim et al., 2018). Similarly, Saboori et al. (2013) investigate to what extent providing soap to primary schools in Kenya increases HWWS and reduces the presence of *Escherichia coli* on students' hands. Handwashing was measured through structured observation of instances of handwashing following toilet use. This is a more reliable method than collecting self-reported data through questionnaires but children's behaviours could nonetheless be affected by awareness of the observations taking place. The percentage of students practising HWWS was considerably higher in schools that were provided with soap (32%) and schools that were provided with both soap and toilet cleaning materials (38%) than in control schools (3%). However, the decrease in *E. coli* presence across schools was not significant (ibid.) and this is a common finding in the literature; positive behaviour change outcomes are not necessarily accompanied by health improvements.

Secondly, there is also strong evidence that substandard WASH provision is associated with damaging health outcomes (Rosenthal et al., 2020), thus deepening pre-existing social inequalities. However, even if WASH interventions are successful in bringing about behaviour change, health improvement outcomes following WASH interventions are inconclusive, with positive impacts in some areas but not others (Patel et al., 2012; Saboori et al., 2013; Humphrey, 2019). In fact, in some cases, it is possible that schools-based WASH interventions could bring about detrimental effects on children's health if not accompanied by successful behaviour change strategies. Greene et al. (2012) caution that the effectiveness of school WASH interventions in reducing children's exposure to faecal matter is unclear. They evaluate a schools-based WASH programme and its impact on the presence of *E. coli* on students' hands in Kenya. An intervention consisting of water treatment and hygiene promotion activities did not decrease the presence of *E. coli*. In fact, construction of new latrines in intervention schools increased *E. coli* presence on girls' hands at a significant level. This study concludes that

'constructing new facilities may pose a risk to children in the absence of sufficient hygiene behavior change, daily provision of soap and water, and anal cleansing materials' (p385).

Chard et al. (2018) evaluate the impact of a comprehensive, Mali-based schools-based WASH intervention on the prevalence of a number of infectious diseases. Using the highly reliable method of dried blood spot testing to observe antibody presence, they find that fewer students from intervention schools contracted diseases such as *E. coli* transmitted through food and water than those attending control schools. Meanwhile, there was no significant finding for vector-transmitted diseases, indicating that the schools-based WASH intervention brought about positive impacts exclusively on water-related disease infection. This is reassuring evidence that schools-based WASH interventions can bring about improvements in the area that they are targeting. A number of studies build upon these findings, investigating the potential correlation between different school WASH interventions and improvements in children's health. However, as Saboori et al. (2013) show, evaluations which identify behaviour change resulting from interventions do not necessarily identify improvements in students' health and stakeholder commitment to intervention adherence is required.

STH infection is ubiquitous in low-income countries with roughly a quarter of the global population infected (WHO, 2020b) so many of these studies focus on this particular health issue. Gitore et al. (2020) evaluate the link between STH infection and WASH in schools in Ethiopia, collecting questionnaire data and stool samples from 1,080 students. They find that children who come from large families are more likely to be infected with STHs. Also, those with minimal knowledge of STHs, those who attend schools without gender-separate toilets and those who attend schools in which the toilets are not easily cleaned are more likely to suffer from STH infection.

However, other findings relating to helminthic infection are inconclusive. An evaluation of a school WASH programme in Cambodia, Laos and Indonesia including daily group HWWS, biannual deworming at school and construction of school handwashing stations did not identify a difference in prevalence of STH infection between intervention and control schools (Dujister et al., 2017). Focusing on the deworming aspect, Freeman et al.

(2013) conducted a cluster-randomised trial evaluating the effect of a school WASH programme in Kenya on the reduction of STH infection after deworming took place at the school. The intervention consisted of WASH infrastructure provision including handwashing containers, water treatment and a one-year supply of a water treatment product, alongside hygiene education. Reinfection decreased following deworming for *Ascaris lumbricoides* but not other species such as *Trichuris trichiura* and hookworm, suggesting that different approaches are required for different types of infection. This finding is echoed by Freeman et al. (2015) who add that water supply is positively correlated more strongly with lower rates of helminth infection than other WASH indicators. Palmeirim et al. (2018) note that children with high understanding of hookworm had less chance of being infected by hookworm but found no relationship for other species, thus echoing the inconsistency identified by Freeman et al. (2013). Palmeirim et al. (2018) also add that the majority of the 2,498 children participating in their study believed that the anthelminthic chemotherapy treatment (e.g. albendazole) they received at school was permanent and that a repeated treatment was unnecessary. They conclude that interventions should aim to increase children's understanding of the risk inherent in becoming infected with helminths and the mechanics of the anthelminthic chemotherapy treatment that is widely available in schools in developing countries. Erismann et al. (2017) and Shrestha et al. (2020b) recorded increased handwashing and reduced presence of intestinal parasites including helminths following combined agricultural and WASH programmes in Burkina Faso and Nepal respectively. The authors of the former study recommend long-term, regular interventions with more focus on households and communities to bring about enduring improvement in children's health while the authors of the latter study recommend engaging children in gardening activities as a key method of improving nutritional and health status.

Moving onto studies which focus on the difference made by water security (see section 1.7) specifically, the literature suggests that improvements brought about by WASH interventions could be particularly significant in schools where water access is precarious. In two studies based in Kenya, Dreibelbis et al. (2014) and Freeman et al. (2014) compare intervention impacts on health across schools with varying water access. The former study evaluates a Kenyan school WASH programme's impact on

diarrhoeal infection and visits to a health centre for the younger siblings of school students. For schools with limited access to water, the WASH programme was associated with a larger decrease in diarrhoea and health centre visits than the comparison schools. A third group of schools which received the intervention but had pre-existing, secure access to water saw no difference in rates of diarrhoea and health centre visits compared to control schools. Freeman et al. (2014) note that students attending what the authors term 'water-available' (p340) schools that received the intervention consisting of water treatment, sanitation improvement and hygiene education did not experience fewer diarrhoeal symptoms than students at non-intervention schools. Conversely, the same intervention at 'water-scarce' (ibid.) schools led to reduced incidence of diarrhoea for students compared to those attending non-intervention schools.

Garn et al. (2016) also compare schools with varying water access, evaluating a Kenya-based WASH intervention. They explore to what extent schools adhere to intervention recommendations (water supply installation and maintenance, latrine construction and soap usage). Schools with a water source further than 1 kilometre away are defined as 'water-scarce' (p752). However, there is no explanation as to why this definition was chosen rather than, for example, the WHO and UNICEF Joint Monitoring Programme's distance limit for basic provision of 'not more than 30 minutes for a roundtrip, including queuing' (WHO/UNICEF, 2017, p8). As the main finding of the study focuses on the difference between 'water-scarce' and 'water-available' (Garn et al., 2016, p752) schools, the conclusion would have been strengthened by more explanation as to how this differentiation was selected. In the group of schools with insecure water access, the rate of diarrhoea was lower among students at schools which adhered to the intervention recommendations. In the group of schools with water generally available, there was no reduction in diarrhoea associated with increased adherence to the intervention protocols. The findings suggest that diarrhoea is increasingly avoided to some extent when the WASH intervention is adhered to more closely by schools. All three of these studies point to the conclusion that in areas with limited water access, addressing water security during school WASH programmes is vital in lessening the burden of diarrhoeal diseases.

As Saboori et al. (2013) suggest in their discussion of the role of teachers, the extent to which stakeholders engage with a schools-based WASH intervention is a significant factor in its effectiveness. Garn et al. (2017) define minimal adherence as 'low level of engagement by beneficiaries' (p984), investigating to what extent schools meet four WASH targets following the implementation of an intervention. They compare success in meeting these targets between intervention and non-intervention schools. Adherence to the intervention targets was not consistent across all schools but intervention schools overall met more targets than non-intervention schools. Meeting multiple WASH targets simultaneously was linked to decreased rates of diarrhoea and respiratory symptoms but had no impact on absenteeism. Focusing on maximising adherence to intervention targets following a WASH intervention could augment the impact of the intervention on school students' health but it may not result in increased attendance.

2.3.2 *Children's attitudes towards caring for the environment*

Aczel et al. (2020) argue that it is essential to include children in discussions about the environment, training them to be 'informed citizens who are capable of defining problems, fostering solutions, and enacting those solutions' (Hollstein and Smith, 2020, p228). As children were encouraged to engage in water conservation, greening the school compound, sustainable disposal of school waste and composting during CURE's intervention, this section of Chapter Two explores previous literature which sheds light on children's attitudes towards caring for the environment.

D'Agostini (2016) defines ecocentrism as 'a world-view attitude…capable of minimizing the human footprint on the natural world' (pv) and acknowledges that minimal research has explored this concept in school children. Conducting ethnographic research with primary-aged children at a 'Green School' (p3) in Michigan, she finds that support from school leadership is key in encouraging children to develop attitudes that could be categorized as ecocentrism. Furthermore, the school principal shared this leadership with other staff, the students and their families, thus empowering other stakeholders to take initiative to sustain environmental schemes. Samaltani and Christidou (2013) focus on water conservation in Greece and conclude that teaching young children about this will support them in building enthusiasm for addressing environmental issues; Hsiao and

Shih (2016) use picture books designed around environmental themes to achieve this in Taiwan. In a similar research design to this current study, Tucker and Izadpanahi (2017) compare students attending schools designed with a focus on sustainability and those attending normal schools in Australia. They find that students from the sustainable schools exhibited behaviours more positive towards environmental issues than those attending the ordinary schools.

Focusing on environmental awareness among children in an Indian context, Akhand and Sunder (2019) acknowledge the important role that teachers play in building children's pro-environment beliefs and behaviours. They administered a questionnaire focusing on environmental awareness to children in the last grade of primary school, finding that teachers prioritising environmental studies builds students' consciousness towards protecting their local environment. Laiphrakpam et al. (2019) point to the fact that environment-focused education has been present in India for centuries, linking to traditional beliefs about nature. They conclude that 'environmental education heightens awareness among students, which brings behavioral changes and practice, thereby leading them towards environmental protection for sustainable development' (p48).

Hammarsten et al. (2019) consider the concept of ecological literacy which is the idea that someone can have 'knowledge and understanding about how the ecological systems of the Earth function and support life' (Pitman et al., 2018, p9). If someone is ecologically literate, they will better understand the need for a focus on issues such as water conservation and composting. Children may receive the environmental education in school to which Akhand and Sunder (2019) and Laiphrakpam et al. (2019) refer but Hammarsten et al. (2019) warn that as cities become denser and green spaces are diminished, children become less familiar with nature and interact with green environments less which can present a barrier to their healthy development. The concerns raised by Hammarsten et al. (ibid.) lead to a question regarding the children participating in this thesis study: if they are living in such an overcrowded concrete jungle as the informal settlements of East Delhi, how are they to develop the ecological literacy required to adopt WASH behaviours long-term which protect the environment

around them? In this way, the importance of the school environment as a space where children access clean, green spaces is emphasised further.

There is frequent mention of school absenteeism, defined here as children not attending school, in previous literature investigating WASH in schools (Chard et al., 2019; Mohammed et al., 2020; Pandey et al., 2020). If there is a link between them, it offers evidence for the role of school WASH provision in children's adoption of positive WASH behaviours. The following section explores the issue of school absenteeism and the extent to which this is linked to WASH-related factors.

2.3.3 *School absenteeism*

The existence of a relationship between school WASH provision and children's absenteeism is unclear. Sclar et al. (2017) conducted a systematic review of the evidence for the impact of sanitation on cognitive development and student absenteeism. They state that the evidence for a link between sanitation and absenteeism is ambiguous as 'Some studies reported lower absence while others reported higher absence' (p917). They give a number of reasons for the inconclusive findings in the literature including varying definitions of sanitation across studies, different methods employed for measuring absenteeism and the reliance on participants self-reporting. They also point out that neither of the two studies in their review which conducted rigorous randomised controlled trials (RCTs) report that school-based sanitation interventions reduced overall student absenteeism (Freeman et al., 2012; Caruso et al., 2014). Sclar et al. (2017) seem to value the findings of RCTs as 'robust study designs' (p922) over other methods. However, there is some debate surrounding the use of RCTs in the social sciences (Deaton and Cartwright, 2018; Krauss, 2018). For example, Thomas (2016) advises against treating RCTs as the 'gold standard' (p390). He explains that establishing this hierarchy of research types implies that the 'gold standard' (ibid.) is more effective than all others in identifying causal patterns and leads researchers away from other ways of analysing complex patterns and relationships which may be more useful.

Results from the evaluation of a schools-based WASH programme in Kenya show that the cleanliness of school toilets is the only WASH-related factor associated with a

decrease in absenteeism (Dreibelbis et al., 2013b). Demographic characteristics such as gender and socio-economic background were more strongly linked to absenteeism than WASH factors (ibid.). Caruso et al. (2014) conclude that improving WASH infrastructure and behaviours in Kenyan schools does decrease absenteeism but only if latrines are in adequate condition and sufficient equipment such as soap is available. They note that, even though increased latrine cleaning does not add to these impacts on absenteeism, the maintenance of sanitation infrastructure is nonetheless important for preserving students' dignity.

Chard et al. (2019) highlight the inconclusive findings of previous studies to clarify the link between improved WASH, decreased illness and reduced absenteeism. They conducted a cluster-randomised trial in Laos, recording students' absence and reported illnesses, and collecting stool samples following a comprehensive WASH intervention. Improved WASH was not found to impact significantly upon absenteeism. The authors conclude that, although school-based WASH interventions are 'potentially critical for the enabling environment' (p11), improvements are required in 'intervention fidelity and adherence and including other complementary approaches' (p12) in order to maximise benefits.

Many studies focus specifically on the impact of menarche on girls' school attendance (Van Eijk et al., 2016; Vashisht et al., 2018; Mohammed et al., 2020). In fact, this relationship can have a cyclical effect. Studying the MHM behaviours of Indian women aged 15-49 years, Almeida-Velasco (2019) presents evidence that education level is negatively associated with instances of reproductive tract infections, a common symptom of unhealthy MHM. This suggests that adolescent girls who do not drop out of school are more likely to practise healthy MHM in adulthood. As discussed in section 1.6.1, there is some evidence that WASH interventions in schools could bring about positive change in this area. Freeman et al. (2012) conduct a cluster-randomised trial of the effect of WASH in schools on student absenteeism in Kenya. Their intervention consisted of three groups: water treatment coupled with hygiene promotion, a second group with improvement in sanitation added to this, and a control group. Although the intervention had no overall impact on absenteeism across all students as mentioned in

the Sclar et al. (2017) review, there was a 58% decrease in absenteeism for girls in schools which received the water treatment and hygiene promotion intervention, as well as those that received this along with the additional sanitation improvements. The authors acknowledge that the role of sanitation in girls' improved attendance could depend on the cleanliness of said sanitation facilities; this suggestion is quantified by Dreibelbis et al. (2013b) who find that the cleanliness of school toilets in Nyanza, Kenya is associated with decreased likelihood of student absence.

Although the fact that the absenteeism data relies on schools' own attendance lists raises questions regarding its validity, Trinies et al. (2016) evaluate a comprehensive programme in Mali including the distribution of hygiene supplies and the institution of WASH governance strategies for schools. They reveal that the likelihood of student absenteeism caused by respiratory symptoms or diarrhoea in the last week was higher in non-intervention schools than intervention schools. However, they make it clear that this finding does not indicate that improvements in health resulting from the WASH programme directly lead to a decrease in absenteeism overall, citing their other finding that the likelihood of student absenteeism for any reason was 23% higher in intervention schools than in control schools. They suggest that there could be a number of other variables apart from those that are health-related which contribute to absenteeism.

Overall, while a causal link between schools-based WASH interventions and reduced student absenteeism is conceivable, the empirical evidence remains inconclusive. More rigorous research is required, taking into account factors such as socio-economic status and the extent of parents' schooling (Dreibelbis et al., 2013b; Sclar et al., 2017). This would assist in ascertaining to what extent school absenteeism, a damaging cause of social inequalities, is brought about by inconsistencies in WASH provision.

2.3.4 *Pupil-parent knowledge transfer*

Children transferring their acquired knowledge, attitudes and practices into their households is often cited as an objective of schools-based WASH interventions (Bresee et al., 2016; Ejelonu et al., 2020) and was a clear aim in CURE's programme:

'Children…take the messages home to parents creating a seamless link between school and home sanitation practices' (CURE, 2020, 'What We Do – School Water and Sanitation'). In this way, children themselves can be a force for positive change and the benefits of schools-based WASH interventions can lessen home-based WASH inequalities. However, it is not frequently mentioned in evaluative studies. A few report findings indicating the potential for success in meeting this objective under the right conditions (O'Reilly et al., 2008; Blanton et al., 2010; Cavill et al., 2016; Karon et al., 2017). Some of the studies explored in this section are less recent due to the infrequent mention of pupil-parent knowledge transfer in the literature.

The evaluation of one Kenya-based programme presents evidence of 'water treatment and hygiene knowledge transfer from student to parent and some evidence of behaviour change among parents' (O'Reilly et al., 2008, p88). It is clear that this was certainly an objective of CURE's project with much effort to engage with students' families through parent-teacher associations (PTAs), community visits and invitations to participate in some of the BCC activities which are listed in Appendix 2. In the case of O'Reilly et al. (2008), students' and parents' understanding of a water treatment product and handwashing improved following the intervention:

> Children's potential effectiveness as agents of change in the home was suggested by the finding that parents who reported that their children influenced their water treatment behaviour had a higher degree of awareness of WaterGuard than parents who did not acknowledge their children's influence, and were significantly more likely to know the correct WaterGuard dose, report current use, and have chlorine residuals in their stored water.

(p88-89)

The authors planned to follow up with parents and children at a later date to ascertain the extent to which the intervention impacts endured in the long term and this is key to the concept of pupil-parent knowledge transfer: the potential role it could play in maximising the longevity of intervention benefits. Karon et al. (2017) reinforce O'Reilly et al. (2008), stating that children who were taught WASH behaviours at school and engaged with this by maintaining school toilet facilities were more likely to pass on this

learning to their parents. However, the authors do not clarify the extent to which parents subsequently adopted these positive behaviours.

Freeman and Clasen (2011) explore the impact of a school WASH programme in India which aimed to raise the standards of drinking water quality, partly through bringing about change in drinking water behaviour in households. They do report that a higher percentage of intervention households (22%) received messages relating to home water treatment from children than control households (7%, p = 0.002) but this sharing of knowledge is not associated with the households subsequently adopting these practices. Referring to the adoption of water treatment technology in the form of a purifier, the authors conclude that socio-economic status and the ability to purchase a purifier play a more significant role than children transferring their knowledge of why such a device is important into the home. This is another example of varying WASH access exacerbating pre-existing income inequalities.

With a more positive outlook on the potential of pupil-parent knowledge transfer, Bresee et al. (2016) also recommend specific approaches for children but argue that, with appropriate support, they can bring about important change in the household context. The authors use qualitative methods in Zambia to investigate to what extent children are able to transfer their knowledge into the home as 'change agents' (p521). First, they used participatory activities in focus group discussions to encourage children to talk about whether or not they believe that they are capable of being 'change agents'. The researchers then provided the children with health information and instructions on building a handwashing facility and encouraged them to share their learning with their household. Secondly, the researchers ran further focus group discussions separately with the students and their mothers to gather their thoughts on the experience. The authors found that the children were keen to pass on their learning to their parents and that the mothers trusted their children to pass on this knowledge accurately. They found that students had successfully brought about small behaviour changes but not significant improvements in infrastructure. It is recommended that, while children are certainly able to transfer knowledge transfer into the household, they require a

foundation upon which to do this such as particular set activities and structured frameworks.

2.3.5 *Low-fee private (LFP) schooling*

If school children are to live healthy, hygienic lives and act as agents of change in the home environment, they require 'safe, non-violent, inclusive and effective learning environments' (UNGA, 2015, p19) as per SDG target 4.a. In Delhi, there exist a number of different school types, falling broadly under the two categories of government and private management. A report published by NUEPA in 2018 using data from five states finds that government teachers in India spend just 19% of their working hours on teaching with election-related duties, survey collection, managing lunch registers and running Pulse Polio immunisation campaigns taking up the rest of their time (Mitul and Agha, 2018). More information is included on the nature of these government schools in section 3.7.3 but this extra burden on teachers leading to their absence from school is an issue that disproportionately affects children from lower income backgrounds. For those who are able to afford them, an alternative is available: low-fee private (LFP) schools.

LFP schools are a phenomenon common in developing countries aiming to provide high-quality education at a cost affordable to low-income families (Mond and Prakash, 2019). This is also referred to in the literature as 'low-cost private schooling' (Day Ashley et al., 2014, p4). Few previous studies focusing on LFP schools refer to WASH specifically but one is Tooley et al. (2010). They investigate the quality of LFP schools in Hyderabad, India, finding that LFP students' academic achievement is higher than their government school counterparts. LFP schools unaided by the government were found to provide WASH facilities more than government schools. Just 58% of government schools had drinking water facilities available for children to use, compared with 96% of government-unrecognised LFP schools. 100% of government-recognised but unaided LFP schools provided drinking water for students. 97% of all LFP schools possessed toilet facilities in comparison to just 52% of government schools. However, the study does not provide information on the quality of these facilities. In Kenya, Girod et al. (2017) compare girls' experiences of MHM at government schools and private schools.

Although it is not clarified whether these schools are defined as LFP, they are situated in low-income, informal settlements in Nairobi. The authors acknowledge that no other studies consider comparisons between public and private schools relating to MHM. They find that students attending government schools had more access to menstrual hygiene materials than those attending private schools because sanitary pads were distributed free of charge at government schools. The authors advise that the government should obligate private schools to provide suitable menstrual hygiene materials for their students.

Much of the existing literature around LFP schools focuses on the question of how and why parents choose them for their children, often instead of government schools. Dixon et al. (2017) investigate the impact of household characteristics and parents' priorities on how they choose their children's school in the context of Nigeria. The quality of a school's leadership, high-quality teaching and distance from home were all found to be statistically significant factors affecting parental choice. The father being educated to a high level increased the likelihood that the child would attend a private school. Heyneman et al. (2014) consider why a low-income family would choose to pay for their child's schooling when the country they live in has a government policy to provide education free of charge. They argue that low-income families who choose LFP schools should still be included in financial assistance programmes because attendance of these schools does not equate to wealth. The popularity of these schools does suggest that the state sector may not be capable of providing education of an adequately high-quality standard but for Heyneman et al., the government sector should nonetheless be the main provider of education so they do not advocate voucher programmes to increase access to LFP schools. Tooley and Longfield (2016) address a paradox in the literature surrounding LFP schools that arises from the observation of Heyneman et al. (2014) that low-income families are choosing LFP schools even though free government schooling is available. While this is true, at the same time there is evidence that the poorest households are unable to meet the cost of these schools (Day Ashley et al., 2014; Sing and Bangay, 2014; Ezaki, 2020). Using the $1.25 and $2 international poverty lines converted to local purchasing power party (PPP) rates, Tooley and Longfield (2016) focus on the cost of LFP schools and suggest a definition for 'low-cost private' as 'a school

affordable to an average family on or above the poverty line, using a given proportion of their expenditure to send all of their school-aged children to such private schools' (p456).

Härmä (2013) investigates LFP schools in Nigeria, offering a balanced view of the role they fulfil. She asks the question why parents would make considerable financial sacrifices to send their children to LFP schools and finds that they do so because they perceive government schools to be unsatisfactory. As an aside, she mentions that in many countries where the government is unable to meet demand for basic education and parents are turning to LFP schools, they are also looking to the private sector for water provision. Härmä also finds that parents' aspirations for their children's education are unlikely to be met by LFP schools which often employ teachers without formal training due to limited budgets. She therefore questions whether this current situation can lead to equitable access to education: 'They are essentially a temporary solution…a much-needed bandage over the problem of providing free, good quality basic education to all' (p564).

Dixon (2012) responds to this common argument in a staunch defence of LFP schools, confronting an alleged 'denial' (p186) among development professionals of the potential for change that LFP schools hold. Referring specifically to schools in Shahdara, the region of Delhi in which the research for this thesis took place, Dixon refutes the frequent criticism cited by Härmä (2013) of LFP schools, that they are nothing more than a solution for the short term, drawing attention to issues in the government sector observed during this current research such as teacher absenteeism and low-quality learning environments. She also points to a gradual change in how LFP schools are perceived by funders, citing the UK Department for International Development's support of a voucher programme in Pakistan so children from low-income families can attend LFP schools, as well as another similar programme in Delhi incorporating a randomised controlled trial (Wolf et al., 2015).

There is also much criticism of LFP schools in the existing literature, particularly questioning whether their existence alleviates or worsens social inequalities. Carr-Hill and Sauerhaft (2019) challenge the notion that LFP schools are more cost-effective than

public schools, raising the concern that, as they operate on tight budgets, they often employ young, under-qualified women as teachers on extremely low salaries. They argue that this is damaging to gender equality and exacerbates issues of social exclusion. While they are right to draw attention to women's rights to a living wage, their assertion that 'children's right to a free quality schooling…is being denied' (p38) disregards the fact that in many cases, LFP schools exist because the free education to which children are supposed to have access is not provided to an adequate level (Dixon, 2012).

Edwards Jr et al. (2017) criticise LFP schools in the context of Kenya, suggesting that teachers are treated poorly, that resources intended for government schools are consumed by LFP schools and that equitable access to an equal standard of education is compromised. The authors condemn public-private partnerships in education and are highly sceptical of relying on LFP schools to meet SDG 4. According to them, financing education through parents paying fees is a contradiction of education as a human right. Singh and Bangay (2014) also critique the role of LFP schools in India. They investigate how LFP fees affect households and shed light on the relationship between private and public education provision. They find that the poorest households are not able to access private schools, resulting in inequitable education provision. The authors call for further research on the impact of the privatisation of education on household indicators because many funders are interested in supporting advances in LFP schools. They highlight the fact that 'parents are not choosing to send their child to school on the basis of whether the school is private or government but whether it is delivering learning' (p148) and report that learning outcomes are better in LFP schools than in government schools. Singh and Bangay disagree with Edwards Jr et al. (2017), arguing that LFP schools should be included as a vital component of providing universal basic education in SDG 4, but should be subject to extensive government regulation and monitoring.

Some criticism of LFP schools in the context of India in the existing literature though is accompanied by relatively weak evidence. Conducting research specifically in Delhi, Mousumi and Kusakebe (2019) refer to the 'dilemmas of school choice' (p230), arguing that low-income parents are 'compelled to send their children to private unaided recognised and unrecognised schools [due to]…the perceived danger of sending younger

children to distant government schools' (ibid.). They refer to a 'growing concern about the role of private schools' (ibid.) but do not explain why LFP schools are a dilemma or a concern. From a sample of 35 households and 13 school principals, the authors conclude that 'Private schools...have no real connection to school choice among the participants' (p245), despite acknowledging 'the government schools' failure to provide dedicated and sincere teachers' (p242) and that 'the parents reject government schools for the teachers' insincerity and the prevalence of drugs, physical and verbal abuse' (p241). Conversely, it seems that the parents participating in this study have justifiable reasons to choose LFP schools for their children.

There is much disagreement in the literature regarding whether LFP schools narrow or widen the education equality gap. What is clear though is that many parents who can afford them choose them based on their perception of low standards in government schools, including those related to WASH:

> The parents' perception is that the government schools do not function well, lack discipline and security and that children do not learn much there. They feel that the...[LFP schools] provide a clean, disciplined, secure environment for learning, teachers pay attention to students and the children get a "good" education in such schools.

(Endow, 2018, p12)

Although there is evidently a debate in the literature regarding the role that LFP schools should play, the current research focuses on the differences between school management types in the context of WASH. Therefore, it is worthwhile in the following section to highlight further common challenges and solutions in the WASH sector.

2.4 Further challenges in WASH

As illustrated by the central importance of SDG 6 to the realisation of many of the other SDGs, WASH is a wide-ranging issue (Milan, 2017). This section offers an overview of common challenges and barriers in improving WASH pertinent to the current research. First, consideration is given to WASH infrastructure and the inequalities that exist relating to accessing it. Secondly, the question of how to ensure sustainability in WASH improvements is considered. Finally, the importance of monitoring progress in WASH is

explored, before progressing onto an overview of common WASH approaches, facets of which were included in CURE's schools-based project.

2.4.1 *Infrastructure and access inequalities*

Access to adequate WASH infrastructure and equipment is a common barrier to people adopting positive WASH-related behaviours; this is particularly true of people living with disabilities (Banks et al., 2019). Here, the focus is on water and latrine access. Boadi and Kuitunen (2005) discuss the continued global expansion of 'megacities with more than ten million people' (p193), the majority of which are in the Global South. They warn that this increase in urban population density means that 'half of urban residents in the developing world are expected to live in crowded settlements without basic sanitation and health amenities' (ibid.). One such megacity is Delhi and Biswas (2010) offers a vivid description of the reality of water access there:

> In cities like Delhi...each household, or block of flats, now acts as a mini-utility. Water of undetermined quality is collected, stored in underground tanks, and then pumped to overhead tanks by individual families. This water is then treated, mostly with filters (and sometimes even with membranes like the ones used for sea water desalination) before it is consumed. The main utilities supply water intermittently (often two to five hours per day), which is supplemented by the mini-utilities at each household to yield a 24-hour supply that still requires treatment at high economic costs. Considering this situation, it is really a charade to claim all these urban inhabitants have access to safe water.

(p162)

The privately-owned equipment mentioned by Biswas (ibid.) such as reverse-osmosis (RO) systems or personal borewells replaces or enhances public sector provision for those who can afford it. RO was originally designed as a process for desalinating ocean water but can be adapted through a number of types of filtration to remove other substances and contaminants such as arsenic (Wimalawansa, 2013). A small-scale, domestic version of the technology is popular in India for household use but up to five times as much water as is produced is wasted during the process (Koshy, 2020). Furthermore, it filters out minerals which are essential to health like calcium and magnesium. This can result in acute deficiency so remineralisation is required which constitutes an additional expense (Janna et al., 2016). It is associated with less negative

impact on climate change than other safe drinking water options like bottled water or purification through boiling but leads to further depletion of water resources: 'four liters of tap water are required in a RO device to produce one liter of purified water' (Garcia-Suarez et al., 2019, p7). Critics claim that due to the prevalence of RO systems, those responsible for government-led water provision are less incentivised to supply high-quality water to the significant majority of low-income Indian citizens who are unable to afford RO devices (Koshy, 2020). The National Green Tribunal, which is an Indian government body responsible for responding to environmental disputes, has taken steps to prohibit RO systems in Delhi due to the concerning depletion of groundwater reserves (ibid.).

Secondly, it is important to note that, regarding sanitation access, there is not a universally appropriate solution. This is clearly seen in the mismatch between the number of toilets constructed during the SBA (section 1.8.2) and the number that are actually used by households which own them. Dreibelbis et al. (2013a) highlight the importance of including hygiene advocacy activities alongside the installation of low-cost WASH technologies in low-income contexts. In fact, building sanitation facilities such as latrines in schools can be detrimental to children's health if not accompanied by consistent soap and water access and behaviour change activities (Greene et al., 2012). Quattri and Smets (2014) also present evidence that the transition from OD to using a simple unimproved pit latrine only results in limited health improvements and note the importance of households committing to upgrading existing sanitation facilities. The presence of an appropriately designed, improved latrine in a household can address inequalities in urban India as poor families are then not compelled to use community toilets, which often close at night, resulting in continuation of OD and the dangers that accompany it (Kulkarni et al., 2017).

2.4.2 *Sustainability of programme outcomes*

If improvement in WASH is to be a priority, another key consideration is how sustainability will be ensured. A call for more focus on securing the continuity of programme outcomes post-implementation is a common thread in evaluations of WASH interventions (Madziyauswa, 2018; Humphrey, 2019; Ejelonu et al., 2020).

Agol and Harvey (2018) lament that 'many school WASH programmes in the developing countries tend to be short-lived partly due to poor operation and maintenance…as well as lack of ownership – i.e. involvement of families and the wider community' (p293). Furthermore, even if stakeholders are motivated to assist in ensuring sustainability, adherence to intervention recommendations decreases over time (Garn et al., 2017). This suggests that in the context of a schools-based WASH programme like CURE's, enthusing and equipping stakeholders such as staff, parents and students to maintain facilities is key in ensuring the longevity of WASH improvements, an important factor noted by Harahap et al. (2018).

In fact, specific plans to guarantee long-term sustainability should be factored into the design of schools-based WASH programmes. Deroo et al. (2015) identify barriers to this while offering a framework for mitigating these barriers. Collaborating with 21 organisations responsible for the implementation of schools-based WASH programmes, they investigate the extent of monitoring and evaluation on these programmes as a key component of ensuring that outcomes endure over time. They highlight five obstacles (socio-political issues, a shortage in funding, a lack of sufficient staff, logistical hurdles and substandard management structures). To overcome these obstacles, the authors recommend that the ability to address the deterioration and breakdown of WASH hardware and software should be a key aspect of the design of WASH interventions in schools. They state that more clarity is required regarding the responsibilities of different stakeholders following implementation. They also warn that the presence of infrastructure such as toilets on school premises does not guarantee that these facilities will be used or adequately maintained, arguing that it is vital to train teachers and school management on national policies for WASH in schools.

However, a sixth barrier to ensuring the long-term sustainability of WASH programmes not mentioned by Deroo et al. (2015) is corruption. A Times of India report (2012) details the case of how funds intended for the provision of toilets in Delhi primary schools were misappropriated by government officials. These schools, under the jurisdiction of the same government body as the participating schools and in the same geographical area, were denied vital facilities as government officials embezzled over 10 million rupees

(roughly 100,000 GBP). If stakeholders during WASH programmes such as government employees are to be motivated before, during and after implementation to meet the intervention objectives in the long term, extractive behaviours such as that described in the Times of India (2012) report must be eliminated as much as possible. This is why close monitoring of such programmes is so important and the following section explores this in more detail.

2.4.3 *Monitoring WASH progress*

Schwemlein et al. (2016) stress the importance of establishing comprehensive and accurate WASH monitoring processes in institutional settings:

> Achieving the goal of water and sanitation for all and to reach the remaining unserved people will require more and better use of data…Improved monitoring and new indicators are needed in non-household settings such as health care facilities, workplaces, and schools.

(p1)

If the SDG 6 targets (see section 1.3) are to be met, indicators for national and international monitoring are required in order to identify best practice. Chatterley et al. (2018) argue that national actors should be encouraged to align indicators with the SDG targets to enable more sophisticated global monitoring. Meanwhile, Cronk et al. (2015) point to the fact that it is challenging to compare indicators and definitions between countries, calling for guidelines that are specific to different contexts and more training for in-country actors to monitor WASH effectively: 'Advancing monitoring and investing resources into capacity building for initiatives will help to improve data collection and allow for more efficient targeting of resources' (p9). According to Cronk et al., schools and healthcare facilities offer the most conducive non-household settings for collecting robust data on WASH to enable systematic monitoring.

Linking SDG 6 (Clean Water and Sanitation) and SDG 3 (Good Health and Well-Being), building WASH capacity is a major factor in fighting neglected tropical diseases such as STHs. Waite et al. (2017) consulted over 50 experts within these two sectors to identify indicators that could be used for joint monitoring and thus joint progress towards these two SDGs, enabling targeted WASH monitoring specific to alleviating the burden of

WASH-related infections. School factors were recognised as highly significant when monitoring WASH in the context of neglected tropical diseases, with the extent to which school compounds are free of faecal matter, HWWS before eating and after toilet use, and the availability of water at the school highlighted as particularly important indicators. The concluding list of indicators is relevant to many neglected tropical diseases and can contribute to WASH monitoring in the context of these diseases at a global level. Since SDG 6 is intrinsically linked to many of the other SDGs, similar consultation processes with experts in other sectors such as nutrition and gender could assist in the creation of lists of indicators relevant to monitoring WASH in the context of these other focus areas too.

2.5 Common WASH solutions

In the WASH community, there are a number of approaches taken to bring about changes in WASH behaviour adoption that are common in the literature. These are outlined in this section; elements of them are incorporated into the WASH software arm of CURE's intervention. According to Mara (2017, p1), 'Sanitation marketing, behaviour change communication, and 'enhanced' community-led total sanitation ('CLTS+'), supplemented by 'nudging'' are the approaches which, when combined, are most effective in supporting communities in eliminating OD entirely. This section offers an outline of these complementing methods and their strengths and weaknesses, in light of their influence on the approach employed during CURE's programme.

2.5.1 *Community-Led Total Sanitation (CLTS)*

Originally conceived by Dr Kamal Kar in Bangladesh, CLTS is a strategy for bringing about 'rapid collective behaviour change' (Mariwah et al., 2017, p131), namely the elimination of OD. CLTS aims 'to help communities analyse their current sanitation practices through a participatory approach that helps community members to confront the reality of negative impacts of practices' (ibid., p31). A key focus in CLTS is that sanitation interventions prioritising latrine construction are prohibitively costly and unsustainable; CLTS reacts to this by raising demand for sanitation solutions in communities without offering any form of aid. In this way, the approach is affordable and sustainable, and

people prioritise spending money on a sanitation solution appropriate for them when they realise its importance through CLTS (ibid.). However, Mariwah et al. acknowledge that financial assistance is required in some situations when participants are genuinely motivated but unable to meet the cost of installing a latrine.

CLTS is a contentious method which 'has been criticized for its use of unethical practices and questioned with respect to the sustainability of its outcomes and the limited health benefits it can generate' (František and Novotný, 2019, p129). Communities are 'triggered' (Bateman and Engel, 2018, p156) which involves a process of 'activities that evoke a sense of shame, shock and disgust' (ibid., p155). There are concerns that it 'echoes coercive, race-based colonial public health practices' (Engel and Susilo, 2014, p157) and according to Galvin (2015), evidence that CLTS is successful in producing durable changes in behaviour is minimal. If these critics are right, it could further disadvantage communities affected by the WASH-based inequalities that CLTS aims to address. In fact, 8 of the 19 practitioners with experience of facilitating CLTS interviewed by František and Novotný (2019) acknowledged that 'CLTS interventions can lead to the abuse of disadvantaged community members and amplification of social inequalities' (p135). However, František and Novotný do not explain how these practitioners were selected to participate in this study, beyond stating that they were issued email invitations, nor do they explain what their specific roles were on the CLTS projects in question. Thus, it is difficult to clarify the practitioners' authenticity and in what way they are qualified to discuss CLTS. The authors also do not directly share the questions posed during the semis-structured interviews so it is not possible to discern whether participants were led to speak about CLTS in a negative light during interviews.

Whittington et al. (2020) conducted a review of 14 randomised controlled trials investigating the efficacy of CLTS programmes. They report that, out of the ten studies which report decreases in diarrhoea in children post-CLTS, only three of these reductions are statistically significant. However, these studies did not include cost-benefit analysis so according to Whittington et al., the small impacts of CLTS may still be worthwhile if the financial cost is not burdensome. There are a number of socio-cultural factors which explain why the positive outcomes of CLTS may not be sustained in the

long term, namely individual preferences for OD (Mara, 2017) and long-held religious beliefs relating to ritual purity which mean that people consider it unclean to have a toilet in the home (Coffey and Spears, 2017).

House and Cavill (2015) acknowledge the role that CLTS can play in addressing WASH-related violence through the replacement of OD with safe alternatives such as latrines in close proximity to households. Nevertheless, they caution against CLTS unintentionally resulting in an increase in violence and state that facilitators should be mindful of potential dangers. It is important to consider that it is not necessarily the approach of CLTS that is damaging but rather when it is implemented by facilitators without adequate training (Otieno, 2012). However, there are clear, documented examples of abuse stemming from the implementation of CLTS. Bartram et al. (2012) draw attention to 'cases where monetary benefits…or the means to practice a livelihood are withheld to create pressures to conform' (p499). Chatterjee (2011) recounts instances of alarming practices during CLTS in rural India such as stoning and humiliation through the display of photos of people who had defecated in the open. She reports how 'A local official…collected a woman's faeces and dumped them on her kitchen table' (para. 9).

Perhaps most relevant to the present study is the concept of School-Led Total Sanitation (SLTS), a variation on CLTS which takes place in schools. It aims to achieve pupil-parent knowledge transfer (see section 2.3.4) through 'effective mobilization of child clubs to motivate the communities to build and use the latrine' (UNICEF, 2006, p10). With objectives of reducing OD, promoting HWWS, development of students' leadership skills, provision of safe school WASH facilities and sustainable school waste management (ibid.), there are major similarities between CURE's project and SLTS. It has been particularly effective in empowering children as 'peer educators of menstrual hygiene' (Cavill et al., 2016, p253).

However, Joshi et al. (2016) raise concerns regarding children being 'not only perceived as…responsible for changing their own hygiene behaviours' but also 'as capable agents in advocating, influencing and enabling change in sanitation attitudes and practices in the wider community' (p1126-1127). They frame this as those with the responsibility to bring about change passing the duty onto the marginalised and argue that children

should not be used as tools for development. Citing the UN's Convention on the Rights of the Child, they cast doubt on whether SLTS provides space for children to decide on their own involvement in the initiative and whether the aim of achieving change through children corresponds with the child's best interests. Even if SLTS does not provide an ethical solution, there is still a great necessity to provide health and hygiene education for children vulnerable to WASH-related diseases (Oliveira et al., 2020). Sanitation marketing, hygiene promotion and 'nudge' theory provide a more subtle approach to WASH intervention.

2.5.2 *Sanitation marketing and hygiene promotion*

Sanitation marketing 'applies social and commercial marketing approaches to take to scale the supply and demand for improved sanitation facilities' (Tsegai et al., 2013). The idea is that people are free to choose the solutions that they want at their own expense. Cairncross (2004) argues that sanitation marketing is vital because one reason sanitation solutions are not adopted is due to a lack of information. He proposes the four parts of social marketing, which 'uses marketing techniques to serve social objectives' (p4) as a foundation for sanitation marketing. These are 'product, price, place and promotion' (ibid.). In social marketing, the *product* can consist of an item or a behaviour at a *price* made accessible, often through subsidies for those unable to pay costs. In order for this approach to be applied to sanitation successfully, the *product* needs to be available in the *place* where the marketing is implemented. Finally, *promotion* is vital so that community members are aware of the product's availability and the benefit they can derive from it (ibid.).

The strength of sanitation marketing is that it constitutes a convincing alternative to the SBA's approach of constructing latrines without incorporating behaviour change activities to encourage use. Dickey et al. (2015) compare a campaign to increase household latrine construction in southern China with a government-led campaign in nearby villages similar to the Indian government's SBA. They find that more toilets were constructed under the government campaign but conversely, that participants in the sanitation marketing campaign were more positive about their new toilets and used them more than recipients from the government campaign. It is also possible to use

sanitation marketing to complement CLTS. Cole (2015) reports on an initiative to maintain OD free status in communities in Malawi, combining a pre-existing CLTS project with sanitation marketing. One success of the project was that linking sanitation marketing with CLTS resulted in strong governmental support but the sustainability of the programme moving forwards was unclear because considerable input is necessary to support those running sanitation businesses.

2.5.3 *'Nudge' theory*

Another common WASH solution used to bring about behaviour change is a branch of behavioural economics called 'nudge' theory. Conceived by Thaler and Sunstein (2012), nudge is defined as 'any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives' (p7). It has a libertarian foundation in that it does not eliminate choice (e.g. illegalising OD); Sunstein (2014) describes nudge theory as encompassing 'liberty-preserving approaches that steer people in particular directions, but that also allow them to go their own way' (p1).

It can overlap with social marketing and can be applied in promoting public health (Acton et al., 2019; Montagni et al., 2020) and environmental sensitivity (Graffeo et al., 2015; Henkel et al., 2019). In the context of WASH, Grover et al. (2018) evaluate the impact of a handwashing intervention in Bangladesh which employed nudge theory using a cluster-randomised trial. The environmental nudges implemented during the intervention were 'paved pathways, painted bright colours, connecting latrines to handwashing stations and shoeprints and handprints on infrastructure' (ibid., p11). The authors examine HWWS following toilet use across twenty primary schools in Bangladesh and schools were assigned to four intervention groups:

1. Handwashing provision with simultaneous nudging
2. Handwashing provision then nudging
3. Handwashing provision with hygiene education instead of nudging
4. Handwashing provision then hygiene education instead of nudging

They conclude that the nudge intervention was successful in increasing HWWS in schools and brought about a similar effect to hygiene education which is considerably more expensive. Therefore, environmental nudges incorporated as part of a schools-based WASH intervention can offer a cost-effective solution. Dreibelbis et al. (2016) also investigate the effectiveness of nudge theory in the context of schools-based handwashing interventions in Bangladesh. They observed HWWS behaviours in two schools at baseline and periodically after nudges specific to handwashing were implemented. They found that HWWS increased from 4% at baseline to 68% the day following nudges were integrated and 74% two weeks and six weeks afterwards. This reinforces the conclusion from Grover et al. (2018) that WASH-specific nudges constitute a viable option for integration into schools-based WASH interventions.

French (2011) critiques the concept of nudge theory, arguing that its application is often not sufficient. Alternative approaches such as a 'hug (e.g. a financial reward for not practising a damaging behaviour), a 'smack' (e.g. a penalty fine) or a 'shove' (e.g. speed bumps to control traffic) should be considered (p159). These approaches are in contrast to the philosophy of libertarian paternalism upon which nudge theory is founded, in which 'choices are not blocked, fenced off, or significantly burdened' (Thaler and Sunstein, 2012, p6-7). However, it is likely that children will need a combination of definitive and more subtle approaches to support them in adopting positive WASH behaviours. Extending criticism of nudge theory further, Goodwin (2012) presents concerns that it is an indirect form of coercion. He suggests that small changes in behaviour brought about through nudge theory are not effective in bringing solutions to problems, offering the example of the negligible impact of increasing recycling on the climate crisis. In the context of WASH, the equivalent could be to question the benefit of an increase in HWWS brought about through a nudge intervention in eliminating OD. While there is no silver bullet to bring about positive behaviour change in the context of schools-based WASH interventions, environmental nudges such as brightly painted footprints leading from toilet blocks to handwashing stations can be effective when combined with other approaches such as infrastructure renewal and behaviour change communication.

2.5.4 *Behaviour change communication (BCC)*

BCC is the term used by CURE to describe the software element of its schools-based WASH intervention, the details of which are presented in Appendix 2. The World Health Organization (2014) defines it as 'a set of activities within a project or programme which are strategically designed and implemented to contribute to the process of changing behaviours, as a means of contributing to improved health outcomes' (para. 1). Within the WASH context, it could incorporate elements of CLTS, sanitation marketing or nudge theory, or could consist of participatory educational activities. In the case of CURE, the latter were used alongside sanitation marketing and skills workshops to effect positive changes in behaviour.

Briscoe and Aboud (2012) review 24 similar programmes attempting to generate children's behaviour change in developing countries and identify BCC best practice. Although this study is outdated, it is included here as it focuses specifically on BCC and on interventions attempting to increase handwashing among children – a key focus of CURE's programme. The authors conclude that the most effective of these programmes use a blend of activities based on the six categories of 'Information, Performance, Problem solving, Social support, Materials and Media' (p613). For instance, an informational and performance-based BCC approach could teach participants a handwashing technique while demonstrating the technique and offering feedback to participants practising it. A problem-solving and social support-based approach could identify obstacles impeding participants' adoption of positive behaviours while establishing a group such as a PTA to address these obstacles. Finally, a materials and media-based BCC intervention could provide resources such as soap or a water treatment product while using posters or drama to instruct participants on how and why to use them (ibid.). In the case of CURE, the BCC activities conducted with students and their parents detailed in Appendix 2 incorporated elements of each of these six categories.

In a more recent review, Martin et al. (2018) do not focus specifically on BCC but consider how behaviours and technologies introduced during WASH interventions are sustained in the long term. They recommend that during the planning phase of WASH

interventions, there should be a focus on 'developing behaviour change models that emphasise factors related to sustained adoption, and how they differ from those related to initial adoption' (p122). Furthermore, Ginja et al. (2021) stress the importance of positive reinforcement in WASH interventions. Negative behaviours could be reinforced through the benefits gained in continuing them. One example pertinent to the current research is the time a child saves by neglecting to wash their hands after using the toilet. On the contrary, BCC can play a key role in reinforcing the positive target behaviours – an example from CURE's programme is an activity in which children pledge to abstain from OD and receive a sticker. The authors recommend withdrawing these constructed reinforcements over time to assess whether behaviour change is sustained.

2.6 Summary

This chapter has presented a variety of literature related to WASH and the driving factors affecting children's WASH behaviours and thus progress towards SDG 6. First, it focused on the impacts of inadequate WASH (section 2.2). These are far-reaching, particularly those symptomatic of OD such as infectious disease and stunted physical and cognitive development in children. Recently, the increased spread of COVID-19 due to substandard WASH is added to this list and implications emerging from the pandemic were explored in this chapter. The impacts of WASH improvements are not limited to health; they can also have economic benefits and mitigate social inequalities.

Regarding WASH in education (section 2.3), this chapter has explored a number of previous schools-based WASH interventions with similarities to CURE's programme. School absenteeism and pupil-parent knowledge transfer were investigated as two phenomena regularly mentioned in schools-based WASH literature, as well as children's attitudes towards caring for the environment. The concept of LFP schools was also explored as this is relevant to the comparison of school management types in the current study and requires some background understanding of the debate surrounding the role of these schools. The common challenges arising in bringing about improvements in WASH (inequalities, sustainability and effective monitoring) (section 2.4) were discussed. Finally, the chapter closed with an overview of common WASH

software approaches (section 2.5), all of which have elements similar to CURE's schools-based programme.

Chapter Three: Methodology

3.1 Introduction

This chapter presents the research methodology for the current study, a component that Schwandt (2001) defines as 'an analysis of the assumptions, principles, and procedures in a particular approach to inquiry' (p161)**.** This analysis is informed by ontology, the theory of what constitutes reality (section 3.3), and epistemology, the theory of what constitutes knowledge (section 3.4).

Epistemology and ontology inform the researcher's selection of methodology for a research project. Bryman characterises epistemological questions as 'to do with what is regarded as appropriate knowledge about the social world' and ontological questions as 'to do with whether the social world is regarded as something external to social actors or as something that people are in the process of fashioning' (2012, p19). Therefore, how the researcher perceives the role of knowledge and how they perceive themselves in the context of this knowledge dictates the direction of the research. These considerations, which are explored in detail below, provide the basis for the following research questions, each of which are linked to SDG targets and indicators.

3.1.1 *Research questions*

Bryman (ibid.) defines research questions as providing 'an explicit statement of what it is the researcher wants to know about' (p9), arguing that the use of questions is important in ensuring that the researcher is precise and targeted with their investigation. Denscombe (2010) offers six possible aims for research questions to predict, explain, evaluate, describe, develop and empower. Aligning with the critical realist foundation of this study, the three research questions listed below seek to uncover the generative mechanisms behind phenomena (Bhaskar, 2013). In this case, these are the driving factors affecting children's capability, opportunity and motivation to adopt sustained WAH behaviours. Together, these three research questions inform the overarching focus of the study: an investigation of the driving factors affecting children's WASH behaviours in East New Delhi primary schools.

Table 4 SDG linkages with research questions

SDG Target or Indicator		Research question relevance
4.a	Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all.	1, 2
4.a.1	Proportion of schools with access to: (a) electricity; (b) the Internet for pedagogical purposes; (c) computers for pedagogical purposes; (d) adapted infrastructure and materials for students with disabilities; I basic drinking water; (f) single-sex basic sanitation facilities; and (g) basic handwashing facilities (as per the WASH indicator definitions).	1, 2
6.1	By 2030, achieve universal and equitable access to safe and affordable drinking water for all.	1, 2, 3
6.2	By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.	1, 2, 3
6.b	Support and strengthen the participation of local communities in improving water and sanitation management.	3

(United Nations, 2015)

Relevant SDG targets and indicators from the United Nations' 2030 Agenda For Sustainable Development (2015) situate these research questions in the current context of global development (Table 4). The three research questions are as follows:

1. How does school WASH provision in differing school types affect children's WASH behaviours?

2. What are the barriers and enablers to school management providing adequate school WASH facilities?

3. How are children's WASH behaviours affected by their socio-economic status?

The first section of this methodology chapter outlines the philosophical standpoint from which this research is conducted, focusing first on ontology and critical realism, secondly on epistemological considerations and thirdly on the chosen research paradigm of postpositivism. Theoretical grounding for data collection and analysis is presented before the research design is outlined including qualitative methods, sampling techniques, instrument design and analysis. Finally, the validity and reliability of the research instruments are investigated and consideration is given to ethical issues arising from the research.

3.2 Philosophical worldview

Creswell (2014) highlights the importance of carefully selecting a philosophical worldview when designing a study. This philosophical worldview subsequently shapes the research design and methods employed to implement it. He uses the term 'worldview' to refer to what others describe as a 'research paradigm' (Kuhn, 2012), an established theoretical framework which acts as a foundation for social research, providing pathways for understanding the experiences and actions of people (Blaikie, 2007). Bryman describes a research paradigm as a 'cluster of beliefs and dictates which for scientists in a particular discipline influence what should be studied, how research should be done, how results should be interpreted' (1988, p4). For Guba and Lincoln (1994), the research paradigm is integral to the ontological and epistemological bases guiding the researcher. Creswell (2014) presents four such common worldviews which are outlined here: constructivism, the transformative paradigm, pragmatism and postpositivism, the last of which is the basis for this study. The researcher has added a fifth (positivism, which is not included in Creswell's outline) to expand upon the origins of postpositivism.

3.2.1 *Common worldview foundations*

Constructivism is typically associated with qualitative research and a design consisting of open-ended questioning (Creswell, 2014). It corresponds with a relativist ontology and subjectivist epistemology and findings are evaluated according to their credibility, transferability, dependability, and confirmability (Lincoln and Guba, 1985). In the tradition of thinkers such as Piaget and Vygotsky, constructivism challenges realism and argues that 'worlds and knowledge of worlds are relative to the knower' (Michell, 2003, p17). The constructivist researcher 'always presents a specific version of social reality, rather than one that can be regarded as definite' (Bryman, 2016, p29).

One criticism of constructivism is that it does not sufficiently advocate for people facing marginalisation and oppression (Creswell, 2014) so the transformative (or emancipatory) paradigm arises from this concern. It aims to provide a platform for the voice of the marginalised with social justice reform and increased access to fundamental human

rights as a direct aim of the research process (Mertens, 2009). It is often implemented through a participatory action research design (Heron and Reason, 2006). This recognises that people living in the research setting are able to participate in every aspect of the research process, the aim of which is to bring about improvements envisioned and enacted by the participants themselves (Kemmis et al., 2013).

The pragmatic worldview, or 'the theory of nontheory' (Aronowitz, 1972, pxv), leads the researcher to employ whichever methods will answer the question most comprehensively (Feilzer, 2010). Objective and subjective approaches are not seen as incommensurable and it does not adhere to a particular ontological theory (Wahyuni, 2012). Pragmatism can act as a philosophical grounding for mixed methods design and in contrast with postpositivism, truth is defined as 'what works at the time' (Creswell, 2014, p11).

In positivism, the researcher tests specific hypotheses using experimental methods, aiming to produce results that are generalisable and reproducible in other contexts (Sritanayarat et al., 2010). Data are analysed to confirm or reject the hypothesis and the focus is on discerning causality, or the lack of it, between variables (Alllsop, 2013). In stark contrast to constructivism, the epistemology of positivism is rooted in the assertion that it is possible to acquire definite knowledge of reality. More exploration of positivist enquiry is provided below in section 3.5.1.

Finally, postpositivism is the epistemological basis of this thesis research and is a research paradigm which evolves from positivism, similarly seeking to uncover truth while acknowledging the imperfections and bias that exist in the social sciences (Phillips and Burbules, 2000; Schlegel, 2015). It admits that 'the traditional notion of the absolute truth of knowledge' is problematic 'when studying the behavior and actions of humans' (Creswell, 2014, p7). In opposition to constructivist thinking, postpositivism is closer to positivism in that it contends that an objective reality exists that is independent from the perception of the observer. However, in contrast with positivism, it recognises that in social sciences research, it is impossible to produce definite, true knowledge from observation of this reality. Postpositivism proposes that objective reality can be

observed but only probabilistically (Denzin and Lincoln, 2011; Humble, 2017). Further detail on postpositivism is given below in section 3.5.2.

The research questions of this study fit a critical realist ontology informed by a postpositivist epistemology which both shape the choice of methods (Guba and Lincoln, 1994; Humble, 2017). This philosophical standpoint leads the researcher towards a mixed methods design (section 3.6) with quantitative analysis of survey data reinforced, contextualised and enriched by qualitative data gathered through the researcher's field observations, semi-structured interviews, photography and document analysis. The following sections will serve to define and justify this choice of methods and philosophical position.

3.3 Ontology

According to Scotland (2012), 'Ontological assumptions are concerned with what constitutes reality, in other words *what is*' (p9, italics in original). The ontological assumptions of a researcher impact the selection of design, data gathering processes, analysis and application of findings (Cavanagh and Fisher Jr, 2016) and shape how the subject of a social scientific investigation, whether that be participants' knowledge, attitudes, lifestyles or habits is chosen (Dillon and Wals, 2006). Ontological approaches can be separated into two categories – those arguing that the researcher's observations are objective and those arguing that they are subjective because any observation of reality is coloured by the perspective and past experiences of the observer (Proulx, 2006). The extent to which the researcher considers their observations of reality to be objective or subjective greatly influences the research process so it is important here to provide a clear grounding to the ontology followed in this study.

3.3.1 *Critical realism*

The two contrasting approaches of subjectivity and objectivity can be situated within the opposing philosophies of constructivism and realism. Constructivism, as outlined in section 3.2, is in opposition to objectivism and argues that knowledge is humanly constructed, constantly modified and never revealing a true representation of reality

(Ernest, 1994). Meanwhile, realism argues that 'a world exists that is logically independent of any knower, and objective knowledge of that world is possible' (Michell, 2003, p17). Guba and Lincoln (1994, p109) summarise this with the notion that within realism, 'apprehendable reality is assumed to exist', differentiating between naïve realism (reality is observable) and critical realism (reality is only imperfectly and probabilistically observable).

The researcher decided to follow a critical realist rather than naïve realist ontology during this study because it is more appropriate for research conducted in a complex environment with human participants. For Archer et al. (2016), 'critical realism represents a broad alliance of social theorists and researchers trying to develop a properly post-positivist social science' (para. 1). They advocate critical realism as a methodology for researchers investigating the generative mechanisms behind phenomena while recognising the complexity and unpredictability that exists in the social sciences. In a study conducted in the multifaceted context of informal settlements informed by the voices of individuals living in that setting (see section 3.7), it is impossible to remove all subjectivity to an extent that results are entirely generalisable to differing contexts. Therefore, critical realism is an appropriate basis for this research and aligns with its aims.

For Losch (2009), critical realism departs from naïve realism by differentiating between the object of perception and the phenomena it produces. In other words, in naïve realism, the observer perceives reality exactly as it is (Millar, 2015) whereas in critical realism, the observer perceives the effects caused by the objects and actors of reality. The observer works to understand which objects are likely to be causing the perceived effects; it is this theoretical basis which suits the central aim of this research: an investigation of the driving factors affecting children's WASH behaviours in East New Delhi primary schools.

This theoretical basis is best understood through an exploration of the concept of stratification, and the three domains of the empirical, the actual and the real, which are central to critical realist enquiry. Roy Bhaskar, the initiator of critical realism, argues that 'the causal structures and generative mechanisms of nature must exist and act

independently of the conditions that allow men access to them' (2013, p56). He offers the notion of stratification as a framework for understanding this concept, differentiating between what he perceives as the varying stages of observation. He refers to the empirical, the actual and the real as the three ontological domains. First, the concept of the empirical refers to immutable phenomena that are constantly observable – Bhaskar mentions the ocean's tide or the fact that metals conduct electricity as examples. In the present research, an example could be the effectiveness of soap in cleansing hands.

Secondly, the concept of the actual comprises events which it is possible to observe but which cannot be monitored at all times. Elder-Vass (2013) separates phenomena occurring in the actual domain into two categories - those which cannot be continuously observed because the observer is not always present and those which cannot be continuously observed because they occur at a level of existence beyond the reach of the observer. He gives the example of observing a pen falling and assuming that the atoms and molecules which constitute it are also falling. In the current research, one example of the actual could be findings derived from the survey asking children how often they have washed their hands in the past month, while it is practically impossible to observe their handwashing behaviour at all times.

Figure 7 The three domains of stratification

The EMPIRICAL: events that are actually observed and experienced

The ACTUAL: events (and non-events) that are generated by the mechanisms

The REAL: mechanisms and structures with enduring properties
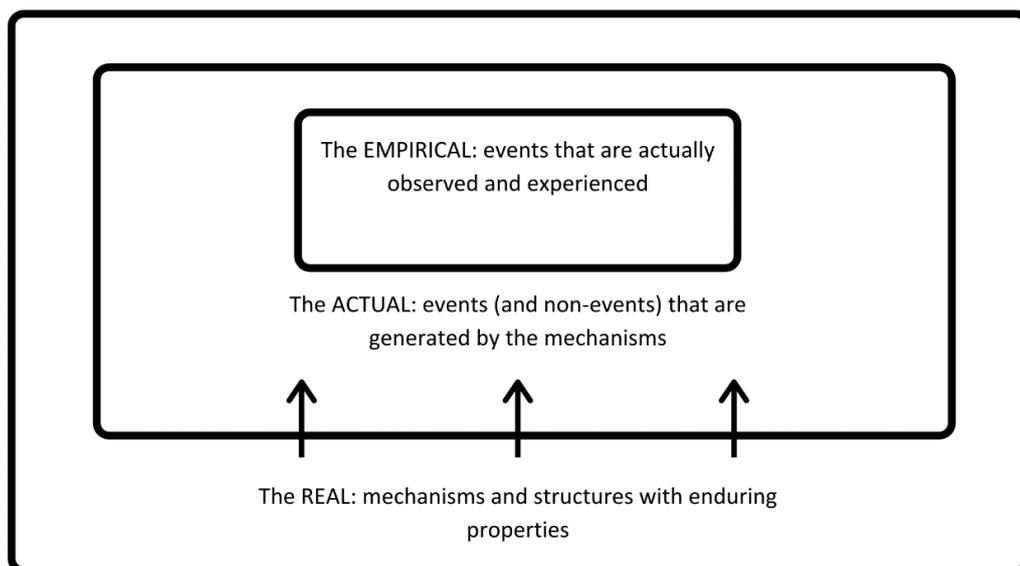
(Mingers, 2004, p94)

Finally, the concept of the real encapsulates unobservable mechanisms which cause phenomena that can subsequently be observed (Kovacs et al., 2008). Edwards (2019) offers gravity as an example of a phenomenon that is only observed through a model of its effects, such as a falling apple. One example from the current research is children's motivation to wash their hands. This abstract concept cannot be directly observed but it can be observed implicitly through children's actions and their engagement with positive WASH behaviours. Figure 7 visualises these three domains and how they interrelate. The arrows denote the fact that the domain of the real causes the actual, and the empirical is situated within the actual. Figure 8 situates the theory of stratification within the context of the current research.

Figure 8 Stratification in the context of the current research

The EMPIRICAL: Effectiveness of soap in eliminating bacteria from hands

The ACTUAL: Children's handwashing habits in the past thirty days

The REAL: Children's motivation to wash their hands
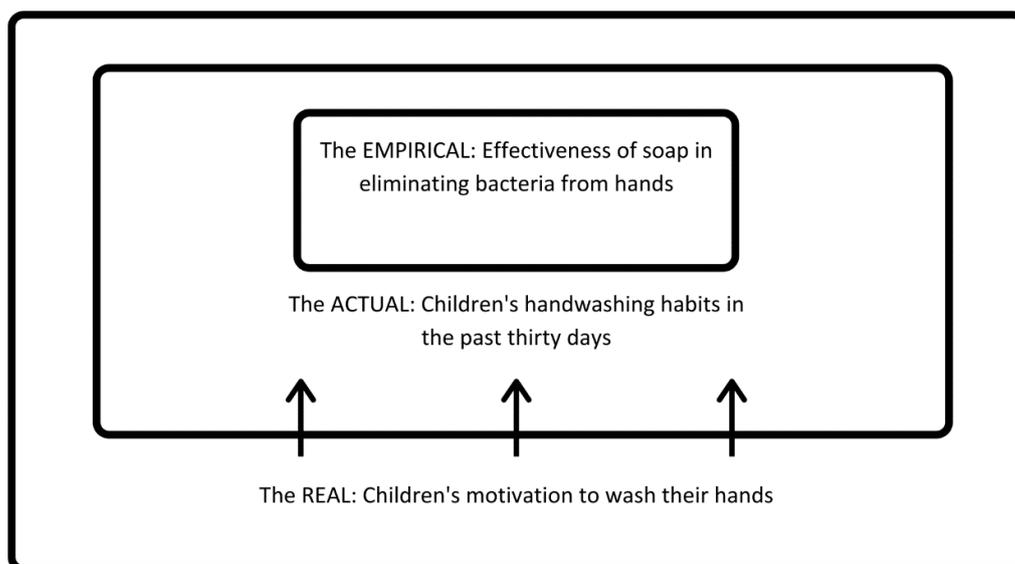
(Mingers, ibid.)

Raduescu and Vessey (2009) cite the advantage of stratification being that 'researchers can go beyond empirically-observed events to determine the causal mechanisms in the *real* domain that result in those events' (p1). This theoretical framework for classifying different levels of reality is useful for in-depth identification, beyond surface-level observation, of connections and relationships between a multitude of variables at play in a research setting such as East Delhi which is so intricate and difficult to predict. Using statistical techniques such as SEM (see Appendix 13), as well as gathering the perspectives of multiple stakeholders, enables the researcher to understand more fully

what is occurring at each of these levels of observation, building increasing likelihood into findings which corresponds with the postpositivist epistemological foundation. For example, socio-economic status is conceptual so is not directly observable (the real domain). However, SEM can be used to model an observation of socio-economic status using directly observed variables (the empirical domain) such as whether the home has an inside toilet or separate kitchen.

Stratification explains the different levels of observable reality at which phenomena operate. Meanwhile, another theoretical concept of ontology key to the application of critical realism to the current research project is emergence. This pertains to how observing phenomena individually is inadequate for gaining a full and clear understanding of what is observed. However, these different phenomena combine and the whole picture is revealed through the complex connection between them. Elder-Vass explains that 'emergence is operating when a whole has properties or powers that are not possessed by its parts' (2005, p316). Examples of this in reality could be how hydrogen and oxygen combine to become water (Edwards, 2019) or how the respective parts of a cell individually cannot explain the behaviour of the entity they constitute (Mingers, 2011).

This concept is particularly useful to the current research as WASH provision in schools is comprised of different parts including facilities and maintenance, staff input and children's behaviour. In light of this, CURE's intervention incorporates multiple complementary components including rainwater harvesting, handwashing stations and participatory WASH education activities aiming to bring about holistic improvements. The concept of emergence is equally relevant when applying the COM-B model (Michie et al., 2011) to consider driving factors affecting children's WASH behaviours (see section 1.8.3). The three separate domains of capability (knowledge and skills), opportunity (external factors enabling behaviour) and motivation (emotional responses and decision making) complement one another to illustrate the ideal conditions through which sustained behaviour change is generated. Emergence also strengthens the justification for using triangulation in a mixed methods approach as the researcher can

understand as much of the whole picture as possible using a variety of observation methods (Denzin, 2017). Triangulation is explained in more detail in section 3.6.1 below.

Through the concepts of stratification and emergence categorising the different domains of reality and exploring the functions possessed by a whole when its parts coalesce, critical realists contend that it is possible to observe reality in a probabilistic sense. In the current research, it is proposed that it is possible to observe concepts such as WASH behaviours and measure them. The epistemological position of postpositivism complements a critical realist ontology, holding that knowledge discovered is more likely to be true when more evidence supports the hypothesis or when certain hypotheses are falsified (Guba and Lincoln, 1994). The following section sets out a definition of epistemology. It justifies the selection of postpositivism by exploring how it complements a critical realist ontology and responds to the limitations of positivism.

3.4 Epistemology

Whilst ontology refers to the nature of reality, epistemology pertains to how reality can be perceived and how or whether knowledge of it can be gained. The choice of epistemological position influences the entire research process and how the rigour of a study is assessed. Epistemology is 'A field of philosophy concerned with the possibility, nature, sources and limits of human knowledge' (Sumner in Jupp, ed., 2006, p145), disassociating knowledge from beliefs. The notion of certain, concrete knowledge is debated by philosophers, focusing on the issue of the social contexts within which knowledge is produced.

For example, empiricists contend that knowledge of the natural world is gained *a posteriori* – based on experience and observed via the human senses. In contrast with empiricism, rationalists believe that knowledge can be obtained apart from observation via the human senses (Markie, 2017), adhering to the view that 'there are deeper causal structures which are not capable of direct empirical observation, but nevertheless underpin cognition as well as language and human society' (Sumner in Jupp, ed., 2006, p145). Rationalists believe that knowledge can be gained *a priori*, that is deduced rather than simply observed (Markie, 2017). For example, Popper's (1959) critical rationalist

approach employs empirical falsification to disprove hypotheses, meaning that knowledge consists of falsifiable statements. For Popper, observations which are not disproved when scrutinised are closer to the truth than others.

Critical realism, the ontological basis of this study, incorporates elements of both of these contrasting traditions. As in rationalism, the 'deeper causal structures…not capable of direct empirical observation' to which Sumner (in Jupp, ed., 2006, p145) refers can be deduced through the use of stratification to explore the different domains of perception in reality and through emergence to scrutinise how the parts of the whole combine to provide meaning. As in empiricism, the ontological stance of critical realists is that reality is independent from human perception.

Carter and Little (2007) highlight three ways in which epistemology shapes research approach: the nature of the researcher's presence, how the quality of data is assessed and how the findings from these data are presented. The following presents these three important impacts of epistemology in light of the critical realist ontology and postpositivist epistemology employed in the current research (Humble, 2017).

3.4.1 *The researcher's positionality in social research*

The postpositivist, critical realist approach of this research recognises that all research design decisions and conclusions drawn from findings in the social sciences are to some extent affected by the researcher's beliefs, experiences and values (Camp, 2001). Malterud (2001) outlines some of these characteristics which may shape the research process such as past professional and personal events, pre-existing worldview and the reasons for choosing the particular field of study. Others include political view, religious beliefs, social class and geographical location (Holmes, 2020). This concept can be described as the 'researcher's positionality' (ibid., p2). Research conducted by someone from one background with a certain set of experiences and beliefs will be very different to the same research conducted by someone with a different history and identity. Epistemologically, the findings and contribution to knowledge will vary.

Lowes and Prowse (2001) discuss the role of the researcher in phenomenological interviewing and argue that the repression, exclusion or non-acknowledgment of the

researcher's positionality is not advantageous. They refer to a researcher's attempt to achieve objectivity by setting aside their previous knowledge and beliefs as 'bracketing' (p473) and propose that the rigour of interview data collection is strengthened when the process is seen as one of co-creation between the participant and the researcher. Therefore, the researcher should detail the preconceptions affecting the interview process. Wright (2013) links the argument for following this approach to critical realism. He claims that the evolution away from the belief that 'authentic knowledge claims must be objectively 'pure', uncontaminated by the subjectivity of local place, specific time and particular culture' (p4) is an important victory won through the emergence of critical realism.

It is important to recognise the effect that the researcher's presence has produced in participants' contributions. As Bryman (2012) acknowledges, the researcher's values affect the research process at every point through selection of topic, method, research design and data collection, analysis and interpretation. He gives the example of the researcher empathising with participants, citing Becker's (1967) observation that sociologists typically express sympathy for the disadvantaged. This is particularly relevant for research taking place in low-income areas.

For this researcher, seeking to help those facing obstacles of poverty is certainly a major influence in conducting research in this field. It is acknowledged that the researcher's background is vastly different to those participating in the research. Having grown up in the United Kingdom in an affluent household, the researcher has no personal experience of the challenges and barriers faced by participants that he is seeking to identify. He has never experienced water insecurity or limited access to sanitation provision. His position as a white man means that he does not face intersectional barriers like the women he interviewed during the process of this research (Haq, 2013). His British nationality links this research to Great Britain's past colonisation of India which in many ways contributed to problems facing India today; this is a context of which the researcher was acutely aware during school and community visits. Finally, his inability to speak Hindi further distances him from those participating in the research.

This positionality affected relationships with research colleagues. First, the researcher was conscious of ensuring the two interpreters were compensated for the significant amount of time they gave towards the data collection period in a culturally appropriate way. While a transparent agreement was in place with one before the project began, the other joined during the process as he was a friend of the first interpreter, and initially refused payment despite spending several weeks on the project. The researcher did not feel comfortable with him assisting unless he was paid but did not want to cause offence through cultural misunderstandings. With help from the first interpreter, eventually the second agreed to accept payment. Similarly, the researcher attempted to find an appropriate way to acknowledge the invaluable input from the CURE employee who acted as a community guide. As this person was an older, devout Hindu who spoke no English and was already employed by CURE, the researcher sought to ascertain the most culturally sensitive way of acknowledging her work and eventually settled on commending her to the director of CURE.

Secondly, the researcher was conscious of physical, social and geographical differences to participants throughout the data collection process. During community visits, accepting refreshments from participants or posing for requested photographs with families was immensely worthwhile in building relationships and trust which enriched data collection. During school visits, conversing with them at their level of English (e.g. 'Hello, how are you?') had the same effect, helping them to relax and acclimatise during surveys and focus group discussions. The researcher realised that, although it was the interpreters who conducted questionnaires and translated for interviews, building meaningful relationships without a common language was possible and vital for the research process.

3.4.2 *Evaluating the quality of data*

The epistemological viewpoint and positionality of the researcher also affect how the quality of data is assessed (Angen, 2000; Carter and Little, 2007). For example, a constructivist researcher will not prioritise experimental methods that are replicable across different contexts while a positivist researcher will not prioritise methods designed to include participants as active voices in the research process (Williams in

Jupp, ed., 2006). Assessing the quality of data is challenging when using a mixed methods approach because different sources of data are evaluated in different ways. For example, Bryman et al. (2008) present validity, reliability, replicability and generalisability as the main criteria for assessing quantitative data. Meanwhile, Cohen and Crabtree (2008) conducted a review of literature pertaining to criteria for assessing qualitative data and identified seven principles: prioritising ethics, the importance of the subject, understandability, appropriate methods, researcher reflexivity, validity and reliability. The first four criteria were universally agreed upon in the included literature whereas the final three were more disputed. They conclude that due to the wide field of different qualitative approaches, it is difficult to settle on universal, defined criteria for assessing qualitative data. With the postpositivist, critical realist approach of this study, the researcher used data triangulation as a method for mutually evaluating the quality of the quantitative and qualitative data collected (Noble and Heale, 2019).

3.4.3 *The presentation of findings*

Finally, the epistemological position adopted by the researcher shapes their presentation of findings. A researcher using empirical data may opt for 'the presentation of a completed, coherent, and unified analysis…in the objective scientific third person' (Carter and Little, 2007, p1322) while the use of qualitative data may lead the researcher to report in the first person, recounting and reflecting upon their experience of the research process (ibid.). As Mantzoukas (2004) explains, both of these approaches are valid but the researcher should be aware of how their epistemological framework guides how they present the data. For the sake of consistency in voice, the researcher has chosen to report findings in the third person in this study. However, this style of presentation does not presume the total distancing of the researcher from influencing the findings.

3.5 Research paradigm

As outlined above, there is an array of paradigms commonly employed across the social sciences and this study is conducted within the postpositivist paradigm, adhering to the critical realist ontological perspective. In the previous section, three significant ways in

which epistemology affects the research process were outlined. This section will explain how postpositivism responds to positivism. Criticisms of positivism are presented, as well as how these are addressed by its successor.

3.5.1 *Positivism*

In opposition to interpretivism, positivism champions the use of empirical methods to ascertain objective, value-free findings in a cyclical process. Theories produce predictions, leading to observations, followed by generalisations which impact upon subsequent theories (Ashgar, 2013). Positivism is the 'methodological underpinning of survey research and experimental approaches' (Williams in Jupp, ed., 2006, p340); statistical modelling is preferred by positivists when selecting research methods. It adheres to an objectivist ontology and positions the researcher as a neutral onlooker, detached and external to the research process.

Various criticisms have been levelled against positivist enquiry. For example, Popper (2014) argues that the researcher is incapable of detached, unbiased consideration, explaining that 'Observation is always selective. It needs a chosen subject, a definite task, an interest, a point of view, a problem' (p61). Guba and Lincoln (1994) highlight an example of this in positivist enquiry – the practice of selecting variables to investigate while controlling for others, which ensures rigour in quantitative methods. However, they argue that this reduces the relevance of findings which are only applicable in similarly limited environments. Guba and Lincoln (1994) also argue that qualitative data provide a deeper insight into the complexities and unpredictable nature of human behaviour than the quantitative approaches typical of positivist research.

The positivist approach is not appropriate as a theoretical foundation for the current research because numerous, unpredictable social factors play a significant role in the structures surrounding inadequate WASH provision. Human behaviour and judgment is affected by specific cultural experiences and phenomena (Hjørland, 2005) which are not effectively observed through positivist enquiry. To gain an understanding of the causes behind human behaviour which operate at the actual and real levels of reality derived from stratification (Bhaskar, 2013; Edwards, 2019), it is important to explore the specific

setting and culture within which that behaviour is occurring. In-depth qualitative data are a vital tool for this (Atieno, 2009).

3.5.2 *Postpositivism*

Aligning with a critical realist ontological position, the postpositivist epistemology selected for this study responds to criticisms of positivism by proposing that researchers seek findings which are likely to be true (Phillips and Burbules, 2000). Cohen et al. (2018) describe the evolution of positivism into postpositivism:

> …the idea of a value-free, neutral, objective, positivist science has been replaced by a post-positivist, critical realist view of science with its hallmarks of conjecture and refutation (Popper, 1980) and with the ability for falsification being the distinguishing feature of science.

(p8)

Postpositivism differs from positivism in several areas. Positivists establish and verify causal relationships through repeated empirical investigation while postpositivism hypothesises that a causal relationship could exist and tests this hypothesis, gathering data to support it. Essentially, positivism holds that science can accurately reveal the truth surrounding causal relationships. Postpositivism insists that false theories can be rejected but that causal relationships cannot be definitively revealed (Corry et al., 2019). For Phillips and Burbules (2000), researchers seeking to improve education should search for knowledge that is designated to be probably true through evidence-based enquiry. They recognise the researcher's fallibility but do not see it as a compromise of validity because this 'ability for falsification', as described by Cohen et al. (2018), means that 'finding that an answer we have accepted in the past is mistaken, is itself an advance in knowledge' (p3). Dewey (1938) suggests using the phrase 'warranted assertibility' (p7) as researchers can gather enough evidence through enquiry to lend weight to a certain finding until further evidence is uncovered which subsequently falsifies or further verifies it. Dewey is arguing that researchers should adhere to beliefs that are warranted rather than seeking truth that is absolute, as this is impossible to achieve. It is in this commitment to verifying findings to the extent that they are warranted and 'probably true' (Guba and Lincoln, 1994, p109) that postpositivism

responds to the criticisms levelled at positivism, providing space for a mixed methods design which incorporates the deeper insight celebrated by Guba and Lincoln (1994) through triangulating different data sources (Bryman, 2016; Humble, 2017).

3.6 Mixed methods

The study follows a mixed methods approach which is defined as a process integrating quantitative and qualitative sources of data to understand a research question better (Creswell and Plano Clark, 2011). According to Kim (2012), it is important that the researcher understands the advantages and disadvantages of both quantitative and qualitative methods in order to clarify the reason for mixing methods. For Creswell (2014), 'Mixed methods researchers need to establish a purpose for their mixing, a rationale for the reasons why quantitative and qualitative data need to be mixed in the first place' (p11). This section aims to follow this advice in reference to the ontological and epistemological positions outlined above, linking these to the research aims.

3.6.1 *Triangulation*

This researcher's primary reason for mixing methods is to 'triangulate' data sources in order to build a more comprehensive picture that answers the research questions more fully than quantitative or qualitative methods would have done when used in isolation (Jick, 1979; Greene et al., 1989). Bryman defines triangulation as 'The use of more than one method or source of data in the study of a social phenomenon so that findings may be cross-checked' (2012, p717). The use of this process in this study enables the researcher to build Dewey's 'warranted assertibility' (1938, p7) in findings, adding weight to conclusions that are classified as 'probably true' within a postpositivist epistemology (Denzin and Lincoln, 1994, p109). It allows for more definitive conclusions in findings, linking phenomena observed in the critical realist stance to their causal mechanisms (Groff, 2004).

In the context of the present thesis study, this is applied as methods such as focus group discussions and household interviews (section 3.8.3) suggest relationships between variables such as socio-economic status and WASH behaviours, and 'warranted

assertibility' (Dewey, 1938, p7) is added to findings through quantitative methods such as SEM (section 3.8.2). When these methods are triangulated, findings that complement one another are classified as 'probably true' (Denzin and Lincoln, 1994, p109).

Cohen et al. (2000) explain the strength of data triangulation in that it allows the researcher to 'explain more fully, the richness and complexity of human behaviour by studying it from more than one standpoint' (p254) and it is this concept which justifies the use of triangulation in this thesis study (Humble, 2017). For example, gathering views on school WASH provision from school staff, parents and students allows the researcher to explain the factors which impede progress towards SDG 6 and cause inequalities in WASH access more fully. Barron (in Jupp, ed., 2006) points out that 'combining elements of the quantitative and qualitative paradigms may enhance the validity of research findings. Because different methods can reinforce and complement each other, the theoretical value of a study can be enhanced' (p316). During analysis, the researcher triangulated the qualitative data according to the central themes of the research questions, uncovering the key phenomena at play in participants' knowledge, attitudes, practices and experiences around WASH. In addition, quantitative analysis using Statistical Package for the Social Sciences (SPSS) software enabled the testing of associations between variables relevant in answering the research questions. The mixed methods consisting of quantitative surveys, focus group discussions, semi-structured interviews, qualitative observation notes and photography complement each other and point the researcher towards phenomena which inform responses to the three research questions.

3.6.2 *The strengths and weaknesses of mixing methods*

Triangulation is one strength of using mixed methods outlined by Brent and Kraska (2010) and they also propose two others. First, quantitative and qualitative data enhance one another. Qualitative data enable a deeper insight into the context in which the study takes place; this is particularly important when researching a topic like water use that is so dependent on the socio-cultural beliefs and traditions of participants (Akpabio and Takara, 2014; Coffey et al., 2015). Meanwhile, quantitative data can build exactitude into findings and depending on validity and reliability, allow for generalising

findings across contexts (Fairbrother, 2014). Secondly, Brent and Kraska (2010) explain that the mixed methods approach enables the researcher to answer a broad range of research questions, such as those presented in section 3.1.1 which are the focus of this study. This is a benefit of a mixed methods design also mentioned by Johnson and Onwuegbuzie (2004).

The rising popularity of mixed methods research has led some critics to question whether mixed methods research presents 'a distinct approach toward social science inquiry' (Tashakkori and Teddlie, 2010, p2) or whether it is merely a combination of quantitative and qualitative approaches that is difficult to synthesise. Creswell (2014) explains that mixed methods grew from the theory that, as all methods are flawed in some way, combining them would counteract these flaws. However, researchers have long debated whether quantitative and qualitative methods are compatible (Greene, 2008; Mertens, 2012). There are certainly ways in which the combination of quantitative and qualitative methods can compound their respective weaknesses. For example, Driscoll et al. (2007) warn against what they term '*quantitizing*…the process of transforming coded qualitative data into quantitative data' (p20, italics in original), pointing out that the strength of qualitative data is their multifaceted nature and ability to reveal interwoven themes. The 'quantitization' (ibid., p23) that sometimes arises from a mixed methods design can remove this strength in depth from analysis of qualitative data as quantitative data are by nature immovable and concrete. As Driscoll et al. explain, 'reducing rich qualitative data to dichotomous variables renders them single dimensional and immutable' (ibid., p25).

3.6.3 *Principal approaches to mixing methods*

Creswell (2014) outlines the three principal ways of mixing methods: convergent parallel, explanatory sequential and exploratory sequential. Convergent parallel design entails collecting quantitative and qualitative data concurrently and integrating both sources when analysing findings. It is useful when the researcher intends to identify links and relationships between the quantitative and qualitative results (Davis et al., 2014). When using an explanatory sequential mixed methods design, the researcher collects quantitative data first and interprets results before providing more explanation for these

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results through the use of qualitative data (Ivankova et al., 2006). Creswell (2014) highlights the difficulty of ascertaining which findings to explore further during the qualitative stage. Finally, exploratory sequential design is the opposite of the explanatory sequential approach. The researcher collects qualitative data and uses participants' responses to design the quantitative stage (Fetters et al., 2013). Similarly, there is a challenge in identifying the most relevant results from the qualitative data collection (Creswell, 2014).

During data collection in January-February 2020, the researcher used a convergent parallel mixed methods design. As well as allowing for financial and time limitations, this approach aligns with the rationale of triangulating data described above. In the convergent parallel approach, neither qualitative nor quantitative data take precedence. This eliminates the challenges identified by Creswell (2014) in the explanatory sequential and exploratory sequential approaches of identifying the most relevant findings from the first round of data collection. In-depth qualitative data allow for a detailed picture of knowledge, attitudes and practices relating to WASH in the areas of East Delhi in which the data collection took place. The qualitative data collected include semi-structured interviews with students, school staff and parents, the researcher's own observations through field notes and photographic and documentary analysis. The researcher is able to triangulate this variety of data to build an understanding of social and cultural factors at play in children's, teachers' and parents' perceptions of WASH which inform the responses to the three research questions (section 3.1.1). Meanwhile, the quantitative strand of data collection facilitates the testing of relationships between variables such as school WASH facilities, school type, WASH behaviours and socio-economic status. These data were gathered through a survey which is outlined in the following sections along with the selection of research setting and sampling methods.

3.7 Research setting and context

This section presents a brief outline of domestic WASH policy in Delhi to provide some geopolitical context to the research. It also describes the background and aims of the organisation which implemented the intervention in the schools which serve as the

setting for this research. Finally, it outlines how the participating schools were selected before describing each of them.

3.7.1 *Domestic WASH policy in Delhi*

The Delhi *Jal* (Water) Board is the government body responsible for water provision in the National Capital Territory of Delhi. Even at the governance level, Delhi's water provision is precarious (see section 1.7). The Yamuna River, itself severely affected by pollution (Mashal and Kumar, 2021), flows from neighbouring states and other water sources serving Delhi (e.g. reservoirs and canals) are located in other states. Therefore, Delhi has signed memoranda of understanding with these local governments so 'relies on surrounding states for meeting much of its raw water needs' (Aijaz, 2020, para. 10). At the household level, according to its website, the Delhi *Jal* Board 'has ensured average availability of 50 gallons per capita per day of filtered water through an efficient network' (Government of NCT of Delhi, 2022, para. 1). However, current research highlights a growing water crisis with supply volume inequality, seasonal inconsistencies and groundwater depletion disproportionately affecting low-income communities (Biswas and Gangwar, 2021). Piped connections are provided in settlements recognised by the government and even in these areas, inhabitants contend with the above problems. It is those living in unrecognised colonies though who face the most intense water insecurity (Aijaz, 2020). Delhi *Jal* Board is gradually extending services into these areas but many currently rely on fragile solutions such as water tankers, borrowing from neighbours or travelling to shared borewells. Those who can afford to acquire private borewells which bypass the need to rely on government provision while widening the gap further for lower-income households.

With regards to sanitation, the use of large areas of the nation's capital for government buildings, office complexes and other administrative facilities exacerbates overcrowding in poor communities (Saroj et al., 2020), highlighting the need for safe, well-maintained sanitation provision, particularly in light of COVID-19 (see section 2.2.4). Yadav and Anand (2021) investigate inconsistencies in sustainable sanitation provision and conclude that 'a radical shift in the behavior of the local people and practices to achieve sustainable sanitation in urban areas' (p519) is required. This is true but fails to consider

that for many communities living in the informal settlement colonies of Delhi, inadequate sanitation provision means that they are unable to adopt recommended behaviours. Delhi Urban Shelter Improvement Board has constructed around 19,000 public toilets in Delhi during the SBA. Yet people in these informal, unrecognised communities continue to practise OD, citing reasons such as the distant location of the community toilets, poor lighting, long queues, childcare responsibilities and the inadequate number of toilets for the population they serve (Upadhyay, 2020).

3.7.2 *Centre for Urban and Regional Excellence (CURE)*

CURE is an Indian NGO based in Delhi that seeks to address the above challenges and was responsible for the schools-based WASH programme that serves as the setting for this research. CURE aims to 'un-think, reimagine, innovate and de-engineer solutions to include and integrate people in the processes of city development' (CURE, 2020, 'Home Page'). It focuses on urban sanitation planning and water resilience with participatory methods and community engagement as core principles, aiming 'to generate real information from people and create infrastructure that is sustainable' while 'nurturing a sense of belonging and positive social interactions' in order to 'produce social change by creating solidarity, commitment, mutuality and trust' (ibid.). CURE describes the schools-based WASH programme thus:

> Six municipal schools in East Delhi are being developed as zero-waste schools using an ecosystem approach. Starting with improvement of the school toile–s - making these functional and changing the toilet use hygiene and behaviour among children, the project has expanded to improving drinking water facilities, harvesting rainwater, recharging wastewater and excessive rainwater into the ground and greening the school compounds. Children monitor hygiene behavior of peers and take the messages home to parents creating a seamless link between school and home sanitation practices.

> (CURE, 2020, 'What We Do – School Water and Sanitation')

CURE's project incorporates WASH hardware and software improvements in the participating schools which complement each other (Dey et al., 2019). These are described as *Infrastructure Development* and *Behaviour Change Communication (BCC) activities* in CURE's reports. The hardware arm of the intervention incorporated multiple

innovations and the CURE project report (2019) outlines the BCC activities included in the programme. These various activities are listed in Appendix 2.

3.7.3 *Selection of schools and sampling*

The research took place in schools in low-income communities of East Delhi where CURE implemented its schools-based WASH programme. Randomised probability sampling was impossible in this study due to time restraints and challenges in accessing schools which introduced a number of limitations detailed in Chapter Five. The researcher employed non-probability convenience sampling, in which participants are recruited according to availability and access, to engage the participating schools for the research. As such, generalisation to the wider population is minimal (Cohen et al., 2000, p218). This sampling method was used because although six schools have participated in CURE's project, only two of these were available and willing to participate. These are referred to in this thesis as Government Intervention School A (GISA) and Government Intervention School B (GISB). The researcher received a tour of these schools and was introduced to school management, teachers and children by the member of CURE staff responsible for implementing the intervention during a preliminary visit in August 2019. CURE originally selected the six schools which took part in the WASH intervention through conversations with the EDMC Education Department regarding the needs and priorities of schools in the EDMC's jurisdiction.

It is important here to clarify the distinction between different types of government-run school in Delhi. The Aam Aadmi Party (AAP) is the ruling party for the National Capital Territory of Delhi, having won 62 out of 70 seats in the 2020 Delhi Legislative Assembly election (The Hindu, 2020). The Bharatiya Janata Party (BJP) is the national ruling party of India, of which Prime Minister Narendra Modi is a member. There are two types of government school in Delhi, the first run by the AAP and the second run by the BJP. Recently, the AAP schools have received much positive coverage in the press after comprehensive investment amounting to USD 5.8 billion and significant improvements in standards since the AAP gained power. Overall, students from AAP-run schools even outperformed their private school peers in school-leaving examinations and it is thought that stringent accountability measures including CCTV in classrooms has contributed to

the improved outcomes (BBC News, 2018; Biswas, 2020). In contrast, there is some concern regarding the quality of the schools run by the North, South and East Delhi Municipal Corporation (EDMC) bodies, which are governed by the BJP (Chopra, 2016; Davis, 2019). The participating government schools in CURE's project were all under the jurisdiction of the EDMC and enrolment at schools operated by this body decreased by 20% in 2018 (Ravi, 2018).

It is challenging to gain access to the BJP-run government schools for research purposes; government teachers are required to sign a statement promising that they will not speak to the media (Kalra, 2019) so many teachers are suspicious of research activities. Despite this, the researcher was able to recruit a government non-intervention school (referred to in this thesis as GNIS) through CURE. The GNIS was due to participate in the next stage of CURE's intervention but at the time of data collection, this had not yet started.

Figure 9 Map of participating schools' location
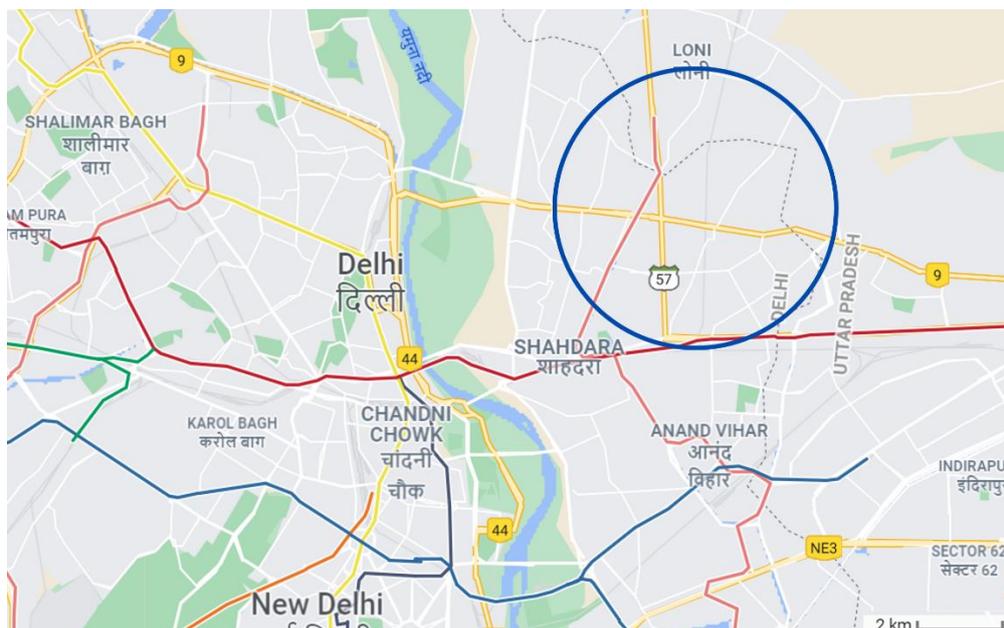
(Google Maps, 2022)

The LFP school (referred to in this thesis as LFPS) was recruited through the researcher's contact in the National Independent Schools Alliance (NISA). The LFPS is a private unaided recognised school, which means that it is not supported financially by the government but meets the standards set by the state for operating as a school

(Mousumi and Kusakabe, 2019). The overwhelming majority of LFP schools in Delhi are classified as private unaided, as opposed to private aided schools which receive government subsidy.

Figure 9 indicates the location of the four participating schools and some key information relating to the schools is presented in Table 5. The following paragraphs also present a brief outline of each school, based on the researcher's observations and secondary data.

Table 5 Participating schools information

School	Year established	School type	Location	Intervention	Enrolment
GISA	1988	Government – EDMC	Shahdara	CURE – no rainwater harvesting or anaerobic wastewater treatment	515 girls (no data for boys)
GISB	1972	Government – EDMC	Shahdara	CURE – with rainwater harvesting and anaerobic wastewater treatment	1,200 (according to CURE staff)
GNIS	1959	Government – EDMC	Mustafabad	None – agreement in place with CURE for the future	1,269 boys (no data for girls)
LFPS	1984	Private unaided recognised	Shahdara	None	1,507

- Government Intervention School A (GISA)

GISA participated in CURE's schools-based WASH intervention in 2018. It is situated in a low-income neighbourhood of Shahdara, in the eastern region of the state of Delhi. All of the participating EDMC schools have a shift for girls in the morning followed by a boys' shift in the afternoon. These two strands operate almost as separate schools on the same site with different principals and staff. As of 2017-2018 (the most recent data available), there were 515 girls enrolled in grades 1 to 5 and 16 female teachers, with a pupil-teacher ratio of 1:32 (NUEPA, 2018). Data are not available for the boys' afternoon shift.

- Government Intervention School B (GISB)

GISB also participated in CURE's intervention in 2018. It is situated in roughly the same area as GISA, approximately twenty minutes' walk to the north-east, towards the border

with Uttar Pradesh. The principal of the boys' shift was unwilling for his students to take part in the research so the participating students from this school are exclusively female. There are no data available regarding enrolment or staff employment for the girls' shift at this school. According to a member of staff from CURE, roughly 1,200 students are enrolled.

- Government Non-Intervention School (GNIS)

The GNIS is an EDMC primary school which , at the time of data collection in February 2020, had an agreement with CURE to participate in the intervention following the completion of the work at GISA and GISB but no work had yet been implemented. It is situated in Mustafabad, 6-8km north from the area in which GISA and GISB are located. As of 2017-2018, there were 1,269 boys enrolled in the afternoon shift and 25 teachers, resulting in a pupil-teacher ratio of 1:51 (ibid.). No enrolment or teacher employment data are available for the girls' shift.

- Low-Fee Private School (LFPS)

The LFPS is a low-fee private, co-educational school which has had no involvement with the CURE intervention. It is also located in Shahdara, approximately 3km to the west of GISA. It is a private unaided recognised school, which means that it is not funded by the government but has 'purportedly met the regulatory requirements of the state' (Tooley et al., 2007, p541) set out in the Right to Education Act (Parliament of India, 2009), allowing it 'to conduct state examinations and to issue 'transfer certificates', which are required for students to move schools, and to transfer to higher levels of education and gain employment' (Tooley et al., 2007, p541). As of 2017-2018, there were 1,295 students enrolled and 30 teachers, resulting in a pupil-teacher ratio of 1:43 (NUEPA, 2018). However, the principal offered more up-to-date information; according to him, there were 1,507 students enrolled and 63 teachers as of February 2020, giving a pupil-teacher ratio of 1:24. The average fee per child is 2,000 Rs (20 GBP) per month and students' fathers work in professions such as business owner, rickshaw driver, labourer, shopkeeper or tailor. However, it is worth mentioning the government's stipulation that 25% of all places in low-fee private schools must be allocated free of charge to children

identified as having 'Economically Weaker Section' (EWS) status. This is required by the Right to Education Act of 2009 (Parliament of India, 2009) but is not yet fully implemented. The principal explained that 8.7% of the students had EWS status and that the government were obliged to reimburse the school for accepting these students free of charge but until he received that payment, he was unable to increase the percentage.

More information about these school contexts and the communities in which the children attending them live is given in the descriptive statistics section of Chapter Four. The following section considers the research instruments and methods employed during qualitative and quantitative data collection, beginning with a discussion of applying survey instruments in cross-cultural contexts.

3.8 Research instruments

This section considers the different research instruments and qualitative methods used during data collection for this study, comparing it to similar previous publications and thus informing the subsequent results chapter. These are selected according to their use of similar data collection methods, procedures or comparable methods of reporting and analysis. The methods used during household data collection in the current study are presented, before progressing onto the quantitative and qualitative methods employed during school visits.

3.8.1 *Cross-cultural application and translation of questionnaire scales*

Care must be taken regarding the valid application of research instruments in contexts other than that in which they were devised (Bruns and Grunert, 1995; Allen and Walsh, 2000; Mpofu and Ortiz, 2009; Humble, 2017). Vreeman et al. (2013) explore measuring health behaviours in cross-cultural settings. They highlight the importance of careful translation and considering 'whether there is cultural equivalence for the concept being measured' (p2-3). During this study, scales employed in previous research were selected to compose the school-based questionnaire (Appendix 1) as on the whole, these included pre-existing validity and reliability measures. Furthermore, comparisons with the findings from previous literature would allow for interesting insights. The health

(Shrestha et al., 2016) component of the school-based questionnaire was devised in Nepal rather than India. While comparison is valuable, it is important that this is achieved through the use of methods which are valid in the context in which the research takes place (Vreeman et al., 2013). This is particularly important when English tests have been translated into a local language, as is the case in this study with tests translated into Hindi (ibid.) and when qualitative data have been collected in the local language and translated into English (Van Nes et al., 2010).

In the field of research into personality types, there is an indication that some characteristics such as extraversion and introversion are universal across differing cultures (McCrae and Allik, 2002; Avdeyeva and Church, 2005). This is certainly true of the majority of concepts mentioned in instruments employed in this study. While health and WASH-related priorities, preferences and values vary between contexts (Isunju et al., 2011; Vreeman et al., 2013)**,** the concepts and key words in this study – clean water, sanitation, hygiene, soap, toilets and so on – are all universal concepts common to everyday Indian life.

Initially, the school-based questionnaire employed in this current study was translated from English into Hindi by a colleague of the researcher at Newcastle University who is native to India. During a preliminary visit to India in August 2019, the researcher shared this first draft with a focus group of CURE staff members, all of whom were Indian, who agreed that the language and tone employed was academic and too complicated for primary-aged children to grasp. A second draft was then prepared by a doctoral candidate at Jawaharlal Nehru University who was recruited to act as an interpreter during the data collection. Unlike the first translator, this individual is native to Delhi and therefore familiar with child-friendly language and local idiomatic usage. This second draft was checked and approved by a member of CURE staff and by the original translator from Newcastle University.

3.8.2 *Quantitative: School-based questionnaire*

In total, 239 children participated in this part of the study. All of them were in Grade 5, the final grade of primary school, and ranged in age from 8 to 15. This grade was chosen

to enable the recruitment of children who were most likely to engage with the content of the study and as the oldest members of the schools, they would be most likely to have participated in CURE's BCC activities (e.g. resource mapping, compost pit decoration, plant growing activities etc, as detailed in Appendix 2). Surveys were administered largely in classrooms at the four participating schools but sometimes, the principal's office, and on one occasion the playground, were used. The survey was administered in Hindi by two doctoral students from Jawaharlal Nehru University, supervised by the researcher. The English version can be found in Appendix 1.

A small-scale pilot phase for the school-based questionnaire was conducted at GISA with six children at the beginning of data collection. Principally, the aim of this was to decide upon the optimal method for administering the questionnaire and increasing its validity. During the pilot, it became clear that the children's literacy level was not of the standard required to read the survey, even though the language was judged by native speakers to be child-friendly. Participants frequently asked the two interpreters for assistance in reading questions which led to the survey implementation being too time-consuming and also compromised responses as other children's decisions could be affected by their peer's conversation with the interpreters. When the researcher noticed this and switched to the alternative method of administering the survey verbally to the small group, the children discussed the answers before writing on the survey paper, even when instructed several times to complete the questionnaire independently. Therefore, it was necessary to administer the surveys on a one-to-one basis. This means that the data are vulnerable to social desirability response bias as the questions were relayed to the children directly by an adult, rather than independently (Thornton and Gupta, 2004). This one-to-one method resulted in a protracted process and a smaller sample size due to time constraints but was necessary for ensuring the validity of the responses as much as possible.

The school-based questionnaire consisted of two components: socio-economic and background factors, and a health questionnaire (Shrestha et al., 2016). The opening section of the questionnaire gathers simple data on a number of indicators relating to participants' schools and family backgrounds. Questions relating to parents'

employment allow for an estimation of socio-economic status based on Sharma's (2017) updated version of Kuppuswamy's socio-economic status scale (1981) which is commonly used in India. Questions regarding the nature of participants' homes and water and toilet access common to WASH questionnaires are included to provide insight into WASH access in children's home environments (WHO and UNICEF, 2018) pertinent to the third research question.

The health section of the school-based questionnaire is based on a study comparing intervention and non-intervention schools following a schools-based health project in Nepal (Shrestha et al., 2016). With the permission of the authors, this questionnaire was incorporated into this study because it was devised to evaluate school WASH provision and children's WASH behaviours in a context similar to that in which this thesis research was taking place. The health conditions referred to in the questionnaire are issues pertinent to Delhi such as worm infection (Garg et al., 2015), diarrhoea (Snehaa et al., 2020, in press), typhoid (Singh et al., 2018), anaemia (Susheela et al., 2018), iodine deficiency (Kapil et al., 2013) and night blindness (Pahwa et al., 2012).

The health questionnaire consists of four sections: *School Facilities*, *Health Knowledge* (the extent to which children were taught about different health conditions), *Hygiene Practices* (the extent of children's WASH behaviours) and finally, *Health Outcomes* (the extent to which children experienced WASH-related health conditions). The authors originally formulated the survey in English, incorporating items from a survey used in their previous work not available to the current study plus four other questionnaires (WHO and HBSC International Coordinating Centre, 1983; Lee et al., 2008; UNICEF, 2011; WHO, 2013b). The questionnaire was translated into Nepali, then re-translated back into English for verification. It was piloted with a group of 100 students and discussed with school staff, pupils and public health experts before the main data collection was conducted (Shrestha et al., 2016). The inclusion of this survey as the second section of the school-based questionnaire allows for detailed insights into WASH provision in the participating schools, as well as the health status of the participating children. There is no scale reliability analysis included in the original study conducted by Shrestha et al. (2016) but the primary data in this thesis research return a Cronbach's alpha value of

0.74, indicating high internal consistency (Nunnally, 1978). Regarding the four individual sections, the Cronbach's alpha value is 0.53 for *School Facilities*, 0.68 for *Students' Knowledge*, 0.62 for *Hygiene Practices* and finally 0.39 for *Health Outcomes*.

A study published after data collection for this thesis study commenced uses a similar school-based questionnaire (Shrestha et al., 2020b). It focuses largely on nutritional status but includes questions relating to HWWS, latrine use and drinking water in school, as well as children's WASH understanding and attitudes. Also based in Nepal, the authors conduct a cluster-randomised controlled trial investigating the impact of a schools-based intervention similar to CURE's with the incorporation of school garden and WASH improvements, as well as nutrition which was not included as a focus of CURE's intervention. In schools where gardening was included as part of the curriculum, the authors reported improved nutrition and reduced parasitic infections for participating children. However, programme sustainability was cited as a challenging factor; the authors identified a need for regular training to reinforce understanding of gardening, WASH, nutrition and health.

3.8.3 *Qualitative: Interviews and observations*

With the convergent-parallel approach of data collection (section 3.6), qualitative methods were employed concurrently alongside the quantitative questionnaire as 'up-close qualitative methods offer us a perspective that is cut off if we limit ourselves to distanced quantitative methods' (Chamlee-Wright, 2010, p326). This section sets out the qualitative methods used during data collection, both in schools and the surrounding communities, and why they were selected.

- Focus group discussions

These were employed with small groups of 4-5 children at each school (10 groups in total) who volunteered to participate following their completion of the school-based questionnaire. With the assistance of an interpreter, the data were collected in Hindi through audio recording. Focus group discussions are especially appropriate for cross-cultural research taking place in contexts where key issues are not known initially to the

researcher because they are an effective tool for quickly eliciting discussion about a variety of topics (Hennink, 2017). The focus group discussions used participatory methods including drawing and diamond ranking to facilitate discussion on topics linked to the school-based questionnaire. The images used were carefully selected to be familiar in an Indian context and were checked with the interpreter before the start of data collection. According to Cooper (2017), 'using visual methods enables children to connect with experiences of place, significant others as well as material things to convey aspects of identity and provide opportunities to witness the layers of rich social experiences that make up social life' (p625). The use of drawings can benefit research by enabling a calm atmosphere and building a framework for discussion (Yuen, 2004) while diamond ranking is an established device useful in encouraging insightful discussion through which 'people…are required to make explicit the over-arching relationships by which they organise knowledge, thus making their understandings available for scrutiny and comparison' (Clark, 2012, p223).

The different initial themes in the focus group discussions were linked to the two sections of the school-based questionnaire: background factors and students' health. In the drawing activity, children were asked to depict their homes and how their household uses water, thus sharing insight into their home lives. For the diamond ranking activity, children were invited to order different health behaviours such as drinking clean water, HWWS and brushing their teeth in order of importance, linking to the health section of the quantitative questionnaire. The diamond ranking images employed are presented in Appendix 8. An example focus group discussion transcript is provided in Appendix 10.

- School staff interviews

At each school, semi-structured interviews were conducted with school staff members to gather their perspectives on the children's learning environment and WASH standards in their school. 11 were conducted in total; these included 2 with members of janitorial staff, 4 with principals and 7 with teachers. In the majority of cases, the data were collected through audio recording. A few members of school staff did not consent to be recorded and in these cases, the researcher took detailed notes. In semi-structured interviews, 'the interviewer prepares a list of predetermined questions' but they 'unfold

in a conversational manner offering participants the chance to explore issues they feel are important' (Longhurst, 2016, p143). They can be described as 'conversations in which you know what you want to find out about' (Fylan, 2005, p65) which 'allow us to enter the other person's perspective' (Patton, 1987, p109). However, it is important not to presuppose understanding; the interviewer's role is to pose a question but this may open avenues of enquiry which were not expected initially (Mears, 2012; Humble, 2017).

The interviews were conducted on a one-to-one basis, in pairs and on one occasion in a group, according to the participants' preferences. At least two staff members were interviewed at each of the four schools. Elicitation questions for principals referred to their role at the school, the school facilities, their supervision of their staff and the past and present challenges they perceived at their school. For principals of intervention schools, there were also questions about their perception of the impact of CURE's work at their school and if they thought there was any aspect of the intervention they would have changed. Questions for school teachers related to children's WASH behaviours, the impact of CURE's intervention, WASH at their school pre-intervention, and issues they face in upholding the beneficial impacts and recommendations of the intervention post-implementation. CURE had aimed to include cleaning staff as stakeholders in their intervention so they were also interviewed at the two intervention schools with a focus on the nature of their role, the issues they face in fulfilling their responsibilities and their involvement in the CURE intervention. Interview questions are presented in Appendix 9. An example school staff interview transcript is provided in Appendix 11.

- School observations

The researcher wrote daily notes based on observations in the schools and surrounding communities, as well as taking photographs of the schools' infrastructure. The WHO and UNICEF Joint Monitoring Programme's 'Core questions for monitoring WASH in Schools in the Sustainable Development Goals' (2018a) informed the collection of these qualitative data (Appendix 1). These questions, used worldwide in evaluating school WASH provision, incorporate items relating to the school's main water source, the type of toilet available, the number of toilets available, handwashing facilities and whether water and soap were available at the time of the visit. While the core questions are

originally intended for quantitative analysis, due to the relatively small scale of this study, they acted as a framework for qualitative evaluation of schools' facilities during data collection rather than as a quantitative tool.

- Household interviews and observations

For the two intervention schools, the household surveys took place at the homes of children attending the schools and in total, 16 were conducted (10 for GISA and 6 for GISB). The data were collected through audio recording or the researcher's detailed notes, according to interviewees' preferences. These surveys consisted of interviews with household members (parents and grandparents of children attending the schools) and field notes written upon observation of their home environments. The member of CURE staff who accompanied the researcher and interpreters during visits had established relationships with parents of children attending the school during CURE's intervention so was able to act as a community guide. She asked parents in the community if they would be willing to take part before the interpreter explained the study at length and sought consent. More information about the informed consent process is given later in this chapter in a section which focuses on ethics. For the GNIS and the LFPS, interviews with parents took place on the school premises because the member of CURE staff did not have pre-existing knowledge of the surrounding area or relationships with households. In total, 8 were conducted (5 at the GNIS and 3 at the LFPS). Again, the data were collected through either audio recording or the researcher's detailed notes, according to interviewees' preferences. The researcher used the WHO and UNICEF Joint Monitoring Programme's 'Core questions on water, sanitation and hygiene for household surveys' (2018b) and the Household Water Insecurity Experiences (HWISE) Scale (Young et al., 2019) to gauge an understanding of respondents' daily experiences of water before posing questions based on their answers. Both of these can be found in Appendix 1. The strength of these is that they are validated for global use and therefore it was certain that they would be appropriate for the Delhi context. As with the WHO and UNICEF Joint Monitoring Programme's 'Core questions for monitoring WASH in Schools in the Sustainable Development Goals' (2018a), these two surveys were designed for quantitative analysis and were originally selected during the

study design phase with that in mind. However, following supervisory feedback, the researcher decided it was not feasible to conduct the number of household surveys required for quantitative analysis. Despite this, during the first few household surveys it was found that both of these instruments served as useful catalysts for discussion and they were retained for this purpose. An example household interview transcript is provided in Appendix 11.

3.9 Analysis

The previous part of the chapter gave an overview of the quantitative and qualitative methods that were employed during data collection. The following section outlines the approach that the researcher took in analysis, explaining the processes of quantitative and qualitative data preparation and the tools employed to analyse the data.

3.9.1 *Quantitative analysis*

First, the school-based questionnaire data were entered into SPSS and checked by the researcher's supervisors for data entry errors. Data cleaning is an essential step in the analysis process and increases the reliability of results (Van den Broeck et al., 2005; McCabe et al., 2012). Descriptive analysis of background factors was performed using measures of central tendency and frequency distributions to build understanding of the nature of the participating schools. The scores from the participants' responses on the health section were totalled to give approximate variables measuring the four sections: *School Facilities, Health Knowledge, Hygiene Practices and Health Outcomes*. Comparisons of students' socio-economic background were also made between the four schools and this analysis forms part of the response to the third research question.

A range of statistical techniques including one-way analysis of variance (ANOVA), Spearman's rank correlation and SEM were used to respond to the three research questions. Each of these is explained in more detail in Appendix 13. Pearson's correlation coefficient can be used to analyse the strength and direction (positive or negative) of the association between two variables (Emerson, 2015). However, there is some debate surrounding the use of parametric tests such as Pearson's correlation

coefficient with discrete data (such as the Likert-style responses from the health section). Norman (2010) comes to the definitive conclusion that 'Parametric statistics can be used with Likert data, with small sample sizes, with unequal variances, and with non-normal distributions, with no fear of 'coming to the wrong conclusion'' (p631). Humble (2020) reinforces this argument in reference to Norman's (2010) research, stating that 'parametric tests tend to give better results [than nonparametric tests] even when statistical assumptions, such as the data needing to be normally distributed, are violated to an extreme degree' (p5).

As such, Pearson's correlation coefficient was considered to explore the extent of relationships between variables included in the health section of the school-based questionnaire. However, there were a number of outliers in the data and Pearson's correlation coefficient is particularly susceptible to being affected by outliers (Humble, 2020). Therefore, it was necessary to use Spearman's rank correlation coefficient (Spearman's rho), a non-parametric test, instead as this is relatively unaffected by outliers (Gautheir, 2001).

The techniques selected serve to apply the theoretical foundations of critical realism (section 3.3.1) and postpositivism (section 3.5.2) in data analysis. For example, in multiple regression, the effects of the covariates on the dependent variable can be investigated individually and collectively. However, it does not provide an explanatory mechanism for these effects (Curran, 2017a). SEM offers a method to apply the theory of stratification (Bhaskar, 2013; Edwards, 2019) by delineating the pathway of covariates' relationships with one another and with the dependent variable in a way that reveals more information regarding the underlying mechanisms at play. Rather than merely gaining understanding of the empirical association at play between an independent variable and a dependent variable, SEM offers a visual representation of the generative mechanisms which facilitate this association. Furthermore, the fact that the error terms (which indicate how much of the variance is caused by other variables) are clearly presented in the SEM diagram adheres to the postpositivist stance by explicitly stating the results of the SEM in terms of likelihood rather than certainty.

3.9.2 *Qualitative analysis*

The qualitative analysis process is presented in Figure 10. During data collection, qualitative field notes were handwritten during school and community visits and then typed up on the same day in the form of a daily diary. This allowed the researcher to build a detailed account of the visit and to add reflexive notes following school and community visits. The researcher coded the qualitative data, comparing every part with others and grouping them into common categories according to thematic similarities. Each of these was considered in turn in relation to the research questions.

Figure 10 Qualitative data collection and analysis process
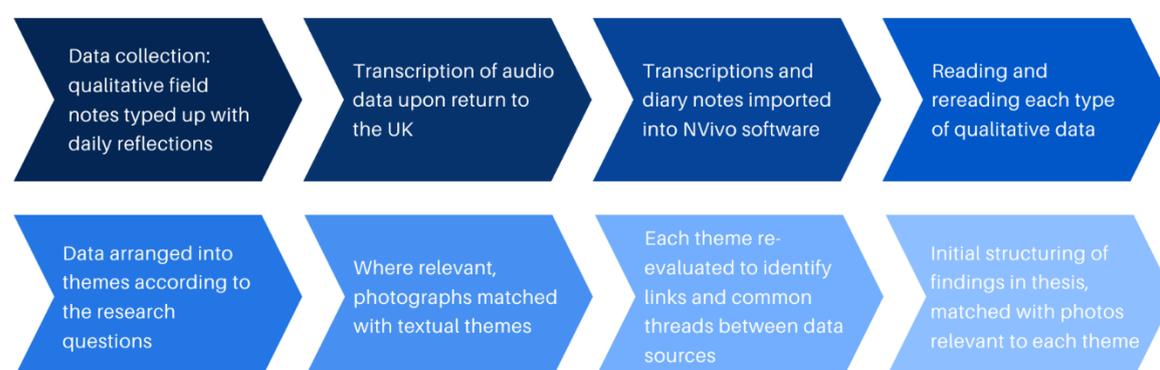
Initial coding commenced during the data collection visit. In the evening of each day spent in the four schools, observation notes were typed up and arranged into a reflective diary according to common themes rather than the chronological order of the interviews and focus group discussions. Below each section of data, the researcher's own thoughts and considerations were included. Themes emerging from this initial coding procedure shaped the direction of the remaining focus group discussions, interviews and observations.

On return to the UK when data collection was completed, the first step in the analysis process was transcribing audio data. The vast majority of interviews during data collection were conducted and audio-recorded in English and Hindi with an interpreter; the only exception was the LFPS where the principal and teachers were fluent in English. As the researcher is not a Hindi speaker, only the parts of the interviews translated into English by the interpreter during the interview were transcribed. This is one limitation in

analysis because, as participants often spoke at length before the interpreter was able to translate, some undoubtedly useful data are inaccessible. However, it is not unconventional for data collected in a different language to undergo such a process; Halai (2007) refers to data collected during interviews evolving into '"transmuted texts,"…[which] reflect the original, but have been recreated' (p344) and this is an accurate description of the process used in this study. The researcher took the decision to present all quotations from the qualitative data in indented block paragraphs, regardless of length, to distinguish them from the main text and draw the reader's attention to the voices of the participants. Once all the audio data were transcribed, the field notes and transcriptions of interviews and focus group discussions were imported into NVivo qualitative data analysis software package.

The second stage of analysis was to read and code each different type of textual qualitative data using NVivo: the translated interview transcriptions, the translated focus group discussion transcriptions and the daily reflective diary of observation notes. Each part relevant to the research focus of driving factors affecting children's WASH behaviours was highlighted and then arranged into themes pertinent to the research questions. The full list of themes, which the NVivo software refers to as 'codes', is presented in Appendix 12. Data pertaining to WASH behaviours, the impacts of CURE's WASH programme, behaviour change, and participants' experiences of school WASH facilities and household WASH access were retained. The photographs were also examined and reviewed, and those useful to the research aim were included and coded according to the same themes. The researcher then re-evaluated these coded data, applying data triangulation to determine robust, clear categories common across the different data sources. During this stage, the researcher began to structure the qualitative findings according to the order of the research questions.

The end result was several themes, each of which were pertinent to the research questions and constituted of qualitative data collected during the research. Example screen captures of the data included in some of these themes in NVivo are presented in Appendix 12. The themes complement each other and in the postpositivist epistemological stance, combine to build 'warranted assertibility' (Dewey, 1938, p7) into

conclusions drawn from them. Creswell (2014) warns that 'The use of different concepts or variables on both sides, quantitative and qualitative, may yield incomparable and difficult to merge findings' (p223). Therefore, the researcher aimed to consider these themes within the context of the key factors arising from the initial quantitative analysis. Use of NVivo to identify common perspectives among participants enabled the researcher to build a picture of the WASH situation in the research setting relevant to each of the three research questions, as well as identifying themes materialising from participants' insights which were not considered by the researcher in the design phase.

In contrast with the quantitative methods used in this study, the qualitative analysis process 'focuses on the exploration of values, meanings, beliefs, thoughts, experiences, and feelings' (Wong, 2008, p14). It is used for 'identifying significant patterns…drawing meaning from data and subsequently building a logical chain of evidence' (ibid.). Thus, it strengthens the postpositivist, critical realist approach applied during this study which seeks to uncover relationships in phenomena and generate findings likely to be true (Denzin and Lincoln, 2011). The qualitative analysis process facilitated data triangulation (section 3.6.1) in a way that is valuable for identifying and clarifying connections and relationships in the data. It was useful for identifying factors enabling or impeding children's development of capability, opportunity and motivation which collectively produce or inhibit WASH behaviour adoption. Finally, the analysis of participants' viewpoints from multiple perspectives applies the concept of emergence by using different voices (parts of the whole) to understand more of the true picture.

3.10 Validity and reliability

When designing social scientific research, the concepts of validity and reliability are at the forefront of ensuring that the methods employed are achieving what the researcher intends them to achieve (Bryman, 2012). The following sections will explore the significance of validity and reliability, particularly within the context of mixed methods, cross-cultural research. First, quantitative and qualitative validity are explored in light of the school-based questionnaire and the various qualitative methods employed in schools and communities.

3.10.1 *Validity*

Validity 'refers to the issue of whether an indicator…that is devised to gauge a concept really measures that concept' (ibid., p171). There are many different types. Bryman (2012) describes measurement, external, internal and ecological validity which can apply to both quantitative and qualitative research. Before exploring these different concepts of validity in relation to the current study, it is important to consider how they are approached in the context of the ontological position from which the research is conducted.

Maxwell (2002) refers to critical realism in the context of qualitative validity, explaining that 'the concept of validity…does not depend on the existence of some absolute truth or reality to which an account can be compared' (p42). Gronlund (1981) concurs, arguing that researchers should strive towards validity and that it is not binary in nature. Hammersley and Atkinson (1995) state that 'Data in themselves cannot be valid or invalid; what is at issue are the inferences drawn from them' (p223). For the critical realist researcher, it is not the absolutely true perception of reality that is valid or invalid, but rather the account of that reality which the researcher arrives at using the data in question, which is deemed to be true in the probabilistic sense (Houston, 2001; Denzin and Lincoln, 2011) through the concepts of stratification and emergence (Elder-Vass, 2005; Bhaskar, 2013; Edwards, 2019). Therefore, it is important to consider the data collected during this study in light of this standpoint.

Cohen et al. (2018) clarify the different approaches taken in validating qualitative and quantitative research. The researcher moves towards quantitative validity through using sound instruments to measure concepts, maximising objectivity and ensuring appropriate sample size (ibid.). Meanwhile, for qualitative research, the researcher can validate their approach

> …through the honesty, depth, authenticity, richness, trustworthiness, dependability, credibility and scope of the data achieved, the participants approached, the extent of triangulation and the disinterestedness or objectivity of the researcher…

> (ibid., p246)

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The researcher for this thesis study took into consideration Bryman's (2012) four types of validity referred to above. First, measurement (or construct) validity is pertinent to quantitative research and clarifies whether a questionnaire or scale actually measures what it claims to measure. This is linked to the reliability analysis of each construct; those used in this study indicate high internal consistency, as outlined earlier in this chapter (Nunnally, 1978). Secondly, the issue of external validity 'is concerned with the question of whether the results of a study can be generalized beyond the specific research context' (Bryman, 2012, p47). As it was not possible to use randomised sampling methods, it is infeasible to generalise the findings of this study to other contexts. However, this does not render them useless; even if findings do not apply to the whole population, they are still beneficial when considering comparable situations and contexts to those in which the research took place (Bogdan and Biklen, 1992; Humble, 2017).

Thirdly, 'internal validity relates mainly to the issue of causality' (Bryman, 2012, p47) and 'inferred and found relationships between elements of the research design and outcomes' (Cohen et al., 2018, p246), asking whether the conclusion that there is a causal relationship between two variables is legitimate or not. Unlike measurement and external validity, this type is relevant to both qualitative and quantitative research. In the critical realist approach, the researcher works towards identifying truth in findings with increasing likelihood. Therefore, if a causal relationship is hypothesised, this can be investigated through the use of data triangulation to verify whether there is an authentic relationship and the strength of it can be evaluated. In this research, SEM offers a clear visualisation of the investigated path relationships between variables, with the regression coefficients and error terms indicating the likelihood of certain variables affecting others.

Cohen et al. (ibid.) point to a number of issues which can affect the internal validity of quantitative research. For example, it is important to avoid attributing outcomes to an intervention when other factors have caused the change. This is easily averted in the use of SEM as the value of the error term is clearly presented in the diagram and represents the variance that is not caused by the variable in question. The researcher should also

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provide clarity on which variable is the independent and which is the dependent, which is again achieved in SEM through the clear display of the direction of relationships between variables. The issue of 'instrument reactivity' is also relevant to this study; it is defined as 'effects that the data-collection instruments exert on the people in the study' (ibid., p252). Lavrakas (2008) expands reactivity to refer to effects caused by the researcher and the setting too. Instrument reactivity could occur for example through social desirability bias, when participants respond to questions with their aspirations for their future behaviour or how they perceive themselves to behave, rather than their behaviour in reality (ibid.). Reactivity can be lessened by the researcher taking into account how participants from different backgrounds and positions in hierarchy respond to different situations they face in the research process. For instance, during this thesis study, the questionnaires were conducted in settings to which participants were accustomed (classrooms and playgrounds) and small groups of children awaiting their turn played a logic game in the same room while others completed the questionnaire with the interpreters. Gathering data in a familiar setting with peers present served to mitigate reactivity.

Finally, ecological validity applies to both quantitative and qualitative research. Cicourel (1982) summarises this type of validity with a question: 'Do our instruments capture the daily life conditions, opinions, values, attitudes, and knowledge base of those we study as expressed in their natural habitat?' (p15). Ecological validity is weakened when the research process does not correspond with participants' normal lives. For example, it is not natural or everyday to express opinions through a questionnaire. The implications for the ecological validity of this research arising from the quantitative component and the researcher's role during qualitative interviews were tempered through the observational component which enabled the researcher to reflect upon the behaviour of participants in their habitual environment.

With regards to improving the validity of qualitative research, Lincoln and Guba (1985) present four criteria which helpfully correspond with those used for quantitative research. Bryman (2012) presents them thus:

- Credibility, which parallels internal validity – that is, how believable are the findings?
- Transferability, which parallels external validity – that is, do the findings apply to other contexts?
- Dependability, which parallels reliability – that is, are the findings likely to apply at other times?
- Confirmability, which parallels objectivity – that is, has the investigator allowed his or her values to intrude to a high degree?

(p49)

Regarding credibility, when considering the qualitative data gathered during the current study, they provide insights from school students, staff and parents who are affected by the issues pertinent to the research questions on a daily basis. Therefore, it is certain that the participants' contributions during data collection are useful in achieving the aims of this study. However, it is possible that participants' responses were not entirely truthful at all times. For example, a school principal may have a more optimistic view of the school than a dissatisfied parent. On a few occasions, participating teachers sought assurance that their employers would not be able to identify them in the final report and may have been less forthcoming in sharing their perspectives. This is why it was important to gather qualitative data from a wide range of voices so as to build credibility into the overall picture of reality in the participating schools as inferred from the data. This is again an example of the critical realist concept of emergence applying to the data collection as individual divergent voices combine to reveal more of the complete picture.

In terms of transferability, although the convenience sampling methods employed mean that the findings are not strictly generalisable across multiple contexts, the participating schools are typical of Delhi and other urban settings of north India. Following Bogdan and Biklen (1992), it is therefore reasonable to suggest that findings could inform decisions affecting future interventions in schools in similar areas. The researcher aimed to ensure confirmability by enabling participants to lead discussion during interviews, thus reducing the impact of the researcher's preconceptions and assumptions on the data. This was also achieved through reflection on the researcher's presence in the research during analysis. As Bryman (2012) states that dependability is equivalent to reliability, this is discussed in the following section.

Cohen et al. (2018) cite member checking, peer debriefing and triangulation as ways in which these criteria of qualitative validity can be met and Creswell and Miller (2000) identify these as practices which correspond with the postpositivist and critical realist perspectives. Each of these three processes were employed during the current research. Member checking, which 'consists of taking data and interpretations back to the participants…so that they can confirm the credibility of the information' (ibid., p127) is seen as central to building fidelity in research (Lincoln and Guba, 1985). As the researcher did not have contact with participants after data collection, member checking was conducted during interviews and focus group discussions through summarisation of participants' comments repeated to them for clarification, particularly with points of ambiguity. In peer debriefing, a neutral fellow researcher appraises the research design, analysis and final report, offering an alternative, impartial view of the study (ibid.). This was undertaken by two colleagues from Newcastle University, both of whom are undertaking WASH research in New Delhi but are not connected to this thesis project. The process of triangulation was described earlier in this chapter.

3.10.2 *Reliability*

Bryman (2012) explains that 'Reliability refers to the consistency of a measure of a concept' (p169) and refers to its three key aspects of stability, internal reliability and inter-observer consistency (ibid.). Stability denotes the idea that research instruments should give similar results when administered to the same sample at different times or groups derived from analogous populations (ibid.). Secondly, internal reliability measures to what extent the responses on a research instrument's items are related to each other and pertain to the same theme (Higgins and Straub, 2006). Thirdly, inter-observer consistency refers to disparity that emerges when more than one researcher is involved in subjective interpretation, such as when a response to a question could be categorised in different ways by different researchers.

In the current research, it was not possible to carry out test-retest reliability during data collection to test scale stability. The students from GISA and GISB represent two similar groups and there were minimal differences in the findings for the school-based questionnaire between these two contexts, suggesting that the scales included in the

questionnaire are stable. Although there was just one researcher on this overall project who analysed and interpreted the data, inter-observer consistency is nonetheless relevant because two interpreters assisted in data collection. Therefore, some inconsistency could have developed through the interpreters coding ambiguous responses from participants in different ways. This was mitigated through discussions between the researcher and the interpreters in between surveys, as well as asking participants for clarification.

Guba and Lincoln (1994) propose the concepts of authenticity and trustworthiness as alternatives to validity and reliability in qualitative research. Dependability can be described as the equivalent of reliability pertaining to qualitative data (ibid.) and considers whether it is probable that the findings from these data are applicable across other times (Bryman, 2012). This notion of dependability adheres to the idea that reality is observable from multiple viewpoints. The researcher rejects the constructivist concept that knowledge of reality as it exists (external to the observer) is impossible (Proulx, 2006). Nonetheless, the idea of this reality observed from several viewpoints corresponds with critical realism's notion of emergence (section 3.3.1) which 'is operating when a whole has properties or powers that are not possessed by its parts' (Elder-Vass, 2005, p316). It is the aim of this study that gathering perspectives from numerous participants and triangulating data sources will draw a dependable, reliable picture of the true reality of the context in which the research was conducted.

Sections 3.7-3.10 have explained how the research was designed and conducted, with detail relating to sampling, instrument selection, methods, analysis, validity and reliability. The final section of Chapter Three outlines the efforts taken to ensure rigorous ethical standards in this research.

3.11 Ethics

Guillemin and Gilliam (2004) state that 'Ethical tensions are part of the everyday practice of doing research—all kinds of research' and ask the question 'How do researchers deal with ethical problems that arise in the practice of their research, and are there conceptual frameworks that they can draw on to assist them?' (p261). The British

Educational Research Association (BERA) provides clear guidelines on ensuring that any proposed project meets the rigorous ethical standards required of high-quality academic research (BERA, 2018). Detailed consideration of these in the context of the proposed research is presented here, alongside specific issues that relate directly to WASH and to the context in which the research took place. The project received ethical approval from Newcastle University's School of Education, Communication and Language Sciences ethics committee in November 2019, before data collection commenced.

When conducting research with human participants, there are a number of ethical issues that require consideration; this is particularly true when conducting international fieldwork in the Global South (Sultana, 2007) and when children are participating (Morrow and Richards, 1996). BERA's Ethical Guidelines for Educational Research 'represent the tenets of best ethical practice' (BERA, 2018, p. iii) and provide the basis for the below discussion of various issues pertinent to ensuring ethical research in the context of the present study. The following matters highlighted in BERA's (2018) guidelines are discussed:

- Gaining access to participants
- Cross-cultural ethical research
- Minimising risks
- Voluntary informed consent
- Incentives and benefits
- Data storage and analysis
- Participant debriefing and dissemination

3.11.1 *Gaining access to participants*

First, there are a number of points to consider when seeking access to participants for research purposes. Gatekeepers are a common aspect of this process, particularly when conducting research with vulnerable participants (Walker and Read, 2011). In the case of the current study, CURE acted as a gatekeeper organisation (see section 3.7.2). The government schools which participated were selected from CURE's schools-based WASH project. CURE has official access to these schools granted through a written agreement

with the EDMC education department. A letter of agreement with the researcher was provided by CURE confirming the researcher's access to their project for the purposes of doctoral research. Despite this, the principal of the boys' section at one of the schools was unwilling to participate so the participating students from GISB are exclusively female. The principal of the LFPS also acted as a gatekeeper and was initially contacted through the researcher's contact with the network of such schools across Delhi.

Data were also collected through a small number of household surveys (5-10 per school) in surrounding areas and CURE acted as a gatekeeper for this aspect of the research too. Having developed long-term relationships with a number of students' parents, a member of CURE staff acted as a community guide, linking the researcher and interpreters with households which were subsequently invited to participate in household surveys.

3.11.2 *Cross-cultural ethical research*

It is prudent to consider any particular issues that could arise in terms of ethics when conducting research in an international context such as India. The BERA (2018) guidelines explain this:

> The application of these principles [of ethical research] in different social, cultural and political contexts requires careful negotiation, adaptation and sensitivity…In some countries it is advisable to work with a local person as co-researcher/co-investigator in order to establish adequate levels of trust with prospective local participants…

(p14)

In this case, the two interpreters who accompanied the researcher during data collection were both native to Delhi and one was native to the specific area of Delhi in which the research took place. They were able to communicate clearly with the participating children with the aim of enabling children to feel comfortable during the one-to-one survey and focus group discussions. Children attended the survey in groups of 4-6 as per the principals' preferences so the researcher provided a logic puzzle game (Figure 11) to engage children out of the classroom in an educational activity while awaiting their turn for the survey. The particular game was chosen as it required

demonstration rather than explanation to play and its 'traffic jam' theme was appropriate for cross-cultural use. The children who did not have the opportunity to play the game because their survey turn was first were offered the chance to play after their survey response.

Figure 11 'Traffic jam' logic game

3.11.3 *Minimising risks*

In terms of the researcher's safety, there were numerous aspects of this project which, without prior planning and due care during fieldwork, could have posed a risk. The researcher travelled to New Delhi for the fieldwork with all immunisations up-to-date and took necessary precautions while there to avoid common infections. Transport around New Delhi required attention to safety and the researcher followed the advice of local interpreters while using public transport. The researcher had first-hand experience of New Delhi having conducted a short preliminary visit in August 2019 which reduced risks through building familiarity with the research setting.

The BERA (2018) guidelines stipulate that 'researchers have a responsibility to think through their duty of care in order to recognise potential risks, and to prepare for and be

in a position to minimise and manage any distress or discomfort that may arise' (p19). They also state that 'Researchers should make known to the participants…any predictable disadvantage or harm potentially arising from the process' (ibid.). There was no risk for participants in giving consent for their data to be used in this project because all data were anonymised and stored securely both in digital and hard form. A data management plan was used to ensure this (Appendix 7). All participants were notified of their right to withdraw at any time and participants received assurance that their responses would be anonymised throughout the research process.

There were also no physical risks for participants inherent in the research proposal. No aspect of the process involved participants taking risks abnormal to their daily lifestyle. In fact, one outcome of the study could be the reduction of these risks through increased understanding of the importance of clean water and hygienic living.

There were minor potential risks to participants sharing sensitive information about their experiences of WASH; it was important that participants never felt pressured to share information that they did not wish to share. This is why giving participants clarity regarding the aims of the research, their right to withdraw at any time and their right to omit to answer certain questions was so important. Equally, they had the opportunity to contact both the researcher and the collaborating organisation (CURE) through the contact details on the participant information sheet if they had any queries regarding their involvement after the fact.

3.11.4 *Voluntary informed consent*

Acquiring informed consent from participants is universally considered to be essential in ensuring ethical best practice (Heath et al., 2007) but presents some challenges when conducting schools-based research in low-income settings (Okello et al., 2013). For example, when principals have given consent by proxy for the research to take place, it is important that other staff and students understand that they too have the right for their consent to be requested and can decline to participate.

In the present study, participants were required to give voluntary informed written consent before they took part in any aspect of the research process. This was given via a

tick-box on a consent form document (Appendix 5). In case any participants did not have sufficient literacy skills to read the document, it was also read orally by one of the Hindi-speaking interpreters. Translation of the consent forms was initially undertaken by a UK-based Hindi speaker known to the researcher and was subsequently checked and adapted by one of the interpreters who is native to Delhi specifically.

All participants received detailed written information explaining the aims of the study, what would be required of them if they took part, how long it would take and their right to withdraw at any time during the process. This information was read to them in Hindi by the interpreters before they were asked to give consent. During data collection in schools, this information was provided to school management and teachers as well as students. There was no particular information relating to the study withheld from participants for the sake of the research design.

Regarding the issue of parental consent, the BERA (2018) guidelines specify that when it is not possible to contact certain groups, consideration should be given to how to proceed. This was the case for parents of children who had been invited to participate as the only way to contact them was by distributing documents to the children to take home. The original plan was to give children an information sheet to pass onto their parents or guardians with an attached opt-out form for parents to sign; this is a strategy recommended in the BERA guidelines (ibid.). However, in discussion with CURE staff familiar with the schools and surrounding communities, the point was raised that many parents in these communities were not able to read and thus may have removed their children from the study mistakenly, assuming that the opt-out form was an opt-in form. Therefore, the parental consent forms were not distributed to children and the consent of the school principal, class teacher and child was deemed to be sufficient for the child's participation. All consent forms and participant information sheets are presented in Appendix 4-5.

3.11.5 *Incentives and benefits*

According to the BERA (2018) guidelines, 'incentives to encourage participation should be commensurate with good sense, such that the level of incentive does not impinge on

the free decision to participate' (p19). In line with this recommendation, no financial incentives were offered to adults or children participating in the research but children received a certificate (Appendix 6) and a 'Water is Life' sticker to thank them for giving time to completing the questionnaire aspect of the project. Although there are no direct benefits for participants, the research offered students and staff at the schools the opportunity to give feedback on how they perceive CURE's project during quantitative and qualitative data collection. It will also be indirectly beneficial to students attending other schools in which a similar project will run in the future, as is the case for students attending the GNIS.

Regarding benefits this research project could provide for participants in the long term, findings relating to CURE's schools-based programme could inform decisions taken by policy makers on why and how to progress with improving WASH infrastructure in schools while building students' adoption of positive WASH behaviours. Supportive findings could justify a decision from CURE to expand this project into other schools in the Delhi region, as well as across other cities and regions of India. This would particularly be the case if it were demonstrated that such a schools-based project could bring positive neighbourhood effects beyond the confines of the school premises into households and local communities, as is claimed in the project's mission statement (CURE, 2020).

This study is beneficial to CURE in that they will be able to use findings to inform decisions around future interventions. However, CURE did not sponsor the study in any way and no financial transaction of any kind took place between CURE and the researcher.

3.11.6 *Data storage and analysis*

Regarding best practice for data storage, the BERA (2018) guidelines state that 'Researchers should recognise the entitlement of both institutions and individual participants to privacy, and should accord them their rights to confidentiality and anonymity' (p21). For the current study, research participants were asked to provide their names so that their data could be identified if they wished for it to be excluded

from analysis after data collection. All participants are anonymous in the final thesis report and all information shared during the data gathering process was kept confidential.

Once the data collection process in India was finished, the researcher returned to the UK with the data. Hard and digital data were kept in secure storage during and after the fieldwork, according to the data management plan (Appendix 7). Datasets were saved securely on a password-protected hard drive and a secure cloud storage system. They were backed up to a password-protected external hard drive. Hard copies of raw data were kept securely at the researcher's home rather than on Newcastle University premises due to data input taking place during the COVID-19 pandemic.

The digital audio data were deleted from the recording device after it had been correctly uploaded onto the password-protected cloud storage system. A back-up copy of digital data was also made on an external hard drive and stored securely in the researcher's home with the physical data, which were written up on quantitative analysis software programme SPSS in the weeks following the field work visit. After data analysis and thesis write-up, the datasets were retained for potential future research.

3.11.7 *Participant debriefing and dissemination*

When conducting social scientific research, it is important to consider a strategy for sharing findings and recommendations with participants following analysis, particularly since it is often the case that participants are interested to receive feedback (Purvis et al., 2017). For this thesis project, there are two strands of participant debriefing that require consideration and the first is disseminating findings to CURE. The CURE staff suggested that this could take place through an abridged version of the final report. The second strand of participant debriefing is to produce an accessible report for circulation at school and community level. The BERA guidelines (2018) recommend that

> Where research is conducted in international settings in which English is not the prevalent language, researchers should seek to make the fruits of their research available in a language that makes it locally as well as internationally accessible.

3.12 Summary

Using a mixed methods approach to triangulate different sources of data, this research aims to investigate the driving factors affecting children's WASH behaviours, and therefore progress towards SDG 6, in East Delhi primary schools. This chapter has given an overview of the methodology and research design as well as the ontology, epistemology and research paradigm underpinning them. The efforts undertaken to pursue high standards of validity and reliability have been detailed, demonstrating that the researcher strives to reach meaningful conclusions. The research questions have been presented which, in the critical realist approach, strive to explain the generative structures at play in observed phenomena. The following chapter presents initial findings in descriptive statistics before answering these three research questions in detail using the mixed methods data gathered during the study.

Chapter Four: Results

4.1 Introduction

This chapter presents the findings from data collected during January – February 2020 investigating the driving factors affecting children's WASH behaviours, and therefore progress towards SDG 6, in four East Delhi primary schools. This research adds a core contribution to the knowledge surrounding this topic and addresses a gap in the literature by combining quantitative and qualitative methods to identify these driving factors. The school environment and socio-economic status emerged as possible key factors affecting children's WASH behaviours during the literature review. For this reason, the research questions (listed in section 3.1.1) are focused on the school and household domains (Figure 12). They investigate the effect of school WASH provision on children's WASH behaviours, barriers and enablers to school management's provision of school WASH facilities and the effect of socio-economic status on children's WASH behaviours. These findings add useful insights to the existing literature relating to children's experiences of WASH behaviours through the analysis of data collected in these two environments.

Figure 12 Research question focus areas
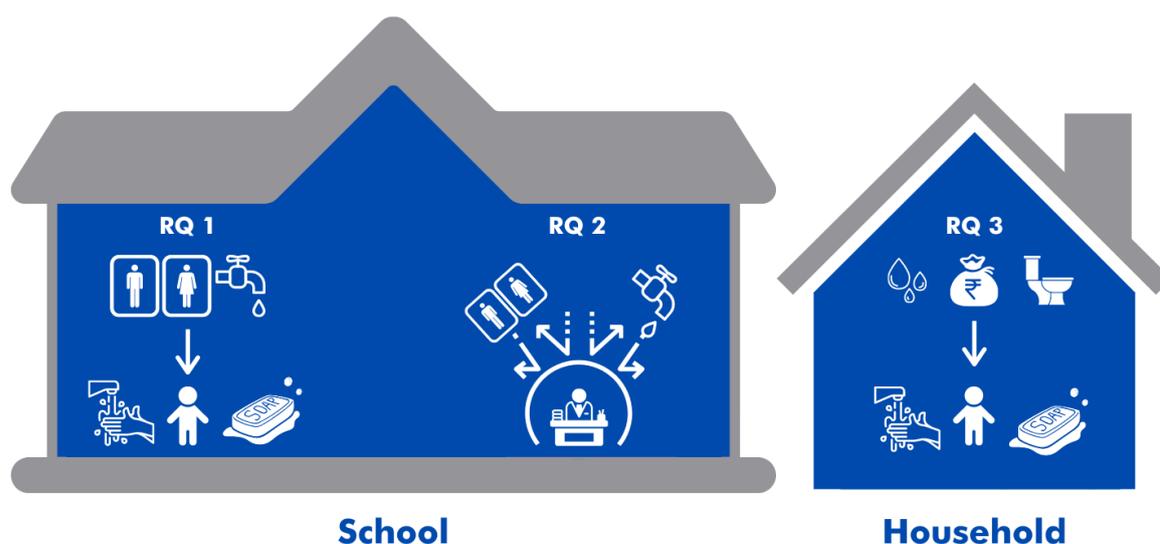
The first research question (section 4.2) considers WASH provision across school types as a potential driving factor affecting children's capability, opportunity and motivation to

practise positive WASH behaviours (e.g. HWWS before meals and after using the toilet, tooth brushing). Two of the participating schools are government-led (GISA-B) and participated in an intervention with the NGO CURE in 2018. The others are a government non-intervention school (GNIS) and a non-intervention low-fee private school (LFPS). This first research question aims to identify to what extent success or failure in the delivery of 'safe, non-violent, inclusive and effective learning environments' as per SDG 4 (UNGA, 2015, p19) affects children's WASH behaviours. It applies data from the school-based questionnaire (Appendix 1), as well as field observations, focus group discussions with children, semi-structured interviews with school staff and photography of the school compounds. It seeks to address the partial narrative about school WASH in reports such as the Economic Survey of Delhi 2019-2020 (Government of NCT of Delhi, 2020), challenging the assumption that just because 100% of schools have toilets and drinking water facilities, that means that children adopt positive WASH behaviours long-term.

In light of the first research question, the second (section 4.3) investigates the factors impeding school management's provision of adequate school WASH facilities and considers schools-based WASH interventions, such as CURE's programme, as an enabling factor in strengthening school WASH provision. Qualitative data from semi-structured interviews with school staff and parents, and photographs of school infrastructure formulate the response to this research question.

The third and final research question (section 4.4) shifts from the school environment to that of the household, considering socio-economic status as a potential driving factor affecting children's capability, opportunity and motivation to practise WASH behaviours. It highlights the wider context of household WASH access, focusing particularly on parental perspectives and investigating whether the benefits of schools-based WASH interventions extend into the surrounding communities in which the children live. Data elicited through household interviews, field observations and the school-based questionnaire inform the response to this question.

4.1.1 *Descriptive statistics for school contexts*

Before turning to each of the three research questions, this section will present some brief descriptive statistics outlining the characteristics of the four participating schools. Data were gathered in four schools in East Delhi, three of which are managed by the EDMC. The EDMC is governed by the Bharatiya Janata Party (BJP) which is India's national ruling party led by Prime Minister Narendra Modi (see section 3.7.3 for a fuller explanation of school management types). The fourth, the LFPS, is a private school recognised by the government, managed by a community member, charging fees of approximately 2,000 Rs (20 GBP) per month.

Figure 13 Percentage of students attending the four participating schools
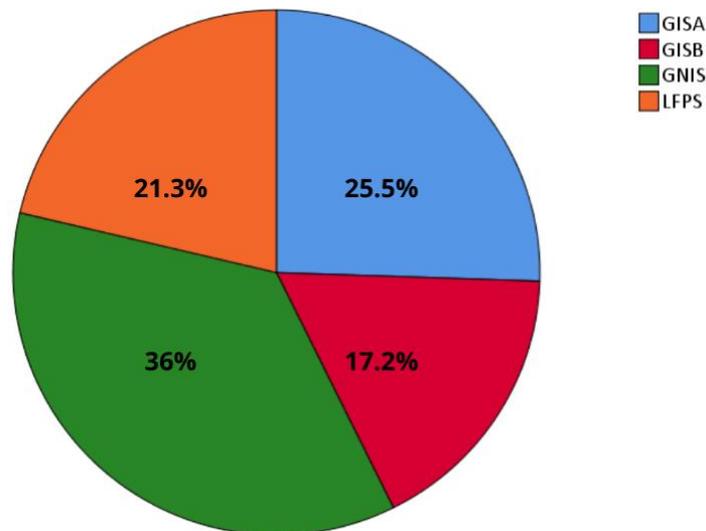
Figure 13 shows what percentage of children attended each school. From the 239 children participating in the research, 59% were girls. This is because the three government schools are separated into morning and afternoon shifts by gender with girls attending in the morning and boys attending in the afternoon (the private school has mixed gender classes). The separate shifts also have separate principals; the principal of the boys' shift at GISB did not give permission for the research to go ahead so the participants from GISB are exclusively female. Due to the varying numbers of students in fifth class and permission for the extent of the research differing across the schools, the number of participating students from each school is different. Although all

students were recruited from fifth class, the final grade of primary school, there was some variety in age ranging from 8 to 15, with a median age of 10 years (Table 6).

Table 6 Age of participating students across schools

	Age	Frequency	Percent	Cumulative Percent
Valid	8	2	0.8	0.8
	9	21	8.8	9.6
	10	117	49.0	58.6
	11	64	26.8	85.4
	12+	35	14.6	100.0
	Total	239	100.0	

The following section responds to the first research question which explores WASH provision in contrasting school types as a potential driving factor affecting children's capability, opportunity and motivation to practise positive WASH behaviours. This lays the basis for the investigation of factors impeding and enabling school management's provision of adequate school WASH facilities in the second research question.

4.2 Research Question 1: How does school WASH provision in differing school types affect children's WASH behaviours?

This research investigates the driving factors affecting children's capability, opportunity and motivation to adopt positive WASH behaviours, and thus progress towards SDG 6, in East New Delhi primary schools. The first research question (Figure 14) considers the WASH provision in differing school types as a potential driving factor. The first section (4.2.1) analyses quantitative and qualitative data to ascertain whether or not there are differences in children's WASH behaviours between school types. The second section (4.2.2) investigates differences in WASH provision between school types, both in terms of WASH facilities and the extent to which students are taught about different WASH-related health topics. The final section (4.2.3) brings the findings of the first two together to investigate whether differences in WASH provision between school types are responsible for differences in children's WASH behaviours and if they are, how this occurs.

Figure 14 Research Question 1 structure
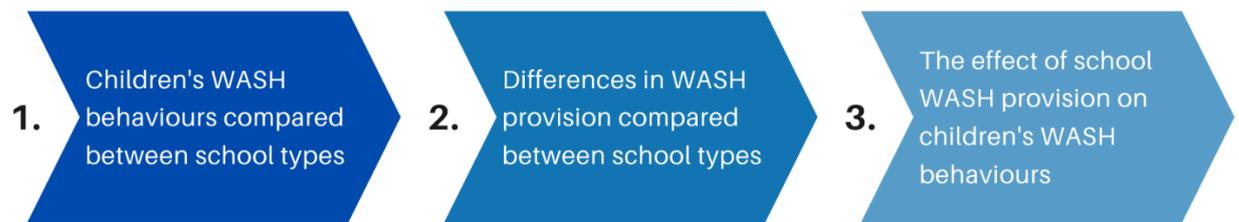
4.2.1 *Children's WASH behaviours compared between school types*

It is important to clarify whether or not there are differences in children's WASH behaviours between school types. This section applies the *Hygiene Practices* (Q39-42) section of the school-based questionnaire (Appendix 1). Regarding the four items listed in Table 7, a score of 0 indicated that the child never practised that behaviour while a score of 3 indicated that they always did so. The scores for the four items were totalled to give a theme for analysis with a maximum score of 12.

Table 7 Differences in children's *Hygiene Practices* between groups

Scheffe				*p*-values of differences		
	GISA/B	GNIS	LFPS	GISA/B-GNIS	GISA–B – LFPS	GN–S – LFPS
Items	Mean (SD)	Mean (SD)	Mean (SD)			
Handwashing before eating at school	2.5 (0.73)	2.72 (0.45)	3 (0)	-0.22***	-0.5***	-0.28***
Handwashing after using the toilet	2.73 (0.62)	2.98 (0.15)	3 (0)	-0.25***	-0.27***	-0.02
Using soap when washing hands	1.95 (1.08)	1.79 (1.05)	2.96 (0.2)	0.16	-1.01***	-1.17***
Brushing teeth	2.03 (0.65)	1.92 (0.58)	2.12 (0.48)	0.11	-0.09	-0.2*
N	102	86	51			

p***<0.001, p**<0.01, p*<0.05

Figure 15 shows the distribution of children's *Hygiene Practices* scores across school types. Students across the four schools generally report adherence to these positive WASH behaviours but adoption is more consistent at the LFPS than the government schools. The one-way ANOVA illustrates statistically significant differences between school management types (government and private) ($P[F(2, 235) = 20.514] < 0.0005$).

Figure 15 Frequency distribution of children's total *Hygiene Practices* scores across school types
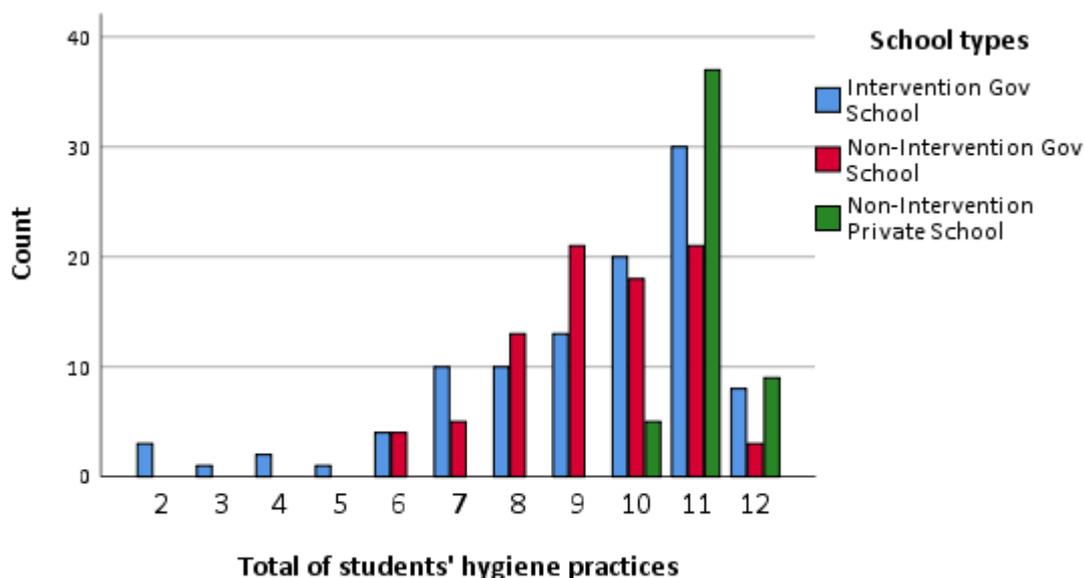
Tables 8-9 show the differences in children's WASH behaviours between school types. Table 8 presents results from the Scheffe post-hoc test showing that the statistically significant differences are between the LFPS and GISA-B ($p < 0.05$, 1.87, 95% CI, 1.12 to 2.62) and between the LFPS and GNIS ($p < 0.05$, 1.68, 95% CI, 0.9 to 2.45). The mean totalled scores in Table 9 reveal that what students claim about their WASH behaviours barely differs between GISA-B (9.21) and the GNIS (9.4). However, LFPS students report considerably more frequent WASH behaviours (11.08) than their government school peers.

Table 8 *Hygiene Practices*: Multiple comparisons for one-way ANOVA post hoc test

Scheffe

(I) School Types	(J) School Types	Mean Difference (I-J)	95% Confidence Interval	
			Lower Bound	Upper Bound
GISA/B	GNIS	-0.19	-0.84	0.45
	LFPS	-1.87*	-2.62	-1.12
GNIS	GISA/B	0.19	-0.45	0.84
	LFPS	-1.68*	-2.45	-0.9
LFPS	GISA/B	1.87*	1.12	2.62
	GNIS	1.68*	0.9	2.45

*. The mean difference is significant at the 0.05 level.

Table 9 *Hygiene Practices*: **Homogeneous subsets**

Scheffe [a, b]

School Types		Subset for alpha = 0.05	
	N	**1**	**2**
GISA/B	102	9.21	
GNIS	85	9.4	
LFPS	51		11.08
Sig.		0.8	1.000

Means for groups in homogenous subsets are displayed.
   a. Uses Harmonic Mean Sample Size = 72.857
   b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type 1 error levels are not guaranteed.

Qualitative data from observations and focus group discussions complement these quantitative findings. Children's clear motivation for pursuing positive WASH behaviours, particularly in terms of drinking clean water and maintaining the school compound, was a theme that arose across the schools:

> My observation is that nowadays, our children in our school, they are getting more and more aware about these things and they are paying much more attention than previously on water, sanitation and cleanliness…It has increased and children have become more aware of how to use water and other resources, to conserve them. In our school especially they are very much aware. When they go out, they switch off the lights. When they are in the washroom, they generally turn off the taps. They are improving.

(LFPS female teacher, 4th February 2020)

In addition to this example from a teacher at the LFPS regarding students' prioritisation of positive WASH behaviours, at GISB, students understood the importance of drinking water regularly. The facilities were functioning and students were observed at breaktime refilling their reusable water bottles while others cupped their hands and drank straight from the tap, albeit without washing their hands beforehand. This is an example of the complementary impact of components of the COM-B model (see section 1.8.3) combining to produce positive WASH behaviours. Children were motivated to practise the behaviour of drinking clean water and their opportunity to do so was provided by the functioning facilities and their water bottles. However, the capability (skills and knowledge) element was absent as they did not wash their hands before cupping water, risking the possibility of damaging health outcomes. Here, the findings show that every

element of the COM-B model must be in place to ensure positive, safe, hygienic behaviours.

Similarly, at GISA, one student displayed good understanding of the importance of drinking potable water:

> Drinking clean water is important too because if you drink dirty water, there will be germs in your body.

(GISA male student, 23rd January 2020)

Another GISA student demonstrated understanding of the need for water conservation:

> When we grow up, the amount of water will be reduced and there will be no water even to drink.

(GISA male student, 22nd January 2020)

However, the drinking water facilities were not operational at GISA or the GNIS so children did not have the same opportunity to practise this WASH behaviour as at GISB. At the LFPS, whole classes visited the facilities under the supervision of their teachers, resulting in a designated opportunity for filling their water bottles and washing their hands before lunch. In this case, the school schedule acted as a driving factor enabling children's WASH behaviours. Teachers acted as role models to support children in building motivation to practise WASH behaviours and this daily practise embedded the capability and opportunity to do so.

Maintenance and improvement of the school compound is another common WASH behaviour which emerged during qualitative analysis. During data collection, there were two instances at GISA-B when children were observed in small groups in the undergrowth, independently planting twigs in the ground and even fetching small amounts of water to nurture them (see section 1.1). This displayed an unprompted motivation to engage with nature and take responsibility for the environment, as well as an understanding of what plants need to grow. During the intervention, a system was put in place for improving the greenery of the school compound whereby staff and students participated in tree planting activities. However, there was no evidence of structured activities post-intervention around tree planting, supported by staff. This

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provision of capability and opportunity would build upon this example of the children's motivation and would nurture these small leanings towards positive environmental behaviours.

Similarly, at GISB, children seemed to relish the task of emptying classroom bins into the large bins at the school entrance; three students enthusiastically completed this task together when the classroom bin could easily have been carried by one. At the time when these large central bins were installed by CURE, staff and students received training on waste segregation (e.g. dry and wet waste, recyclable materials etc). In fact, when asked what she thought was the most significant impact from CURE's work, a GISB teacher referred to the green waste disposal mechanisms in place:

> Mainly to know what is dry and wet waste. CURE people distributed dustbins specifically for dry waste and liquid waste to every class. They made a compost pit on school premises. Children visit the compost area with the teachers. They know what compost is, they know about it.

(Female teacher at GISB, 16th January 2020)

However, during observation, this training was not followed and all waste was mixed together in the central bins. At GISA, the compost area contained paper and plastic waste (Figure 16).

Figure 16 Compost area at GISA

(22nd January, 12.40)

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This observation was corroborated by children's criticisms of their classmates' WASH behaviours:

> I want the school more clean. Students do not use the dustbin properly. They litter nearby which makes the place dirty.

> (GISA female student, 2nd February 2020, focus group transcript included in Appendix 11)

> I want cleaner toilets. Some children go to the toilet but they do not flush properly which is a problem. Some children do not close the tap which makes the water tank empty and we won't have enough water.

> (GISA female student, 2nd February 2020, focus group transcript included in Appendix 11)

Despite the children's evident motivation to adopt these positive WASH behaviours, their capability was not sufficiently embedded to result in sustained, consistent adherence. Waste segregation would perhaps have been easier to sustain if a similar approach of collective group behaviour to that at the LFPS, led by teachers, had been followed.

The qualitative data presented here around the WASH behaviours of drinking water and maintaining the hygiene of the school compound suggest that children at GISA-B are motivated to pursue positive WASH behaviours but do not necessarily receive the staff input to develop the capability and opportunity to do so. Meanwhile, there was some evidence of students receiving support in their WASH behaviours at the LFPS through staff supervision. The data indicate differences in children's WASH behaviours between school types with students attending the LFPS reporting more frequent WASH behaviours. This implies that socio-economic status is a driving factor in securing WASH behaviour adoption because while these LFP schools are affordable, the literature suggests that they are often not accessible to the poorest families (Day Ashley et al., 2014; Ezaki, 2020, see section 2.3.5). Socio-economic status is investigated in greater detail as the focus of the third research question (section 4.4).

4.2.2 *WASH provision compared between school types*

Figure 17 Research Question 1 structure
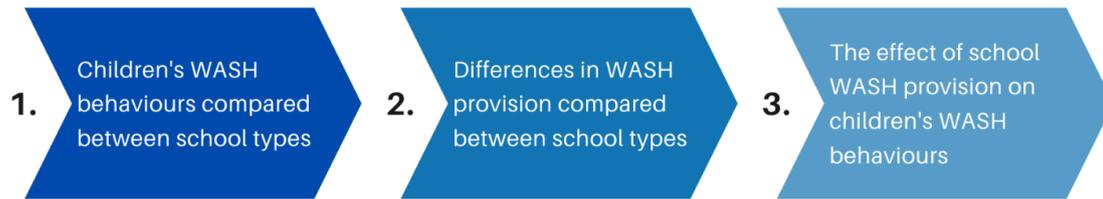
RQ 1: How does school WASH provision in differing school types affect children's WASH behaviours?

The above qualitative analysis demonstrates that a supportive school environment is instrumental in ensuring children have the capability and opportunity, alongside their motivation, to practise positive WASH behaviours. Therefore, the school environment is central to the aim of this research. It is where the participating children spend much of their time, influenced by their peers, teachers and input from CURE and the curriculum. As Figure 17 shows, the first section of this response to the first research question investigated the differences in WASH behaviours between the four participating schools. This second section considers potential differences in WASH provision between school types, in the same manner as the analysis of WASH behaviours in section 4.2.1.

In the school-based questionnaire (Appendix 1), school WASH provision is categorised into the two domains of *School Facilities* (opportunity – external factors facilitating behaviour) and the extent to which children are taught *Health Knowledge* (capability – skills and knowledge, and motivation – emotional responses and decision making). For the theme of *School Facilities* (Q20-29), a score of 2 indicated that according to the student, the facilities included in that question (e.g. *Q27 Is there soap to wash your hands?*) were available or sufficient at their school. A score of 1 indicated that the student was unsure and 0 indicated that these facilities were not provided. Listed in Table 10, the maximum score available across the 10 items is 20. With a maximum score of 2 each, the variables with the largest statistically significant differences between school types are 'Water in or next to the toilets' and 'Soap available to wash hands'. The GNIS mean score for 'Water in or next to the toilets' is 0.87 ($p < 0.001$) lower than the mean score for the LFPS and 0.82 ($p < 0.001$) lower than that for GISA-B. For 'Soap available to wash hands', the GNIS and GISA-B mean scores are both lower than the LFPS

mean score. The GNIS mean score is 1.66 ($p < 0.001$) lower and the GISA-B mean score is 1.38 ($p < 0.001$) lower.

Table 10 One-way ANOVA: WASH facilities compared between school types

Scheffe				p-values of differences		
	GISA/B	GNIS	LFPS	GISA–B – GNIS	GISA–B – LFPS	GN–S – LFPS
Items	Mean (SD)	Mean (SD)	Mean (SD)			
Drinking water available at the school	2 (0)	1.64 (0.77)	2 (0)	0.36***	0	-0.36***
Toilets available at the school	2 (0)	1.96 (0.24)	2 (0)	0.04**	0	-0.04*
Gender separate toilets in the school	1.64 (0.74)	1.95 (0.26)	2 (0)	-0.31***	-0.36***	-0.05*
Water in or next to the toilets	1.95 (0.29)	1.13 (0.99)	2 (0)	0.82***	-0.05*	-0.87***
Place to wash hands after toilet	2 (0)	1.87 (0.48)	2 (0)	0.13***	0	-0.13***
Place to wash hands pre-eating	1.99 (0.1)	1.98 (0.22)	2 (0)	0.01	-0.01	-0.02
Enough water to wash hands	1.97 (0.22)	1.84 (0.55)	2 (0)	0.13***	-0.03	-0.16***
Soap available to wash hands	0.62 (0.9)	0.34 (0.75)	2 (0)	0.28***	-1.38***	-1.66***
After-school club for nutrition, WASH	0.89 (0.81)	0.59 (0.74)	0.8 (0.8)	0.3	0.09	-0.21
Students taught about health	1.82 (0.5)	1.83 (0.44)	1.82 (0.56)	-0.01	0	0.01
N	99	86	50			

p***<0.001, p**<0.01, p*<0.05

Figure 18 shows the distribution of students' responses to the *School Facilities* questions across school types. There is more variety in students' responses in government schools, compared to the LFPS, and students at GISA-B considered their schools' WASH facilities to be more comprehensive than their GNIS counterparts.

Figure 18 Frequency distribution of total *School Facilities* scores across school types
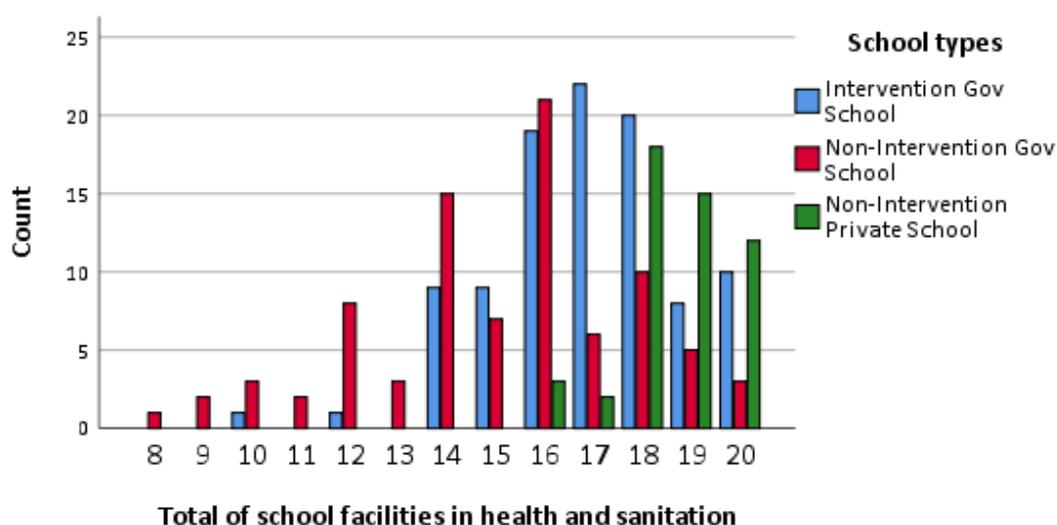
With a maximum score of 20, Table 11 presents statistically significant differences in the mean total scores for the *School Facilities* factor ($P[F(2, 232) = 45.202] < 0.0005$). The largest mean difference of 3.49 is between the LFPS and GNIS ($p < 0.05$, 95% CI, 2.57 to 4.41). There is a statistically significant difference of 1.77 between GISA-B and the GNIS ($p < 0.05$, 95% CI, 1.01 to 2.53) and of 1.72 between the LFPS and GISA-B ($p < 0.05$, 95% CI, 0.82 to 2.62). LFPS students perceive their school WASH facilities to be the most comprehensive but GISA-B compare favourably regarding WASH facilities with the GNIS.

Table 11 *School Facilities* differences: Multiple comparisons for one-way ANOVA post hoc test

Scheffe

(I) School Types	(J) School Types	Mean Difference (I-J)	95% Confidence Interval	
			Lower Bound	Upper Bound
GISA/B	GNIS	1.77*	1.01	2.53
	LFPS	-1.72*	-2.62	-0.82
GNIS	GISA/B	-1.77*	-2.53	-1.01
	LFPS	-3.49*	-4.41	-2.57
LFPS	GISA/B	1.72*	0.82	2.62
	GNIS	3.49*	2.57	4.41

*. The mean difference is significant at the 0.05 level.

The mean total scores for *School Facilities* demonstrate that overall, students at GISA-B (16.9) perceived the facilities at their schools to provide more opportunity to practise WASH behaviours than students at the GNIS did (15.1). However, LFPS students saw their school WASH facilities as the most comprehensive (18.6) (Table 12).

Table 12 *School Facilities* differences: Homogenous subsets

Scheffe [a, b]

School Types		Subset for alpha = 0.05		
	N	1	2	3
GNIS	86	15.13		
GISA/B	99		16.9	
LFPS	50			18.62
Sig.		1.000	1.000	1.000

Means for groups in homogenous subsets are displayed.

    a. Uses Harmonic Mean Sample Size = 71.893
    b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type 1 error levels are not guaranteed.

The other factor relating to school WASH provision, children's *Health Knowledge* (Q30-38), comprises students' responses to questions, listed in Table 13, about whether they have received teaching in school on healthy living habits such as healthy eating and handwashing, as well as conditions such as diarrhoea, anaemia and iodine deficiency. This pertains to schools' efforts to build children's capability and motivation to practise positive WASH behaviours through increased understanding of the dangers associated with damaging WASH-related health outcomes. A score of 2 indicates that according to students, they have received input on the topic in question, while a score of 1 indicates that they are unsure and 0 indicates that they have not. The maximum total score available for these items is 18. The statistically significant results are smaller and fewer in number than for the *School Facilities* factor. The largest are for 'How to avoid worm infections' and 'Iodine deficiency'. Differences of 0.52 ($p < 0.001$) between GISA-B and the LFPS, and of 0.34 ($p < 0.001$) between GISA-B and the GNIS, show that intervention school students reported learning about avoiding worm infections more than LFPS and GNIS students. LFPS students reported learning about iodine deficiency more than GNIS students (0.32, $p < 0.001$).

Table 13 One-way ANOVA: Children's *Health Knowledge* compared between school types

| | Int | Non-Int | Priv | *p*-values of differences | | |
				I–t – Non-Int	I–t – Priv	Non-Int - Priv
Items	Mean (SD)	Mean (SD)	Mean (SD)			
Benefits of healthy eating	1.79 (0.51)	1.81 (0.56)	1.96 (0.28)	-0.02	-0.17***	-0.15***
Importance of handwashing	1.93 (0.35)	1.99 (0.11)	2 (0)	-0.06**	-0.07**	-0.01
Importance of teeth cleaning	1.93 (0.35)	1.93 (0.37)	1.96 (0.28)	0	-0.03	-0.03
How to avoid worm infections	1.76 (0.51)	1.42 (0.85)	1.24 (0.89)	0.34***	0.52***	0.18
Where to get treatment for worm infection	1.03 (0.75)	1.12 (0.86)	1.2 (0.8)	-0.09**	-0.17	-0.08
Any other infectious diseases	1.08 (0.88)	1.04 (0.89)	1.41 (0.8)	0.04	-0.33	-0.37
Anaemia	1.26 (0.84)	0.81 (0.89)	0.6 (0.87)	0.45	0.66	0.21
Iodine deficiency	0.48 (0.58)	0.28 (0.55)	0.6 (0.75)	0.2**	-0.12**	-0.32***
Night blindness and vitamin A	0.99 (0.84)	0.7 (0.88)	0.9 (0.94)	0.29	0.09*	-0.2
N	102	86	51			

Figure 19 shows the distribution of students' responses to the *Health Knowledge* questions across school types, indicating little difference between GISA-B, GNIS and the LFPS. The one-way ANOVA indicates no statistically significant difference across school types for the children's *Health Knowledge* factor ($P[F(2, 229) = 3.026] < 0.05$).

Figure 19 Frequency distribution of totalled children's *Health Knowledge* scores

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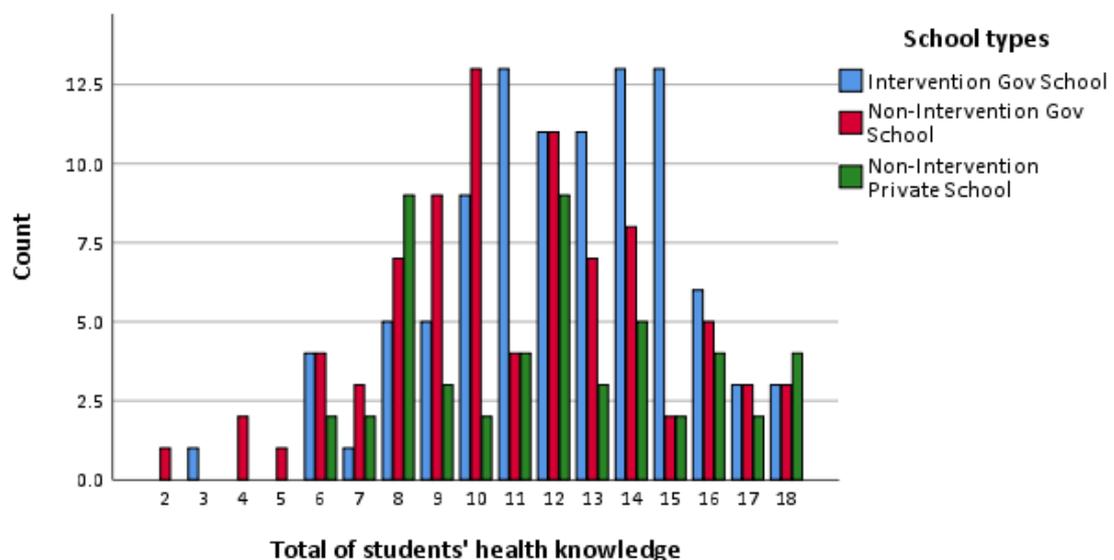
Table 14 *Health Knowledge*: Multiple comparisons for one-way ANOVA post hoc test

Scheffe

(I) School Types	(J) School Types	Mean Difference (I-J)	95% Confidence Interval	
			Lower Bound	Upper Bound
Interv Gov	Non-Interv Gov	1.2	-0.01	2.41
	Private	0.41	-0.98	1.81
Non-Interv Gov	Interv Gov	-1.2	-2.41	0.01
	Private	-0.79	-2.23	0.66
Private	Interv Gov	-0.41	-1.81	0.98
	Non-Interv Gov	0.79	-0.66	2.23

*. The mean difference is significant at the 0.05 level.

Table 14 shows that the largest mean difference of 1.2 was between GISA-B and the GNIS (p = 0.052, 95% CI, -0.01 to 2.41). There are only minor differences between school types with GISA-B students reporting that they were taught about the respective topics the most (12.3), compared to LFPS students (11.9) and GNIS students (11.1) (Table 15).

Table 15 *Health Knowledge*: Homogeneous subsets

Scheffe [a, b]

School Types		Subset for alpha = 0.05
	N	1
Non-Interv Gov	83	11.1
Private	51	11.89
Interv Gov	98	12.3
Sig.		0.094

Means for groups in homogenous subsets are displayed.
   a. Uses Harmonic Mean Sample Size = 71.667
   b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type 1 error levels are not guaranteed.

CURE's participatory BCC activities (Appendix 2) aimed to increase students' capability to practise WASH behaviours through building their knowledge and understanding of the health issues listed in Table 13. Therefore, the fact that the GISA-B scores are higher than the GNIS score in this category suggests that these activities could have been successful to a degree, although the finding is not statistically significant. During interviews, the BCC activities were described by teachers and the member of CURE staff responsible for implementing them. In one activity, the member of CURE staff demonstrated the importance of handwashing by painting one child's hand. This child then shook hands with another student, who did the same with another student and so on. Eventually, every child had some paint on their hand thus visualising how germs can

spread easily. Another activity, the name of which translates as 'Passing the Ball', served to reinforce the children's learning. Children passed a ball while music played; when the music was paused, the child holding the ball was invited to share one positive hygiene habit and one negative hygiene habit. This then stimulated a discussion between children about healthy WASH behaviours. These qualitative findings suggest that CURE's BCC activities fulfilled a need through health education that was not met by the school curriculum and thus was not yet met at the GNIS.

According to the COM-B model (Michie et al., 2011), these efforts to build children's capability and motivation, alongside improvements to school facilities to develop their opportunity, in theory represent two factors which produce sustained adoption of positive WASH behaviours. To explore this further, the following section concludes the response to the first research question by investigating the effect of school WASH provision on children's WASH behaviours.

4.2.3 *The effect of school WASH provision on children's WASH behaviours*

Figure 20 Research Question 1 structure
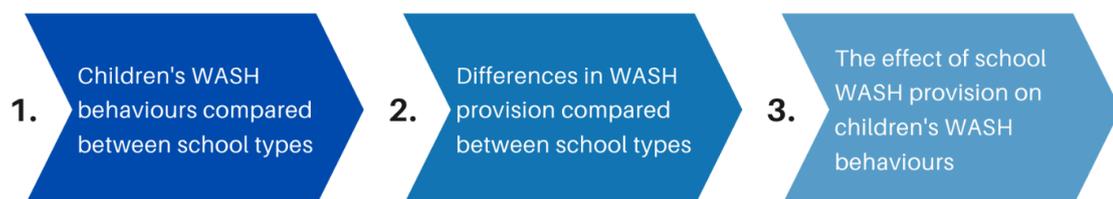
RQ 1: How does school WASH provision in differing school types affect children's WASH behaviours?

Figure 20 presents the structure of this first research question. In this final section, associations between *School Facilities*, *Health Knowledge* and *Hygiene Practices* are used to clarify the extent to which differences in WASH provision between school types are reflected in children's WASH behaviours. Secondly, a structural equation model provides a visual representation of the relationships between these three factors, also incorporating the WASH-related *Health Outcomes* (toothache, diarrhoea, dysentery and

worm infection) factor from the school-based questionnaire.[1] Thirdly, qualitative analysis outlines how school WASH provision affects children's WASH behaviours.

There are statistically significant, positive relationships of varying strengths between the two school WASH provision factors and children's WASH behaviours (Table 16). The strongest is the moderate, positive correlation (Cohen, 1988) between students' *Hygiene Practices* and *School Facilities* ($r_s = 0.472, p < 0.0005$). The other correlation that would be classified as moderate (ibid.) is that between students' *Health Knowledge* and *School Facilities* ($r_s = 0.313, p < 0.0005$). The correlation between students' *Health Knowledge* and *Hygiene Practices* would be considered weak. These correlations denote a key function for school WASH facilities in ensuring children have the opportunity to adopt positive WASH behaviours.

Table 16 Spearman's rho for *School Facilities*, *Health Knowledge* and *Hygiene Practices* factors

		Correlations		
		School facilities	Children's health knowledge	Children's hygiene practices
Spearman's rho	School facilities			
	Children's health knowledge	0.313**		
	Children's hygiene practices	0.472**	0.203**	

**. Correlation is significant at the 0.01 level (2-tailed).

Looking more deeply into the links between these three themes, a structural equation model (SEM) offers a causal model of how these factors relate to each other and assists in ascertaining whether differences in WASH provision between school types are reflected in children's WASH behaviours and their associated health outcomes. More explanation of SEM is given in Appendix 13. The SEM diagram illustrates that although there are other factors at play as denoted by the error terms (ε), there exists relationships between the four themes (Figure 21).[2] There is significant likelihood that

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[1] Analysis of the *Health Outcomes* factor is presented in Appendix 14.
[2] The fit indices of Root Mean Square Error of Approximation (RMSEA, 0.000), Standardised Root Mean Square Residual (SRMR, 0.000), Coefficient of Determination (CD, 0.167), Tucker-Lewis Index (TLI, 1.000) and Comparative Fit Index (CFI, 1.000) indicate that the model is a relatively good fit. The χ^2/df ratio is less

Hygiene Practices will improve (β = 0.34, *p* < 0.01) given an improvement in *School Facilities*. The same is true of *Health Knowledge* (the extent to which children are taught at school about different health issues) (β = 0.29, *p* < 0.01).

Figure 21 Structural equation model for the effect of school WASH provision on *Hygiene Practices* and associated *Health Outcomes*
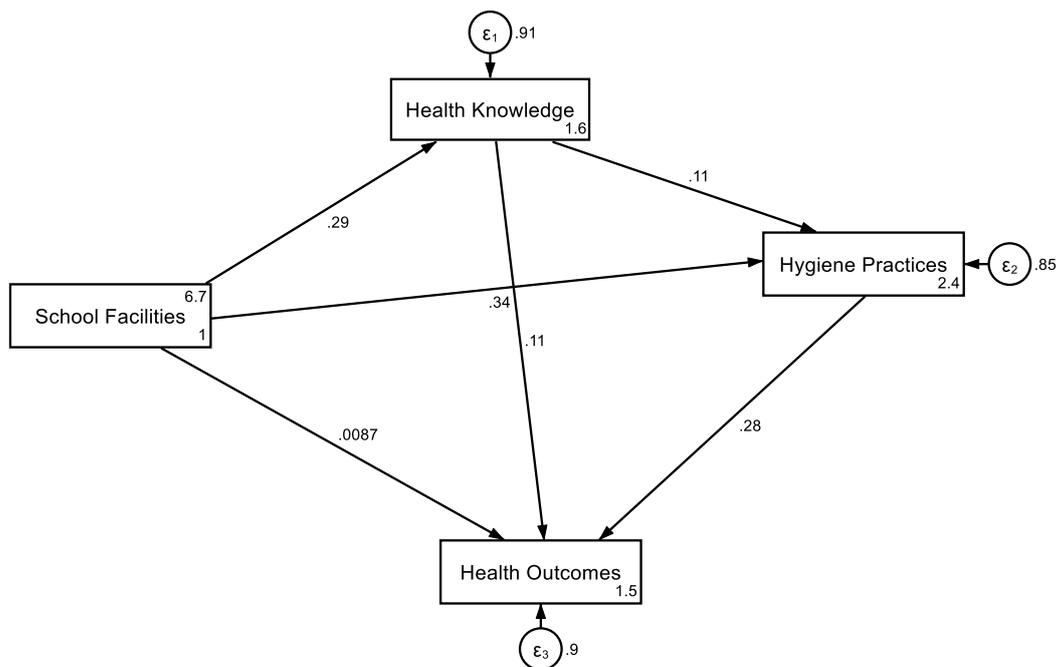
The model illustrates that as children adopt positive *Hygiene Practices*, their WASH-related *Health Outcomes* (toothache, diarrhoea, dysentery and worm infection) are more likely to improve (β = 0.28, *p* < 0.01) The effect of students' *Health Knowledge* on *Hygiene Practices* is negligible and not statistically significant. These directional relationships show that the availability of WASH facilities in these schools affects the extent to which children practise positive WASH behaviours which in turn exert a positive effect on *Health Outcomes*. The effect of *School Facilities* on children's *Hygiene Practices* is the strongest link in the structural equation model. The COM-B model defines opportunity as 'the factors that lie outside the individual that make the behaviour possible or prompt it' (Michie et al., 2011, p4).

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than 3, which also indicates that the model is a good fit for the data (Hoyle, 2015). This means that there is not considerable distance between the observation data and the model's prediction (Curran, 2017b).

Having established a link between school WASH provision and children's WASH behaviours, the following analysis presents qualitative data which shed light on how this occurs and how school WASH provision, rather than acting as a driving factor supporting children in developing healthy WASH behaviours, can act instead as an impeding factor. Themes emerging from the qualitative analysis explored here comprise the shortfall in WASH facilities provision, obstacles in existing provision particularly affecting girls and a lack of support and accountability for school cleaning staff.

At the GNIS, the researcher observed a shortfall in WASH facilities provision which was mostly not encountered at GISA-B and which impedes children's pursuit of positive WASH behaviours. Two GNIS teachers explained this shortfall at length in an interview. They declined to be recorded so their comments are presented as summaries rather than verbatim.

- The teachers try not to use the toilets because there are roughly 1,300 children in the morning and afternoon shifts, only one member of cleaning staff and ten toilet seats in the school. These toilet blocks are not equipped with adequate drainage systems so the floors are dirty and slippery (Figure 22). There are no separate toilets for staff.

Figure 22 The boys' toilets at the GNIS

(10ᵗʰ February 2020, 13.20)

- One major problem for children at the school is the faulty RO water purification system (see section 2.4.1). It was received from the government education department five years ago but is not working properly. Drinking water is a

problem at this school; the teachers tell students to bring water from their homes.

- The teachers recommended that they should have a handwashing facility on every storey of the school because currently, there is only one handwashing block in the whole school and it is in the main compound outside the building. The tap of the sink in the above photo (Figure 22) was not functioning during the researcher's visit and no soap was present. According to the two teachers interviewed, inspectors who come to the school want teachers to make sure that students are inside the classrooms at all times so the teachers feel pressurised to ensure that children are not unsupervised outside the classroom. In comparison, the LFPS had a corridor pass system where children would receive a card to show members of staff while leaving the classroom during lesson time. The two GNIS teachers recounted that children were accustomed to washing their hands outside the classroom window by pouring drinking water from their bottles over their hands. Not only is this ineffective without soap but they were also wasting their drinking water for the day that the teachers had asked them to bring from home because the RO purification system was dysfunctional.

These testimonies from staff at the GNIS show how inadequate school WASH facilities serve to withhold from children the opportunity to practise positive WASH behaviours, even if they have the capability and motivation to do so. Another theme regarding school WASH facilities acting as a barrier to children's pursuit of healthy WASH behaviours is the way in which girls especially lack support in accessing them. During a preliminary visit to New Delhi in August 2019, the researcher spoke to a member of staff from CURE who had previously worked on establishing the schools-based WASH project. CURE gathered viewpoints from stakeholders throughout the project and one of these was a young girl who attended a primary school in which the intervention was taking place. She complained that the window of the pre-existing toilet block was opposite the toilet itself, meaning that people across the street in first-storey flats could easily look into the toilet block. This lack of privacy was, understandably, impacting on the girl's enthusiasm for attending school. As a result, when CURE renovated the toilet blocks, they ensured that the windows did not offer a line of sight on any facilities that children

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would be using. These sorts of preventable issues mean that young girls face an enormous struggle to reach their potential as a result of inadequate WASH provision.

The researcher observed examples of this at the GNIS. There were privacy issues relating to the toilets that could prevent children, especially girls, from practising healthy behaviours. Figure 23 shows a ladder leaning against the window of the girls' toilets which remained in place each day the researcher was in attendance. It was unclear whether this was for legitimate maintenance purposes or not.

Figure 23 Exterior of toilet blocks at the GNIS

(10th February 2020, 13.20)

In addition, there were six similar windows to the rear of the toilet blocks, one per toilet cubicle, which opened onto public ground, meaning anyone could see the interior (Figure 24).

Figure 24 Interior of toilet blocks at the GNIS

(10th February 2020, 13.20)

Young girls especially are perhaps not going to feel comfortable using this facility with this ladder acting as a potential tool for voyeurs and rendering the toilet block an unsafe space. The researcher did not witness any usage of the girls' toilet block during visits to this school, while male students were observed using the toilets to the left. School WASH facilities similar to this, coupled with the need for safe MHM provision, are a compounding factor in the high rate of girls dropping out of school according to the literature (Alam et al., 2017; Sivakami et al., 2019). This is a way in which SDG 6 (Clean Water and Sanitation) is interlinked with SDG 5 (Gender Equality). This is an example of an impeding factor which particularly affects a section of the school population, denying female students the opportunity to adopt safe WASH behaviours. In comparison, following CURE's intervention, GISA-B had gender-separate, private toilets inaccessible to outsiders (Figure 25) which should be the absolute minimum guarantee for school WASH provision.

Figure 25 Toilet doors at GISB

(Left – 17th January 2020, 13.25; right – 4th August 2019, 11.40)

Returning briefly to the SEM diagram (Figure 21) to support these qualitative data, when comparing the two models with regards to gender (Figures 26-27), there is a greater likelihood that *School Facilities* are having a larger effect on girls' *Health Knowledge* (β = 0.4, p < 0.01) than that of boys (β = 0.12 p = 0.249), for whom it is not statistically significant. This suggests that girls' opinions of their school's WASH facilities impact upon their perception of how much their capability to adopt WASH behaviours has been addressed through their learning about health issues such as healthy eating and handwashing. Girls are also more likely to have improved *Hygiene Practices* (β = 0.37, p < 0.01) due to *School Facilities* than boys (β = 0.32, p < 0.01). This suggests that as girls' perception of school WASH facilities improves, so do their positive WASH-related behaviours, more so than boys.

Figure 26 Structural equation model for the effect of school WASH provision on children's Hygiene Practices and associated Health Outcomes (female students)
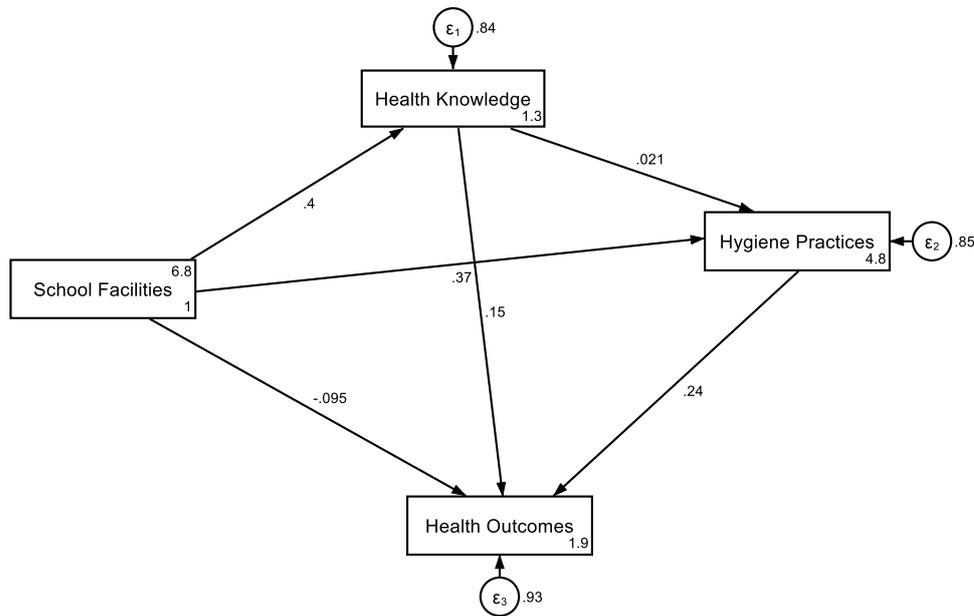
However, boys' WASH-related *Health Outcomes* are more likely to be affected by their *Hygiene Practices* ($\beta = 0.3$, *p* < 0.01) than those of their female peers ($\beta = 0.24$, *p* < 0.01). In terms of facilitating opportunity for sustained WASH behaviour adoption, these results reinforce the qualitative analysis, indicating that school WASH provision is a driving factor more so for girls than for boys.

Figure 27 Structural equation model for the effect of school WASH provision on children's *Hygiene Practices* and associated *Health Outcomes* (male students)
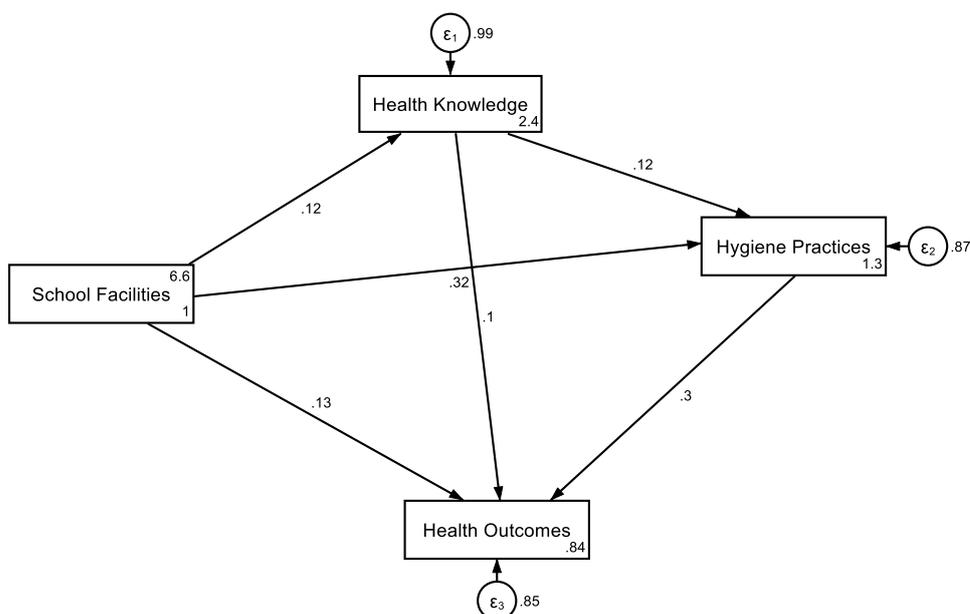
Another difference in WASH provision between school types which could present barriers to children's opportunity to adopt WASH behaviours is the extent to which different schools prioritise the maintenance of WASH facilities. The LFPS prioritises this with clean facilities (Figure 28).

Figure 28 LFPS toilet

(6th February 2020, 10.00)

These are checked against standards similar to the WHO and UNICEF Joint Monitoring Programme's core questions for schools (Appendix 1) every two hours by the senior member of cleaning staff (Figure 29). One teacher explained the process:

> The maid in charge does rounds of the school. She is responsible. Sometimes it happens that some area is not clean, she would enquire with the other cleaning staff why is it not clean.

> (LFPS female teacher, 4th February 2020)

Figure 29 Toilet block cleaning schedule at the LFPS

(5th February 2020, 12.25)

Staff responsible for maintaining school WASH facilities require support and accountability and the COM-B model (see section 1.8.3) is also useful here to analyse the barriers impeding the full maintenance of school WASH facilities. While there is a clear prioritisation of facility maintenance at the LFPS with a strong accountability system for cleaning staff supporting their motivation to fulfil the responsibilities of their role, their counterparts at GISA-B appear to be under-supported. The janitor from GISA is solely responsible for maintaining thirty rooms and four toilet blocks during the morning shift and this overload means that he does not have the capability to achieve the full task. When interviewed, he mentioned that this was partially addressed when he received protective equipment (gloves and a mask) from CURE but now that CURE's work at the school had concluded, he needed replacements and had not received them from the EDMC. Thus, even if one's capability to achieve their task is addressed in the short-term, this is not sufficient to ensure a durable solution.

Another issue he cited was that his colleague responsible for the afternoon shift was a contractor rather than being directly employed by the school and thus was lacking in motivation to complete the job to the required standard. The GISA janitor considered this to be an inconsistent arrangement as if the contract was terminated, he was left

alone. Similarly, the janitor at GISB is the only member of cleaning staff for the morning shift. The principal insisted on being present for the interview, so it is possible that this affected his comments, but he did recommend that he be joined by a second member of staff for the morning shift. To ensure the motivation of those responsible, accountability measures are required, particularly for contractors, to ensure that the maintenance of school WASH facilities is appropriately prioritised. To ensure capability and opportunity, a sufficient number of staff needs to be employed for the task to be possible and appropriate safety equipment must be supplied.

As with the statistically significant mean differences between school types for *School Facilities* presented earlier, a contrast between the WASH facilities at GISA-B, the GNIS and the LFPS emerges from these qualitative data, strengthening the case for the role of high-quality school WASH provision as a driving factor in building children's opportunity to pursue healthy WASH behaviours.

To conclude, there is a more meaningful role for school WASH facilities in building children's opportunity to practise positive WASH behaviours, in comparison to children's understanding of WASH-related health issues in building their capability and motivation (section 4.2.2). Students attending schools with higher-quality WASH facilities are more likely to practise positive WASH behaviours more often. A lack of adequate WASH facility provision impedes children's pursuit of positive WASH behaviours and can particularly affect female students. There was a model of support and accountability in place to aid the motivation of school staff responsible for WASH facilities maintenance at the LFPS which was not in place at the government schools (section 4.2.3). In essence, school WASH facilities are a driving factor affecting participating students' WASH behaviours, particularly in terms of supporting the opportunity domain of the COM-B model.

4.3 Research Question 2: What are the barriers and enablers to school management providing adequate school WASH facilities?

The previous research question considered how differences in WASH provision between the four schools affect children's capability, opportunity and motivation to practise WASH behaviours. The second research question (Figure 30) expands on this by

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investigating why there are differences in school WASH provision between the schools, exploring barriers and enablers to school management's provision of adequate school WASH facilities which equate to 'safe, non-violent, inclusive and effective learning environments for 'll' (SDG 4, UNGA, 2015, p19; see Table 4 in section 1.3). The challenges faced by school principals in providing these facilities are explored before an examination of whether schools-based WASH interventions, like CURE's programme, could act as an enabling factor in their provision.

Figure 30 Research Question 2 structure
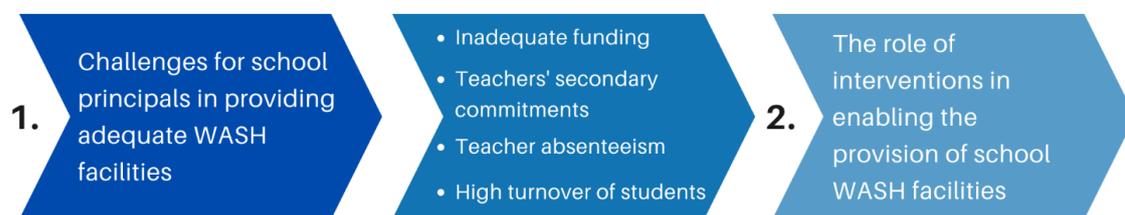
4.3.1 *Barriers to school principals' provision of adequate WASH facilities*

The response to the previous research question showed that inadequate school WASH provision denies children the opportunity to adopt positive WASH behaviours. Consequently, the analysis of qualitative data in response to this second research question reveals some reasons why school WASH provision is insufficient. These comprise inadequate funding, teachers' non-school compulsory commitments, teachers' unexplained absenteeism and students joining the school who did not participate in the BCC activities programme. In the context of the COM-B model, with the exception of inadequate funding which pertains to opportunity, each of these four challenges is pertinent to the capability and motivation domains: 'the individual's psychological and physical capacity to engage in the activity concerned…brain processes that energize and direct behaviour' (Michie et al., 2011, p4).

First, some school management staff claimed that the funding available for WASH provision is inadequate. The principal of GISA explained that in May 2019, CURE's intervention had provided clean, private Indian-style toilets. These were not suitable for children with disabilities who needed support handles to hold and a Western-style toilet

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but the school had no funds available to provide these. At this time, the head was preoccupied with work for local elections but she contacted CURE (even though their formal arrangement had expired) and they made the necessary improvements within 24 hours. She said she only has funds for minor renovations from the government so relies on CURE. This is one example of an institutional barrier faced by school leaders in providing the opportunity for every child in their school to practise positive WASH behaviours, regardless of their age, gender or disability, as per SDG 4: 'Build and upgrade education facilities that are child, disability and gender sensitive' (UNGA, 2015, p19). The deputy principal at the GNIS cited a similar funding problem in terms of inadequate numbers of cleaning staff. According to him, guidelines stipulate that there should be one per 300 students. In reality, approximately 800 boys were enrolled and only one member of cleaning staff was employed. She was 60 years old and had difficulty fulfilling the role (she was absent each day the researcher attended the GNIS and was replaced by two temporary cleaning staff from the EDMC).

The second barrier that school principals face in providing adequate WASH facilities is the non-school, compulsory commitments of staff which encroach on their time in the classroom. This pertains to the capability and motivation domains of the COM-B model. If children are denied considerable amounts of classroom time with their teachers, they will not benefit from the teacher support that is important in developing the skills and knowledge they need to practise positive WASH behaviours, nor will they receive prompts from their teachers which motivate them to do so. Staff were frequently absent during the researcher's visits at GISA-B due to their compulsory roles as 'Block Level Officers' and their compulsory attendance of training for working in running elections (Mitul and Agha, 2018). When teachers were unavailable for interview, this was always the reason given. However, no replacement staff were in place during this training, leaving classrooms of children unsupervised for the whole school session, and the government's decision to use teachers in this role is controversial. An unpublished report from the National University of Educational Planning and Administration concluded that teachers spend less than a fifth of their time teaching in classrooms (Kalra, 2019). In a report for Education World (2018), MRSK Chaitanya, an activist for the Right to Education, summarises these concerns:

> The drawback is that the government looks at these teachers as government employees. This attitude needs to change. We need to look at teachers in government schools as agents of social change. Yes, it is true that there is a lot of burden on the teachers to take up administrative work besides teaching. This does hamper their quality of teaching.

(para. 5)

However, the third challenge faced by school principals in ensuring adequate WASH provision is that some teachers at the government schools were absent for reasons that were not explained. During one research visit, the boys in the afternoon shift at GISA had an assembly and practice for the upcoming Republic Day celebrations which lasted from 1-1.45pm. Following this, the boys went to their classrooms and two of the class teachers walked out of the school gates. They had not returned by the time the researcher left the premises at 3pm, despite the afternoon shift for boys finishing after 5pm, and the children remained unsupervised during that time. One of the interpreters who was originally from the area surmised that the reason for this could be that they ran small businesses such as private tutoring alongside their employment at the school to supplement their government income, which was perhaps inadequate. It is possible that they were on official school business and that no one had arranged classroom cover. There are a number of other possible reasons for why they were not present. Low pay and poor employment conditions could drive the necessity for teachers to seek additional income. One teacher at the GNIS explained that part of her role was identifying children not attending school and visiting them in the community so they may have been fulfilling similar duties. They also could have been attending training or work-related meetings. The interpreter's theory was strengthened by a parent with four children attending GISB:

> They are not getting proper education in the school. The teachers do not teach the students properly. They give their tasks to young girls.

(GISB mother, 14th January 2020, interview transcript included in Appendix 11)

CURE's intervention methods (Appendix 2) are most effective in the long term when teachers are equipped and motivated to implement the intervention benefits independently moving forwards. In this way, they take responsibility over time for building children's capability and motivation to adopt WASH behaviours long-term.

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Thus, developments such as parent-teacher associations directly involve teachers in intervention implementation and may serve to address this unexplained absenteeism issue. One teacher from GISA described a professional development event organised by CURE in which roughly 100 teachers from five or six schools were invited to a hotel where they were given tasks in groups and study materials for use at school such as books, games and even music systems. This aimed to build teachers' motivation to carry intervention recommendations forward and support children's capability to adopt WASH behaviours. The first step towards this, though, is to ensure that children have teachers for the entire school shift.

The final challenge emerging from qualitative analysis for school principals in the provision of school WASH facilities which enable children's WASH behaviours is the high turnover of students and the intake of new, young students who did not participate in the BCC activities programme. It is difficult for school staff to support children's capability and motivation to adopt WASH behaviours long-term if they only attend the school for a short time and new students enrol continually. A member of CURE staff explained that while there are roughly 1,200 students enrolled at GISB, only 700-800 actually attend. She attributed this to the fact that there are many students who attend temporarily because they come from transient migrant families who move in and out of Delhi, arriving for festival periods before returning to their homes in other regions. This means that some children who have not participated in CURE's BCC activities persist with unhealthy practices. Furthermore, young children enrolling in school for the first time will not receive this training from CURE unless it is passed on by their teachers or older peers. The principal of GISA girls' shift cited an issue relating to children's understanding of toilet use and other GISA staff members explained how CURE's work had impacted this:

> They would use the toilet but they didn't know how to use the toilet. They would just shit everywhere.

(GISA girls' principal, 16th January 2020, interview transcript included in Appendix 11)

> CURE people told the students how to sit on the toilet seats and use it properly. Before that, children would go to the toilet anywhere in the toilet block.

(GISA male janitor, 16th January 2020)

> CURE has done a lot of work in this school and they give good qualities to the students like handwashing before eating and after toilet. Students who come to this school didn't know how to sit on a toilet seat because in their locality there is no facility. So they usually defecate in the open. CURE NGO specifically taught them how to sit on the toilet seat. Students in the school defecate in the toilet block but not on the seat. It causes problems like bad smell and filthiness in school toilets. The students were taught how to sit on the toilet seat and how to wash their hands properly after the toilet.

<div align="right">(Female teacher at GISA, 16th January 2020)</div>

However, there was some evidence at GISA-B that this misuse of the toilet blocks persists, suggesting that many children using these facilities have not built the capability to use them properly and either have not participated in CURE's activities or have not persisted with applying their learning. This included faecal matter in the corridor at GISB which the member of cleaning staff said was caused by the youngest children not having learnt how to use the facilities.

When asked what he thought was the most significant change brought about by CURE in GISA, a teacher responded thus:

> The infrastructure, the activities performed by the CURE people. These are things regularly the children want. Every day, they need such activities, they are children. You tell them every day, do this thing, do this thing then they don't do it the next day. So regularly you should tell them. Yes these are the very small children – they need to be taken care of regularly. They are not much capable – that thing is taught once. Every day we need to teach them.

<div align="right">(Male teacher at GISA, 17th January 2020)</div>

Despite having attended CURE's professional development event, this teacher demonstrates dependence on input from CURE, which had ceased at GISA by the time of data collection. If schools-based WASH intervention outcomes are to be sustained beyond the end of the intervention, teachers must commit to their role in building children's capability, opportunity and motivation to adopt WASH behaviours long-term. Teachers themselves need the capability, opportunity and motivation to do this through regular staff training (skills and knowledge), removal of their non-school, compulsory commitments, (external factors facilitating behaviour) and robust, motivating and fair

accountability measures (emotional responses and decision making) to clarify the reasons for unexplained teacher absenteeism.

This section has considered four ways in which school principals experience barriers in ensuring their schools are equipped with safe and healthy WASH facilities and develop children's capability, opportunity and motivation to adopt positive WASH-related behaviours. These are inadequate WASH funding, teachers' commitments imposed upon them as government employees, teachers' unexplained absenteeism and the high turnover of students. The following section investigates whether schools-based WASH interventions, such as CURE's programme, can act as an enabler in the provision of safe, hygienic, reliable school WASH facilities.

4.3.2 *The role of interventions in enabling the provision of school WASH facilities*

Figure 31 Research Question 2 structure
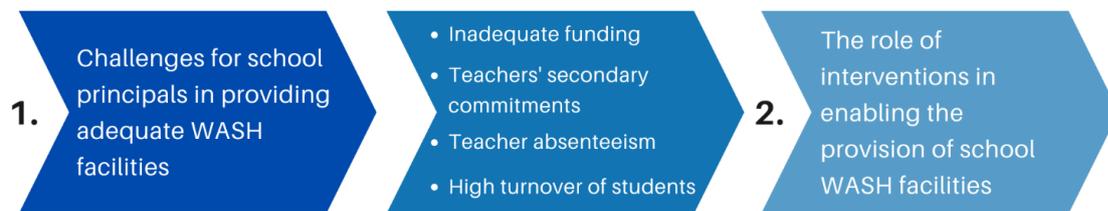
RQ 2: What are the barriers and enablers to school management providing adequate school WASH facilities?

While the previous section highlighted a number of barriers to adequate school WASH provision which impede children's adoption of WASH behaviours, this section considers whether CURE's intervention and other similar schools-based WASH programmes could act as enabling factors, mitigating the barriers identified in the previous section (Figure 31). School staff and parental perspectives on CURE's intervention are presented, as well as evidence which points to school staff's overreliance on CURE to ensure sustained positive behaviour change.

Results presented earlier in response to the first research question indicated that the school WASH facilities in intervention government schools (GISA-B) are superior to those in the government non-intervention school (GNIS). It was reported in Table 12 (section 4.2.2) that the mean total scores for *School Facilities* show that students at GISA-B (16.9)

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perceived the facilities at their schools to be better than students at the GNIS (15.1). However, there was no significant difference between the two types of government school for students' stated *Health Knowledge* and only a very marginal significant difference for *Hygiene Practices*, in favour of the GNIS. This suggests that although there are environmental differences in terms of school WASH facilities between GISA-B and the GNIS due to the improvements completed during the intervention, this has not translated into more frequent WASH behaviours at GISA-B.

Focusing further on environmental differences, although GISA-B had undergone significant renovations and students attending them were more positive about their WASH facilities than children at the GNIS, there was evidence at GISA-B that some environmental factors relating to WASH facilities continued to pose a risk to students. For example, as was the case with the GNIS, during each visit to GISA, the researcher found that the water taps were not functioning so the opportunity element enabling children's WASH behaviours was lacking. The principal attributed this to a pipe problem that she did not have funding access to address; she did not have jurisdiction to sanction significant works and needed to wait for the EDMC's response to have sufficient funds. Secondly, the solar-powered water cooler tower at GISB (Figure 32) was used by children as an informal climbing frame.

Figure 32 GISB water storage tower

(Photograph provided by CURE report, 2019)

A break-in had occurred previously and some electrical components had been stolen, exposing the circuitry inside which children climbed around. This was first observed by the researcher during the August 2019 preliminary visit and the fact that it remained accessible to children and had not been resolved by February 2020 presents evidence that the maintenance of WASH facilities was not prioritised at GISB. This raises questions regarding the sustainability of WASH intervention outcomes and the responsibility of imposing regulatory standards when the intervention provider is no longer involved.

The staff at GISA-B who participated in interviews were positive about the impact of CURE's infrastructural work, citing increases in attendance, greenery in the school compound and improved cleanliness at the school as major factors. An example staff interview is included in Appendix 11. Comments from a teacher in a group interview at GISB indicate that CURE's programme provided capability support for girls in MHM which impacted positively on attendance:

> Girl children were taught especially how to take care during menstruation. The students were not aware, what happens, how they can keep clean during this themselves. During those days, girl students didn't come in, they used to remain at home…Only a few girl students have access to menstrual hygiene products, not all of them…They do not fear about it now, they take it normally now as a natural process and they come to school.

> (Female teacher at GISB, 16th January 2020)

Although it was not possible to access formal school attendance data, when asked whether the programme had improved children's attendance in the school, the head teacher of the girls' shift at GISA described how CURE staff addressed this directly:

> CURE people went to visit the parents of students and through various activities they have connected with them. They have worked in the communities and collected students to bring them to school…They have started various activities – students are more excited and encouraged specifically for these activities. So CURE's work in this way increased attendance because students were more keen to be here. Students are happy to work with activities like cleaning or planting a tree.

> Students go with the parents to earn money begging, to work on the farms. They miss school and this makes attendance lower…One of the main things is CURE acts as an interface between the school and the community. So the dropouts from school, CURE brings them back.

Working with the community simultaneously alongside the school-based activities aimed to ensure a complementary, multi-focus approach, fostering behaviour change at the school and household levels by building this school-community 'interface'. This approach could mitigate the capability challenge presented by the high turnover of students causing reduced adherence to intervention recommendations as younger children could be reached with hygiene education in advance of them joining the school.

The principal of GISB was also interviewed but was not recorded. She cited greenery in the GNIS compound as the main impact of CURE's work. Edible plants like mango trees and spinach were planted within the GNIS compound and GISA attendance allegedly increased because children praised the school in the local community. Attendance was previously low because the school was dirty; all the toilets were blocked so children urinated in the open but CURE renovated the toilet block. The principal said that the project had been so successful that children attending private schools in the area moved to the government school. She mentioned that she would like CURE to get more funding so they can do more work on the infrastructure of the school but did not draw attention to any future role for school staff in upholding the intervention benefits. During the group interview at GISB, the teachers did recognise the importance of sustaining positive behaviour changes over time but did not discuss how this might be achieved:

> We hope that the children will carry these changes with them for a long period of time. These changes can just be for a limited time but they should remain for a long time.

(Female teacher at GISB, 16th January 2020)

As with the GISA boys' shift teacher's comments in section 4.3.1 regarding children requiring daily input from CURE to ensure behaviour change, the above comments from female staff at GISA-B point to a reliance on CURE to bring about change in the short term which is subsequently not sustained when CURE is no longer running the activities detailed in Appendix 2. During one visit to GISA, when noticing a particularly raucous classroom with no teacher next door to where the survey collection was taking place, the interpreter asked the children what they were going to do all day and one responded that they were going to play. While surveys were collected in an adjoining

classroom, there were twelve children playing in the corridor. When asked where the teacher was, one said:

> He has not come today…we are going to play with a ball. When he comes, he doesn't teach, he just writes in his book. He doesn't write on the board.

Attendance may have risen as a result of the intervention but without teacher role models, it is difficult for infrastructural intervention outcomes to be sustained and for children to build the capability and motivation to adopt WASH behaviours.

In summary, schools-based WASH programmes such as CURE's intervention can be enabling factors which mitigate the barriers faced by school principals in providing safe WASH facilities. Infrastructure improvements implemented during interventions can offer support to principals in tackling the challenge of limited funding. It is reasonable to suggest that the incorporation of community outreach could address the capability challenge of a high turnover of students too by reaching those not yet attending the school with WASH education. CURE offered some discrete training for teachers from intervention schools through the professional development event. If another schools-based WASH programme incorporated regular, long-term training, unexplained teacher absenteeism could be addressed by building teachers' capability and motivation to fulfil their professional obligations and sustain behaviour change outcomes in their schools. However, communication with teachers in a safe, reassuring setting is required to clarify the reasons behind unexplained absenteeism. Schools-based WASH interventions are an enabling factor in school management providing adequate school WASH facilities but if infrastructural improvements are to translate into children's sustained adoption of positive WASH behaviours, teachers must be equipped to lead students in doing so through regular training input with municipal funding and reasonable accountability measures akin to those in place at the LFPS.

To conclude the response to the second research question, ensuring school WASH facilities are adequate is fundamental to supporting children in developing the capability, opportunity and motivation to practise WASH behaviours. School principals face a number of barriers in achieving this: limited funding for WASH facilities, teachers'

obligatory commitments as electoral officers, teachers' unexplained absenteeism and the transitional nature of student enrolment. Schools-based WASH interventions such as CURE's can act as an enabling factor to mitigate these barriers, maximising the long-term positive impact of WASH hardware and software input through engagement with the local community and particularly through their work with school staff to increase their motivation for supporting children's adoption of positive WASH behaviours.

4.4 Research Question 3: How are children's WASH behaviours affected by their socio-economic status?

The previous research questions suggested that students from a higher-income background develop more capability, opportunity and motivation to adopt WASH behaviours because they are able to attend the LFPS where the facilities and staff engagement are more comprehensive. This research question (Figure 33) applies the COM-B model to investigate this further, considering how children's socio-economic status and their WASH access in the home environment affect their WASH behaviours. To gain a full picture of the driving factors affecting children's WASH behaviours, it is important to investigate children's home lives and the challenges that families face in gaining secure water access and adequate sanitation provision.

Figure 33 Research Question 3 structure

The first section (4.4.1) investigates whether there are differences between school types for families across a number of variables relating to socio-economic status and household WASH. The second (4.4.2) details accounts from school children's parents of their experiences surrounding water security to explore whether the potential socio-economic inequalities that exist between children attending differing school types impact upon their opportunity to adopt WASH behaviours. The third section (4.4.3) builds on this, using Spearman's rho correlation, independent-samples t-tests and

structural equation modelling to clarify the impact of socio-economic status upon children's WASH behaviours. The final section (4.4.4) considers whether schools-based WASH interventions could play a role in mitigating the potential effect of socio-economic status on children's WASH behaviours through parental engagement and pupil-parent knowledge transfer.

4.4.1 *Potential differences in socio-economic status between school types*

This section considers whether students' socio-economic status varies between school types. First, qualitative analysis offers an insightful comparison between the school type areas. According to one of the interpreters who lived in the area as a child, of the two schools in which the intervention was implemented, GISA is situated in a poorer neighbourhood of East Delhi than GISB. However, during a household interview, one parent of a child attending GISB explained that the main issue affecting her community is poverty, which she said was a problem for everyone in the area:

> I think there is no problem for children but the main problem is just with income. There's only one family member earning and there's ten to feed…[Prime Minister] Modi has to think about it, he will do it.

> (GISB mother, 14th January 2020)

Meanwhile, a GISA parent spoke of the pressure of being a sole earner for his family:

> I think that there are psychological problems for me because I am the sole earning person. As my children grow up, there is a burden. If I fall sick, my children will get in a problem. It is my duty as a father.

> (GISA father, 15th January 2020)

During community visits around GISA-B, the researcher built an understanding of the semi-permanent colonies in which the participating children live. This was not possible for the GNIS and LFPS because the community guide had not developed familiarity with the surrounding areas or relationships with parents. Homes near GISA, in the colonies where participating students live, are constructed of brick or concrete with makeshift material roofs. Greywater stagnates in garbage-filled drains which curve around buildings, often in close proximity to areas used for water storage and cooking (Figure

34). During a household visit in this area, the researcher watched a small toddler playing with matches in the ashes of a home cooking fire at the entrance of the interviewee's home. The child was trying to set fire to a plastic disposable cup and it became apparent that this was the method used by many households to start their cooking fires. The bathing area, constructed from bamboo covered in material curtains, was outside the front of the home. Water stored in buckets adjacent to the bathing area appeared to be turbid but it was beyond the remit of this study to test water quality during household visits. Common professions for fathers in this area are driver, factory worker, hostel worker, labourer and mason.

Figure 34 Photographs of the residential area adjacent to GISA

(15th January 2020, 11.40 – 13.20)

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Some homes near GISB are built as more permanent structures than GISA, thus corroborating the interpreter's assessment that the GISB area is wealthier than the GISA area. They consist of multi-storey apartments with durable roofs and entrances with steps. Stagnant greywater drainage is present but is underneath household entrance steps; cooking areas and water storage are in the interior of homes. Common professions for fathers are carpenter, driver, electrician, factory worker and labourer. One GISB parent ran a small business selling flowers for use in religious ceremonies (Figure 35). However, other homes in the area which the community guide said were populated by 'ragpickers' were of a similar condition to those in the GISA area; these can be seen in the bottom right photo of Figure 35.

Figure 35 Photographs of the residential area adjacent to GISB
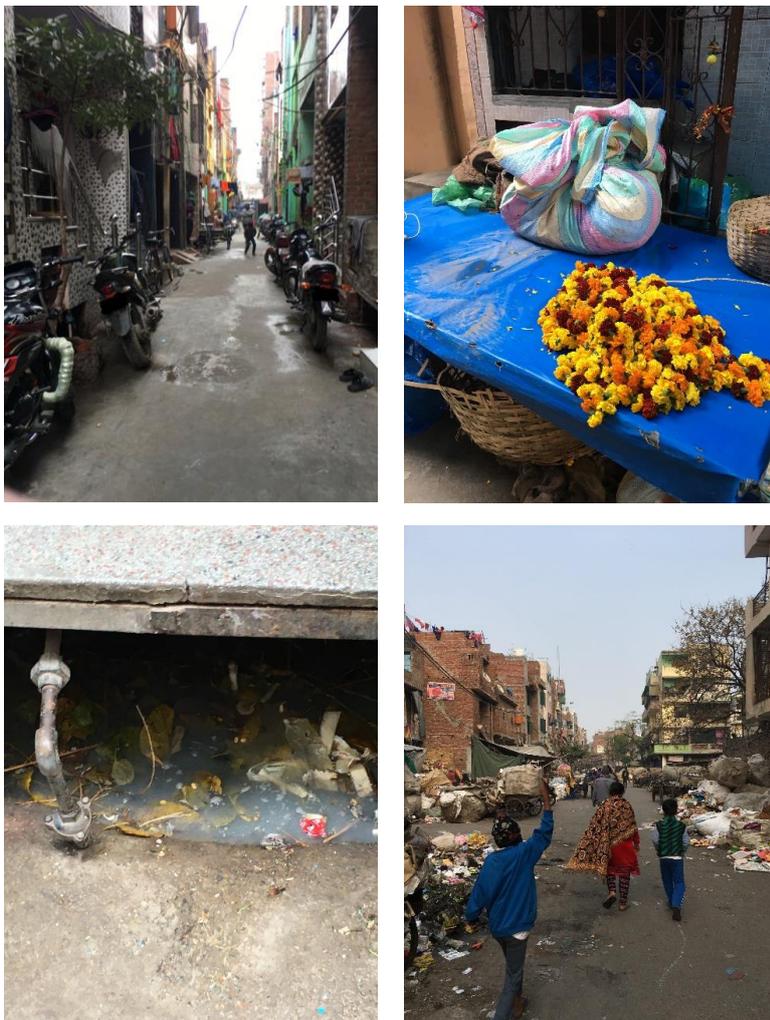
(14th January 14.50 (bottom right), others 17th January 2020, 14.10 – 14.50)

Insights from the area surrounding the GNIS and LFPS are more limited as the researcher did not have the same access to the community through CURE's existing relationships (see section 3.8.3 for an explanation of this process) and parent interviews took place on the school premises. The GNIS area is further from the centre of Delhi than GISA-B and thus less developed, with inferior road infrastructure. As with the area around GISB, housing varies from fragile brick constructions with temporary roofs to more permanent concrete structures. Common professions for fathers are carpenter, driver, labourer, shopkeeper and tailor. One parent from the GNIS (10th February 2020) provided insight into the realities of school choice in the area, explaining that her child previously attended an LFP school which charged roughly 550 Rs (5.32 GBP) per month. However, the mother became ill for a few months, the fees accumulated when she was not working and she was unable to afford them anymore so her child joined the GNIS instead.

Although it is situated in the same region of Delhi as GISA-B, the LFPS is in a visibly wealthier neighbourhood with concrete residential apartment blocks and shops as well as the usual street stalls. Common professions for fathers are businessman and shopkeeper. Further qualitative data pertaining more specifically to household WASH is presented below in the section discussing whether schools-based WASH interventions could mitigate the effect of socio-economic status on children's WASH behaviours.

Quantitative analysis of potential differences in particular variables between school type relevant to socio-economic status are also investigated. Regarding parental income, professions were categorised using an indicator commonly used in India called Kuppuswamy's socio-economic status scale (1981), revised and updated by Sharma (2017). This scale groups professions into seven categories: unemployed, unskilled worker, semi-skilled worker, skilled worker, arithmetic skill jobs, semi-professional and professional. Due to the size of the sample in this study, 'semi-professional' roles were grouped with 'professional' roles and 'arithmetic skill jobs' were grouped with 'semi-skilled worker' roles to give five categories rather than seven.

Figure 36 Which sources of income do mothers have?
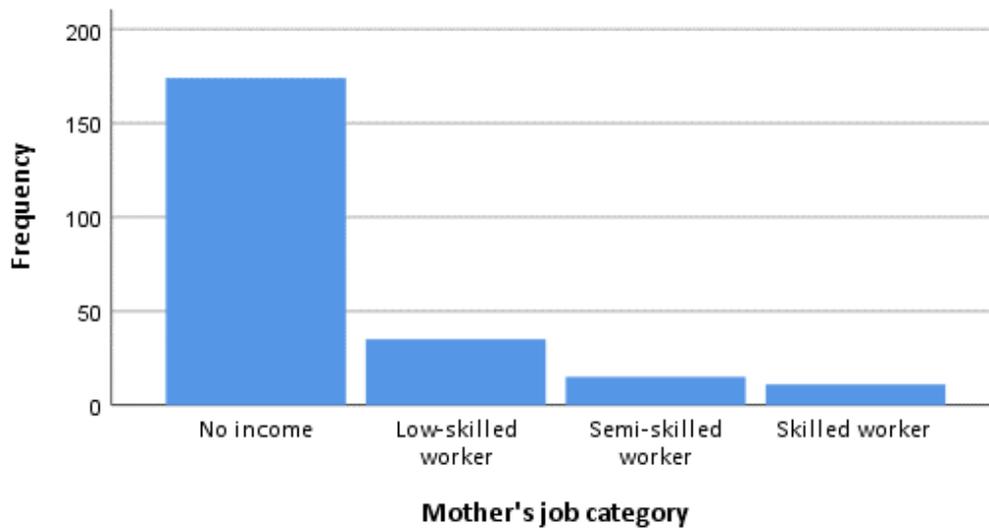
Figure 36 shows that the vast majority of mothers in the sample had no income (74%).
Of those 174, one child's mother was deceased. Two mothers whose children described
their income source as 'beggar' are also included in this category. The mode income
level for employed mothers was 'low-skilled worker' which includes factory workers,
housemaids and 'ragpickers'. These are parents from low-income families who earn a
living by sorting waste into recyclable and non-recyclable materials before selling it to
recycling businesses. This profession was only reported at GISA-B. It is a hazardous
profession with much exposure to unhygienic environments and it is not uncommon for
children to participate alongside their parents (Agarwalla et al., 2017). During a
household interview, one child said:

> I go to the school. We work as rag pickers, I think it is a problem for children that
> we work. My mother thinks it's fine and after the work, we attend the school.

(GISB female student, 14th January 2020)

The majority of semi-skilled workers were tailors and most of the skilled workers were
teachers in either government or private schools. None of the mothers were employed
in roles classified as 'professional'.

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Figure 37 Frequency distribution of mothers' income level across school types
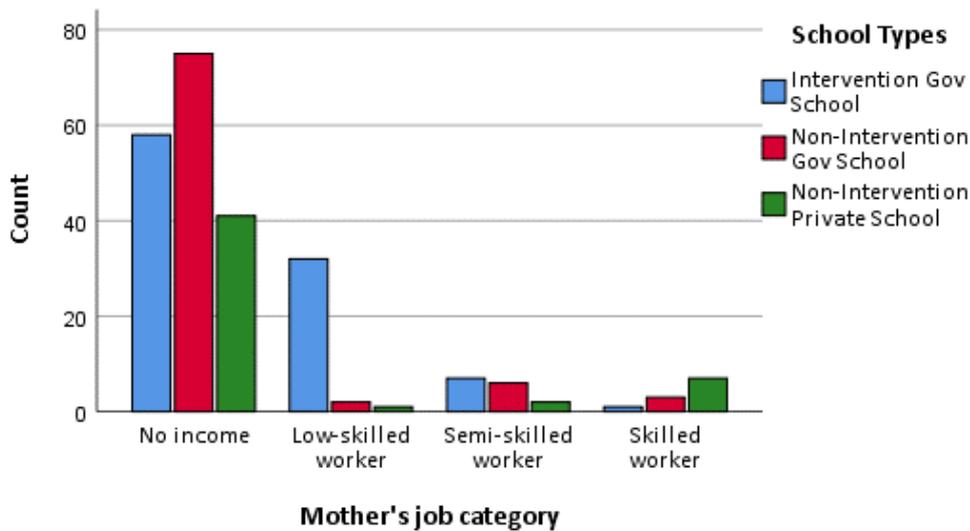
Comparing mothers' income between the private and government schools, only 10 out of 51 LFPS mothers were employed. Of the 10, the majority were in the category of skilled worker. Meanwhile, the mode for employed mothers of government school students was low-skilled worker, with a total of 51 out of 184 mothers in employment (Figure 37). Although the sample size is small because the majority of mothers had no income, this suggests that mothers of children attending the private school were employed in higher paid positions than their government school counterparts. However, when comparing the three school types of intervention, non-intervention and private, the one-way ANOVA shows no statistically significant differences between the mean employment categories of mothers ($P[F(2, 232) = 2.35] < 0.1$).

Figure 38 Which sources of income do fathers have?

Fathers were much more likely to have a source of income (Figure 38). Most fathers (68%) work in 'skilled' or 'semi-skilled' roles as businessmen, carpenters, masons, rickshaw drivers, painters, shopkeepers and tailors. At the low-income end of the scale, a number of fragile income sources stand out including drummer, snake charmer and magician. These unpredictable 'street performer' professions, some of which are illegal due to animal protection laws (Halder, 2017), highlight the precarious position of some of the families in the sample. Further demonstrating this are the 11 families which had no income from a father; 4 of these were deceased and 2 were described as 'gambler' by their child in the survey.

Figure 39 Frequency distribution of fathers' income level across school types
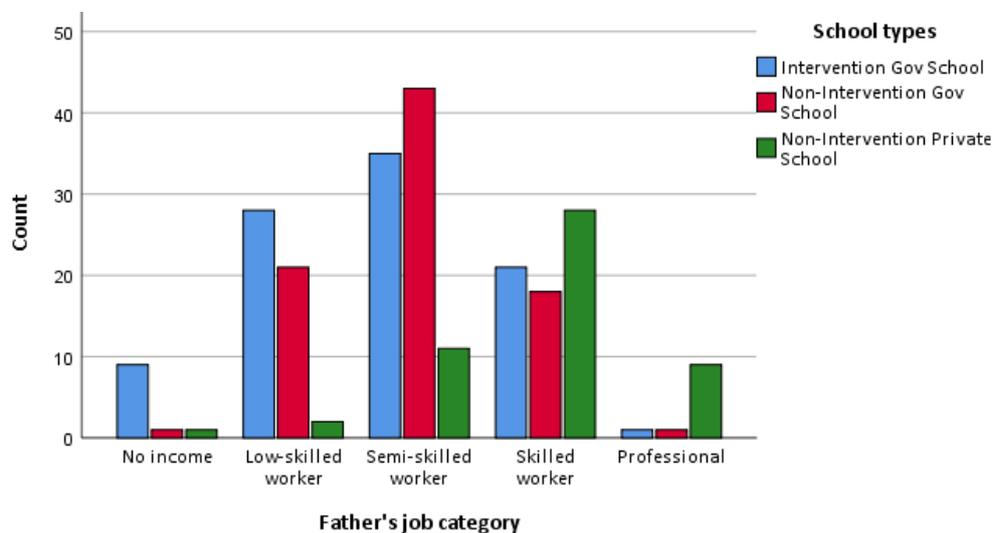
Comparing fathers' income between the government and private schools, the mode income level for fathers of government school students was semi-skilled worker whereas it was skilled worker, one income bracket higher, for fathers of LFPS students (Figure 39). 72.5% of LFPS fathers were employed in positions classified as skilled worker or professional, compared to just 23% of government school fathers.

Table 17 Father's income category between school types: Multiple comparisons for one-way ANOVA post hoc test

Scheffe

(I) School Types	(J) School Types	Mean Difference (I-J)	95% Confidence Interval	
			Lower Bound	Upper Bound
GISA/B	GNIS	-0.21	-0.53	0.11
	LFPS	-1.07*	-1.44	-0.7
GNIS	GISA/B	0.21	-0.11	0.53
	LFPS	-0.86*	-1.23	-0.48
LFPS	GISA/B	1.07*	0.7	1.44
	GNIS	0.86*	0.48	1.23

*. The mean difference is significant at the 0.05 level.

Table 18 Father's income category between school types: Homogenous subsets

Scheffe [a, b]

School Types		Subset for alpha = 0.05	
	N	1	2
GISA/B	94	2.76	
GNIS	84	2.96	
LFPS	51		3.82
Sig.		0.348	1.000

Means for groups in homogenous subsets are displayed.
a. Uses Harmonic Mean Sample Size = 71.173
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type 1 error levels are not guaranteed.

There were statistically significant differences between the mean employment category of fathers within the three school types (GISA-B, GNIS, LFPS) ($P[F(2, 226) = 26.74] < 0.0005$). Fathers of children attending the LFPS are employed on average in roles 1.07 categories higher than fathers of children attending the GNIS ($p < 0.05$, 95% CI, 0.7 to 1.44) and 0.86 categories higher than GISA-B fathers ($p < 0.05$, 95% CI, 0.48 to 1.23) (Table 17). This shows that the LFPS students come from higher-income backgrounds than the government school students (Table 18). However, it is worth noting that 8.7% of students at the LFPS are from the 'Economically Weaker Sections' (EWS, see section 3.7.3 for an explanation) and attend the school free of charge, as mandated by the government.

Four indicators of socio-economic status were compared across school types: number of rooms in home, number of people living at home, type of water access and toilet access. The post hoc test results for these variables are given in Appendix 15. Overcrowding is a

fifth indicator and is typically calculated by dividing the number of inhabitants in a household by the number of rooms (Galobardes et al., 2006). 56.9% of government school students had one room in their home, compared to just 7.8% of the LFPS students (Figure 40).[3]

Figure 40 Frequency distribution of the number of rooms in homes across school types
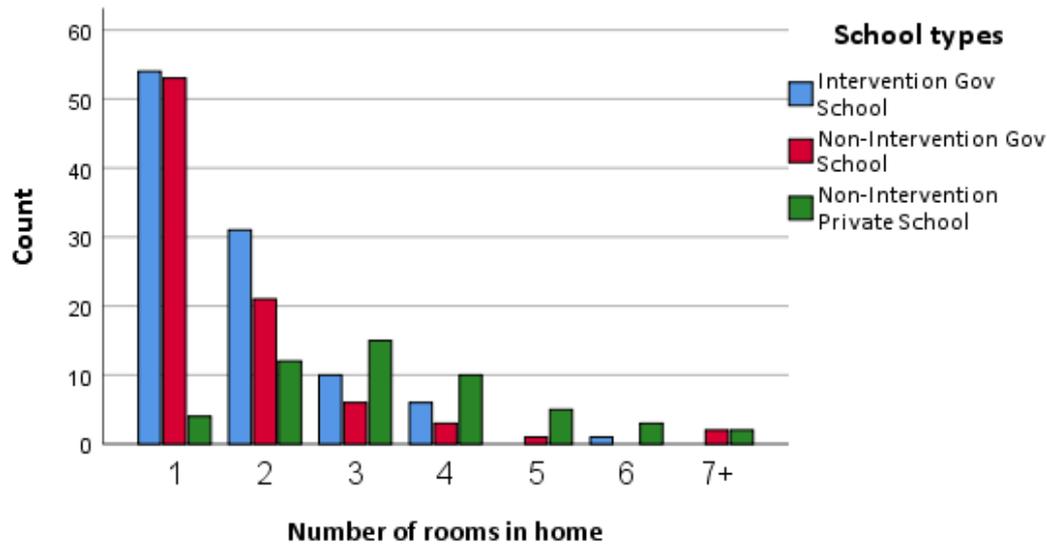
For government school households, the mode number of rooms was 1 and for LFPS households it was 3. Table 19 shows a significant difference in the mean number of rooms between government school households and LFPS households; students from the LFPS have on average 1.63 more rooms in their home than students at government schools ($p < 0.01$), again suggesting that LFPS students belong to families with higher income than those at government schools.

Table 19 Household indicators between school types

	LFPS	All Gov	p-values of differences G–v – LFPS
Items	Mean (SD)	Mean (SD)	
Number of rooms	3.33 (1.49)	1.7 (1.08)	-1.63**
Number of inhabitants	5.39 (1.81)	6.1 (1.55)	0.71
Overcrowding	1.94 (1.13)	4.42 (1.88)	-2.48***
Type of water access	1 (0)	0.94 (0.24)	-0.06***
Type of toilet access	1 (0)	0.86 (035)	-0.14***
N	51	188	

p***<0.001, p**<0.01, p*<0.05

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[3] Skewness = 1.58 ± 0.16, kurtosis = 2.45 ± 0.31.

34% of government school students had more than 7 people living in their home compared with 21.6% of LFPS students. The mode number of people for government school households was 6, compared with 4 for private school households (Figure 41). However, there was no significant difference in number of inhabitants between government school and LFPS households.[4] For overcrowding, the value represents the number of inhabitants per room in the household. Comparing the extent of overcrowding between the two school management types, Table 19 shows a statistically significant difference of 2.48 ($p < 0.001$), demonstrating that government school students generally live in more crowded conditions than the LFPS students.[5]

Figure 41 Frequency distribution of the number of inhabitants in children's households across school types
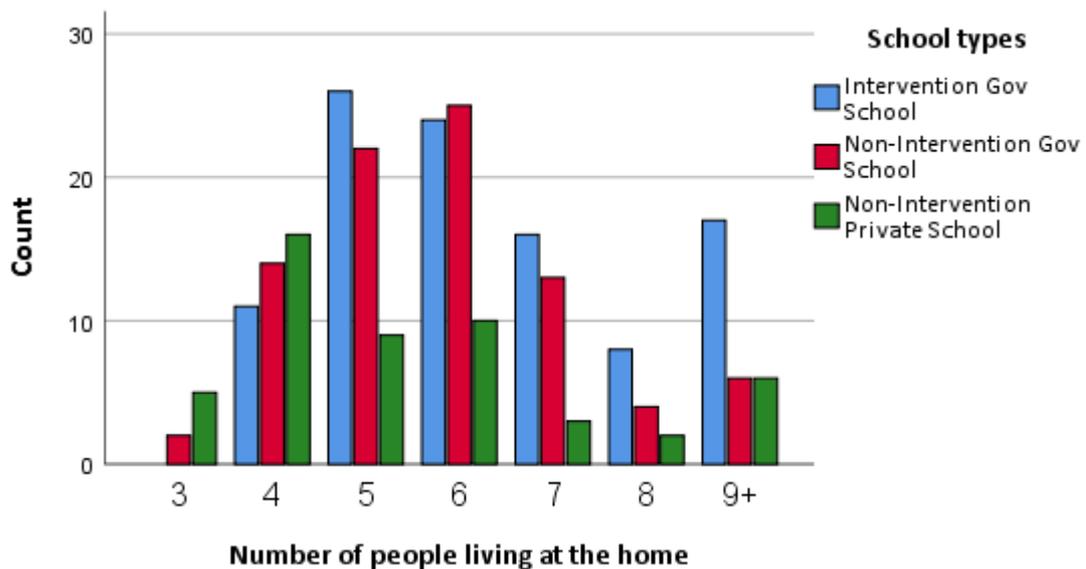
Moving onto factors related directly to WASH, the majority of students (88.7%) also reported having a toilet inside their home (Figure 42). Table 19 shows a negligible, statistically significant difference between the government school students and LFPS students ($p < 0.001$). All LFPS students reported having a toilet in their home while 27 out of 188 government school students reported having no toilet.[6]

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[4] Skewness = 0.45 ± 0.16, kurtosis = -0.61 ± 0.31.
[5] Skewness = 0.52 ± 0.16, kurtosis = -0.39 ± 0.31.
[6] Skewness = -2.46 ± 0.16, kurtosis = 4.09 ± 0.31.

Figure 42 Frequency distribution of toilet access in children's homes
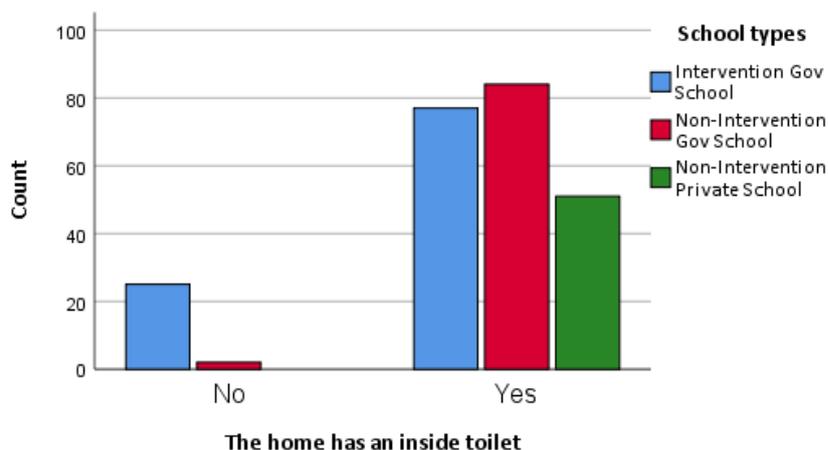
In terms of household water access, the vast majority of students (95.4%) had water piped into their home, either by the municipal Delhi *Jal* Board or via a private water connection such as a borewell (Figure 43).[7]

Figure 43 Frequency distribution of types of water access in children's homes
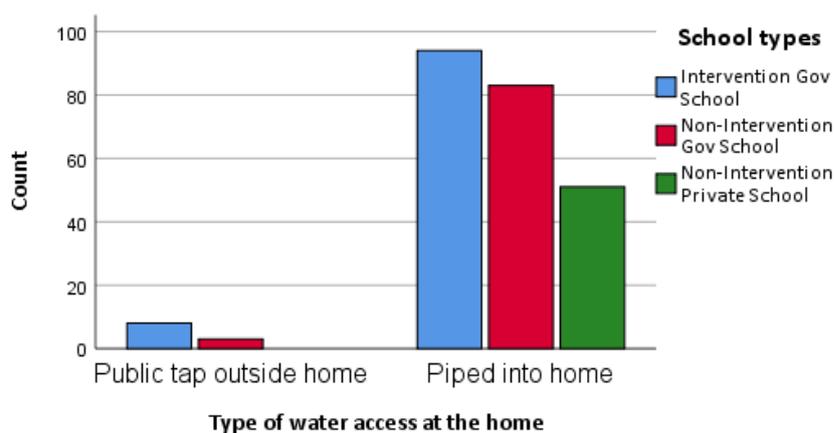
As presented in Table 19 above, there is a negligible but statistically significant difference between government and LFPS students' households regarding water access ($p < 0.001$); every LFPS student had water piped into their home while out of 188 students across the three government schools, 11 used a public tap outside the home. Despite this, household interviews with parents revealed stark inequalities in WASH access between government school and LFPS households. These are detailed in the following section.

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[7] Skewness = -4.36 ± 0.16, kurtosis = 17.16 ± 0.31.

4.4.2 *Comparing parental perspectives on WASH access across the four schools*

Figure 44 Research Question 3 structure

RQ 3: How are children's WASH behaviours affected by their socio-economic status?

The first section of the response to this third research question (Figure 44) investigating the effect of socio-economic status on children's WASH behaviours identified considerable differences in socio-economic status between school types with LFPS students coming from higher-income backgrounds than their government school counterparts. However, the findings relating to household WASH access (Figures 42-43) do not reveal the full picture. This second section presents accounts given by parents across the four schools, detailing their differing experiences of WASH access and particularly water security. Noticeable enabling and impeding factors relating to households' opportunity to access basic WASH needs emerge, contrasting between school types. Enabling factors in government school areas constitute community collaboration and sharing private water sources. Impeding factors include varying water quality, limited hours for piped water, long queues, closure of the community toilet at night and even water remaining switched off during a curfew to subdue political protests. For the LFPS, impeding factors were not mentioned apart from an acknowledgement that Delhi groundwater is quickly depleting. The major enabling factors highlighted were technological rather than social or communal: RO purification systems (see section 2.4.1) and private borewells. Some household members did not give consent to be recorded so in these cases, direct quotations are not available. All interviewees during household visits were parents or grandparents of children enrolled at the participating schools.

- Government Intervention School A (GISA)

During one household visit at a colony adjacent to the school, Father A explained that sometimes, the piped water from Delhi *Jal* Board (see section 3.7.1) is turbid and

opaque. This piped water access was new to his home since four months prior to the researcher's visit. Before this, Father A shared a borewell with 8-10 other families which they had installed using shared funds at a cost of 23,000 Rs (222.70 GBP). Father A contributed 3,000-4,000 Rs (29-39 GBP). They used the borewell for ten years but since Delhi *Jal* Board installed the piped water access, the borewell was no longer operational because the installation of the piped water somehow resulted in the borewell water becoming muddy. However, when the borewell was operational, the water was not potable and they collected their water for drinking from a public community pipe. Father A feels that the government installation of piped water into his home has solved problems, despite its varying quality and loss of his shared borewell.

In comparison to Father A, Mother N lives in the same colony but hers is the only household in the vicinity with no piped water; she or her children ask neighbours if they can have some. Very occasionally, a neighbour will decline (especially when water access is less consistent in the summer) but she asks others and eventually, someone agrees. She washes her hands in an unclean bucket above a stagnant drain containing household waste and greywater. Referring to how her mental health is affected by her household's insecure water access, Mother N explained that she does not sleep well because she has to wake early to deal with the water situation. She feels ashamed to depend on others and this feeling is exacerbated in the summer when water is even more scarce.

Mother C is part of another household in a different colony neighbouring the school but also spoke of her family's unreliable water access. She explained that the tap just outside their dwelling provides water just twice per day, for two hours in the morning and two hours in the evening. Sometimes though, this does not happen and in these cases, they walk five minutes to a Hindu temple where they receive water free of charge. When the water is turned on, Mother C is only able to replenish half of her storage buckets before it is turned off again. She and her family have previously complained about this inconsistent water provision to a local government representative and when they have done this, it has improved, albeit temporarily. The water storage bucket and cooking fire were situated close to an open drain blocked with

household waste and greywater, increasing the possibility of infectious diseases spreading to food and water.

Mother K lives in the same colony as Mother C and similarly, she reports that water comes twice per day for 1-2 hours at a time. During the previous summer, her Delhi *Jal* Board water supply was dirty, perhaps due to contaminants seeping in through damaged pipes. Therefore, she paid 20 Rs (0.20 GBP) per 20 litre bottle to the owner of a nearby private borewell similar to that previously owned by Father A. This individual filters his own borewell water and sells it in a small business. Even when the piped water is working well, Mother K still occasionally purchases bottled water from this business because a doctor advised an elderly member of her household to drink filtered water when ill. Otherwise, she boils water from her home pipe to purify it and fills 'emergency buckets' in the summer in case the water supply is turned off for a few days.

Many members of this community use a centrally located public toilet facility which was maintained to a reasonable standard of cleanliness when visited during data collection. However, when discussing toilet access in this community during focus group discussions, a girl from GISA explained the situation:

> The community toilet closes around 11 at night. So [at night] I would go in the open in the open ground with my mother.

> (GISA female student, 2nd February 2020, focus group transcript included in Appendix 11)

This indicates that OD continues in this community which makes this child and her mother vulnerable to GBV.

- Government Intervention School B (GISB)

The households in the vicinity of GISB are more varied in structure than those around GISA. Some are constructed of crumbling brick and corrugated iron similar to households near GISA, while others are more substantial with several storeys and motorbikes parked outside (see section 4.4.1 for photographs). Therefore, it follows that water security is also varied in this area.

Several parents of students at GISB highlighted the fact that water is more of an issue in the summer, when it is normal to have two or three days in a month without water access from Delhi *Jal* Board than in the winter, when water access is more regular. They have a number of alternative options if piped water is unavailable – they could call a tanker from the municipal board which would deliver water or they could use a shared borewell. Sometimes this water insecurity can be caused by political factors. On 14th January 2020, one respondent explained that during recent protests against the Citizenship Amendment Act, workers responsible for ensuring the water was running were unable to leave their homes due to a curfew that was introduced to suppress demonstrations so the water remained switched off.

Mother F explained that during the summer, she and her family experienced three days in a row without piped water so had to rely on buying bottled water for drinking as the tanker water is non-potable. During such times, she does not prioritise using water for laundry. Similarly, Mother L also worries about water in the summer months and faces challenges in washing clothes. These are informative insights considering that GISB teachers highlighted children's cleanliness as a concern:

> Cleanliness is the main issue and we teach every time in the morning. Students are not able to continue with cleanliness for a long time. Class is clean but children are not clean.

(Female teacher at GISB, 16th January 2020)

Here teachers are detecting an issue in the school environment which is actually a consequence of fragile water security in the home environment. The critical realist notions of stratification (Bhaskar, 2013) and emergence (Elder-Vass, 2005) (see section 3.3.1) are useful here as the account from the parent about water insecurity and prioritising water-related tasks responds to and clarifies the teachers' perception of the students' cleanliness, revealing a more complete picture of the underlying mechanisms and phenomena that cause observable reality. Mother L also referred to an element of community cohesion in her experiences of water security in terms of borrowing neighbours' private borewells for drinking water as piped water quality is often lower in the summer. This leads onto an account from Grandmother S who explained a

community initiative using connectivity to tackle water insecurity and increase resilience. She explained that if the water was to be turned off, they would receive a message warning them through a WhatsApp group created by their residential association. A Delhi *Jal* Board representative communicates with a residents' representative who then posts it on the WhatsApp group. However, not everyone in the community is a member of the WhatsApp group, particularly those who may not have a compatible smartphone, and the message is redirected to them by people who are part of the WhatsApp group.

- Government Non-Intervention School (GNIS)

Parents of children attending the GNIS cited the same seasonal variances in water access as GISB parents. Mother S said that sometimes in hotter weather her family faces issues such as dirty water and loose bowel motions. However, she said that she does not need an RO system or borewell as she boils water for use and stores water for emergency use when the water is turned off. When piped water is dirty, she relies on packaged water. Other parents from the GNIS also mentioned methods for dealing with water insecurity including borrowing neighbours' borewells and buying packaged water. Mother U said that she owns an RO system and conserves water by using the wastewater from the appliance for purposes other than drinking such as cleaning the floor.

Mother P highlighted the challenges of relying on shared water sources. There is a piped connection in the vicinity of her home but it is from a local borewell rather than Delhi *Jal* Board. As about 500 people use this source, she is required to queue which often takes 30 minutes. She is frustrated by her water access situation but lives in rented accommodation so she depends on the landlord for finding a solution and arranging a piped connection from Delhi *Jal* Board. Furthermore, she wonders if, when her children are ill with a fever or stomach pains, the cause is drinking water from the public borewell.

- Low-Fee Private School (LFPS)

Three parents were interviewed on school premises at the LFPS. Father G explained that he has an RO system and private borewell at home which he shares with neighbours in

emergencies such as when their water pumps are broken. Mother M also has a borewell with a RO purification attachment so has no concerns regarding water security. However, when asked what would happen if Delhi groundwater were to be exhausted, she acknowledged that this would change her life drastically as she would have to rely on the Delhi *Jal* Board or buy large containers at the market. She explained that although she is in a secure situation, she nonetheless conserves water by turning the tap off while washing her hands; her children have been taught about this at the LFPS where they celebrated World Handwashing Day. Father D does not have a private borewell but explained that

> …RO system is a must. Without RO, we cannot drink a single drop of water. And the water level is going down every day – people need to understand this. Electricity is important too – if this is off, we cannot run the motor.

<div align="right">(LFPS father, 10th February 2020)</div>

With the apparent prevalence of RO systems and private borewells which bypass the need to rely on the Delhi *Jal* Board for a household piped connection, children attending the LFPS not only come from a higher-income background than their government school peers but also live in more water-secure environments. Thus, WASH-related inequalities are revealed which echo the differences in socio-economic status identified in the first section. These insights into the lived experiences of families show that socio-economic status is a driving factor affecting children's WASH behaviours, as LFPS children more readily have the opportunity through consistent WASH access at home to adopt them. The following section investigates the relationship between household variables from the school-based questionnaire which inform socio-economic status, children's WASH behaviours and their associated health outcomes.

4.4.3 *The relationship between socio-economic factors and children's WASH behaviours*

Figure 45 Research Question 3 structure

RQ 3: How are children's WASH behaviours affected by their socio-economic status?

During data collection, one LFPS father implied that not wanting his child to associate with children from a poorer background and different religion was a reason why he had chosen the LFPS, along with the deficient WASH facilities:

> Every parent wants to provide a secure atmosphere for their child. In government school, children come from very poor background and Muslim community too. Also toilet, water, electricity is a problem in government schools.

(LFPS father, 10th February 2020)

Socio-cultural attitudes like the one displayed here point to the extent to which socio-economic inequalities are engrained in ways of thinking. The response to this research question (Figure 45) has shown that there is a marked difference in socio-economic status between government school students and LFPS students. Private school students' mothers and fathers were employed in higher paid positions than government school students' parents and these income inequalities translate into inequalities in WASH access. LFPS students had more secure access to water and toilets at home than government school students and home overcrowding was a lesser issue for them.

This section examines these household inequalities in more depth and investigates their potential link with children's WASH behaviours. This pertains to each domain of the COM-B model. If children live with the factors impeding their opportunity to access household WASH described by parents above, it is reasonable to suggest that they would be disadvantaged in developing the capability and motivation to practise positive WASH behaviours from a young age, even if taught by their parents.

Figure 46 Structural equation model for socio-economic status, children's *Hygiene Practices* and associated *Health Outcomes*
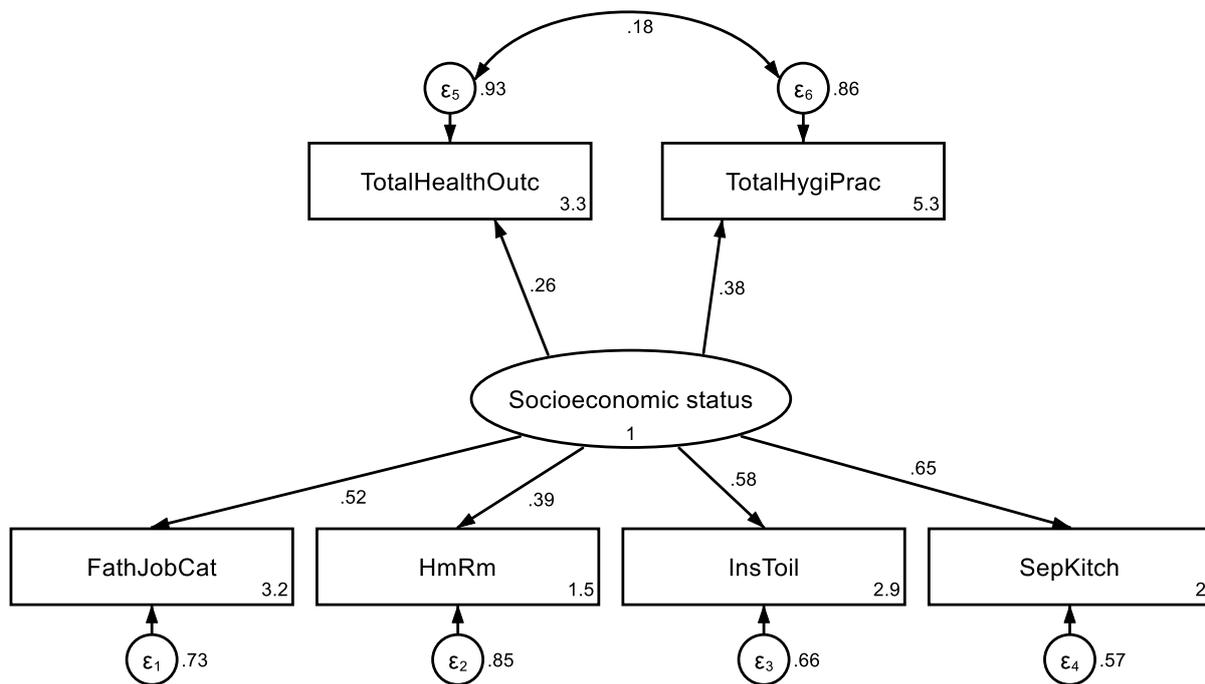
An SEM diagram (Figure 46) illustrates the effect of students' socio-economic status on their *Hygiene Practices*.[8] The latent variable, socio-economic status, consists of father's employment category, number of rooms in home, presence of an inside toilet and separate kitchen as observed variables. Students with a higher socio-economic status are more likely to practise healthy WASH behaviours ($\beta = 0.38$, *p* < 0.01). The model assumes that children's WASH behaviours are correlated with their WASH related health outcomes (e.g. frequency of diarrhoea, dysentery, worm infection and toothache) and indicates that students from a higher socio-economic status are less likely to experience these symptoms regularly ($\beta = 0.26$, *p* < 0.01). The regression tables for the SEM are presented in Appendix 16.

Spearman's rank correlation and independent-sample t-tests were used to examine the potential relationships between the totalled *Hygiene Practices* factor and each of the household background variables individually. A maximum score of 12 (3 for each item) for the totalled *Hygiene Practices* factor indicated that an individual student always

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[8] The model's fit indices (RMSEA = 0.074, SRMR = 0.049, CFI = 0.929, TLI = 0.867, CD = 0.668) and the fact that the χ^2/df ratio is less than 3 (Hoyle, 2015) show that it fits these data well.

washed their hands with soap before eating and after using the toilet, and brushed their teeth twice per day. A number of the household background variables were excluded from analysis because there was little variance in responses. These were mother's employment category, type of home water access, type of material used to build home and type of material used for home floor. First, there are positive, statistically significant but small correlations between father's employment category and number of rooms in home, and children's *Hygiene Practices*, $r_s = 0.298$, $p < 0.01$, $r_s = 0.288$, $p < 0.01$ (Table 20). The number of people living at the household is not correlated with children's *Hygiene Practices*.

Table 20 Spearman's rho correlations for children's *Hygiene Practices* and household variables

Correlations			Father's employment	Number of rooms in home
Spearman's rho	Children's hygiene practices	Correlation Coefficient	0.298**	0.288**

**. Correlation is significant at the 0.01 level (2-tailed).

The next background factors variable to consider is students' home toilet access. 88.7% of respondents said that their home had an inside toilet. As can be seen from the bar chart (Figure 47), the mean total of *Hygiene Practices* for those whose home included an interior toilet was higher than the mean total score for those without an interior toilet. An independent-samples t-test is employed to investigate whether there is any significant difference in *Hygiene Practices* for students whose home includes an inside toilet in comparison to students whose home does not. Students with inside toilets (9.82) scored 1.26 points ($p < 0.01$) more on the questions measuring the frequency of their *Hygiene Practices* than students without inside toilets (8.56).

Figure 47 Household toilet access and children's *Hygiene Practices*
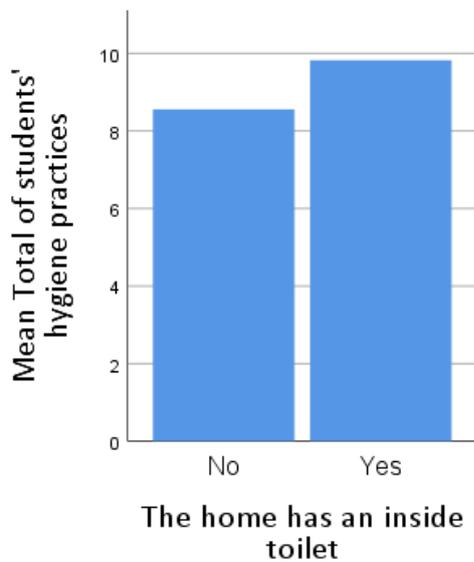
Findings are similar for the variable relating to whether students have a separate kitchen included in their home (Figure 48). 79% of children indicated that their home included a separate kitchen. Students whose homes have a separate kitchen have higher scores in the totalled *Hygiene Practices* factor than those whose homes do not have a separate kitchen. Again, an independent-samples t-test is used to consider differences. Students with kitchens in their homes (9.9) scored 1.13 points ($p < 0.01$) higher on the *Hygiene Practices* questions than students without kitchens (8.77).

Figure 48 Home kitchen access and children's *Hygiene Practices*
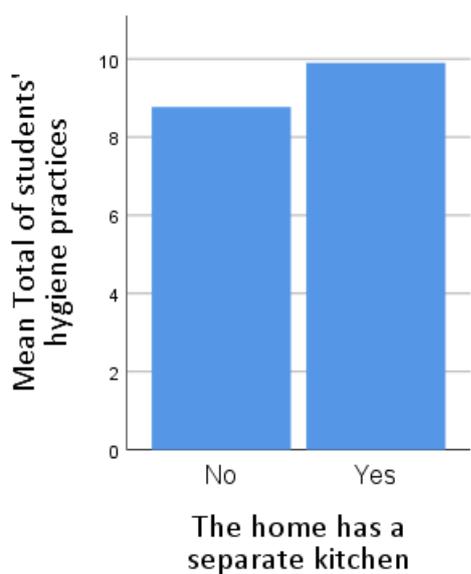
These findings suggest that socio-economic status is a driving factor affecting children's WASH behaviours. Children from a higher-income background are more likely to have the opportunity to practise hygienic WASH behaviours at home and at school as the findings of previous research questions show that the WASH facilities at the LFPS are of better quality than those at the government schools. Children who live with factors impeding their adoption of positive WASH behaviours in the household environment from a young age, such as those described by parents in the previous section, may not have the opportunity to develop the capability and motivation to practise these behaviours unless they receive input at school. In light of this, the following section considers whether schools-based interventions like CURE's programme can address the WASH-related inequalities which the response to this research question has shown are present in these communities.

4.4.4 *Mitigating the effect of socio-economic status on children's WASH behaviours through schools-based interventions*

Figure 49 Research Question 3 structure

RQ 3: How are children's WASH behaviours affected by their socio-economic status?

The final section of this response to the third research question (Figure 49) considers whether schools-based WASH interventions can mitigate the impact of socio-economic status on children's WASH behaviours. This was a central aim of CURE's intervention. In an effort to address WASH-related inequalities at the community level which affect children's WASH behaviours, the programme aimed to extend the benefits of changes implemented in the school environment to benefit the home environment: 'Children monitor hygiene behavior of peers and take the messages home to parents creating a seamless link between schools and home sanitation practices' (CURE, 2020, 'What We Do – School Water and Sanitation'). In this way, the project intended that children would become agents of knowledge transfer, participating in building the capability of the

community to pursue WASH behaviours, having received training through BCC activities at school. CURE took the view that parents would also be key to this in the project objectives: 'Development of life skills and the mobilization and involvement of parents...to work together to improve hygiene, water and sanitation conditions' (CURE, 2019, p4). The project aimed to bridge the gap between schools and the community by involving parents in the work undertaken at the school. In this way, the changes enacted in the school environment would, in theory, filter into family life and support low-income communities to adopt WASH behaviours long-term.

The forming of PTAs aided this; CURE recruited parents to join these groups in which they have opportunities to voice concerns and discuss with school staff. CURE also organised workshops for the parents in which they were taught how to strengthen their household opportunity to practise hygienic behaviours by making more affordable alternatives to common cleaning products such as brooms, soap and disinfectant. During an interview, a representative from CURE explained that the project encouraged pupil-parent knowledge transfer, with children passing onto their parents what they had learnt at school about WASH behaviours. She included an example of how this aim had been successful:

> We teach students from this school to tell their mothers to give them food only after washing hands. The students tell their mothers to wash their hands. If the student goes home and the mother is washing clothes, the student will tell the mother to wash hands before cooking the food.

> A student…from [GISB], CURE taught her about waste segregation (solid waste and liquid waste). And they taught her how to make compost out of liquid waste, whichever waste that came from the kitchen would be put in a box on the roof. She then made this compost at home and her father recounted this story at the school.

(Female member of staff from CURE, 16th January 2020)

A number of staff at intervention schools commented on instances of pupil-parent knowledge transfer arising from CURE's work, corroborating the above. The principal of the girls' section at GISB said that children were returning home from school and sharing their capability with their parents on positive behaviours such as techniques for washing hands (14th January 2020). A parent of a girl at GISB corroborated this, explaining that

her daugh^{te}r taught her about handwashing. She attended a drama at GISB about plastic bag usage and as a result, began to use newspapers to distribute her flower garland business instead of plastic bags (17th January 2020). A male teacher of male students at GISA took a different view on the potential for successful pupil-parent knowledge transfer though:

> These children are from the backward and very poor class families. So definitely what they see here, they don't see at home. So definitely more than half of the time they be with their parents, so whatever the things we teach here, whatever we do with them, they don't follow at home.

(Male teacher at GISA, 17th January 2020)

However, he did not provide evidence towards this viewpoint and comments from his female counterpart contradicted it, although she was referring to female students:

> I can make this out [that the children have passed on what they have learnt to their parents] because the children are cleaner when they are coming to the school. Most of the students are now coming in a very clean way so maybe they told their parents about the cleanliness and that is why they are cleaner when they come to school.

(Female teacher at GISA, 16th January 2020)

No children shared evidence for pupil-parent WASH knowledge transfer taking place as a result of the intervention in focus group discussions and school staff only gave general examples rather than specific instances. While it was an explicit aim of CURE's programme and schools-based WASH interventions could theoretically employ it to mitigate the effect of socio-economic status on children's opportunity to practise WASH behaviours, there was little evidence found for pupil-parent knowledge transfer during data collection.

The data presented in this response to the final research question show that differences in socio-economic status lead to substantial inequalities in WASH access, aligning with the inconsistencies in WASH outcomes and provision across the participating schools explored in the first two research questions (sections 4.2-4.3). This is reflected in accounts of water security from parents of children at the four participating schools and the relationship between socio-economic factors and children's WASH behaviours.

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Schools-based interventions could play a role in narrowing the WASH access gap through building parents' capability, opportunity and motivation during intervention BCC activities and through pupil-parent transfer of WASH knowledge. However, further research is required to understand how this is most effectively implemented.

4.5 Summary

This chapter has presented results in response to three research questions (listed in section 3.1.1) investigating the driving factors affecting children's WASH behaviours in East New Delhi primary schools. With regards to the first research question (section 4.2), there are considerable, statistically significant differences between school types in children's WASH behaviours and school WASH facilities, although not in terms of the extent of their learning about WASH-related health issues. Students at the LFPS reported the most frequent WASH behaviours. According to students from GISA-B, the WASH facilities at their school are of a higher quality than at the GNIS but scores were highest at the LFPS. The investigation of associations between *School Facilities*, *Health Knowledge* and *Hygiene Practices* reinforced this; the strongest positive correlation was between *Hygiene Practices* and *School Facilities* while that between *Hygiene Practices* and *Health Knowledge* was weak. The SEM diagram revealed that students attending schools with higher-quality WASH facilities were more likely to practise positive WASH behaviours more often.

The qualitative analysis built on this, exploring specific ways in which children's access to functioning, well-maintained school WASH facilities affects their opportunity to practise positive WASH behaviours. Evidence from the GNIS, in comparison with GISA-B, demonstrated how a lack of adequate WASH facility provision impedes children's pursuit of positive WASH behaviours, especially for girls. This section also revealed differences in the approach to maintaining WASH facilities between schools. There was a model of support and accountability in place to aid the motivation of school staff at the LFPS who are responsible for the maintenance of WASH facilities. In comparison, the janitorial staff at the government schools were too few in number, under-resourced and contractors attached to the school on an ad hoc basis were not sufficiently motivated to complete their tasks. These findings combine to show that adequate, functioning, well-

maintained school WASH facilities are a driving factor affecting participating students' WASH behaviours, particularly in terms of supporting the opportunity domain.

The response to the second research question (section 4.3) reinforced this conclusion, demonstrating that securing adequate WASH facilities in the school environment is key to the development of children's capability, opportunity and motivation to adopt WASH behaviours. This analysis identified several barriers that school principals face in achieving this: a lack of funding for WASH facilities, teachers' compulsory commitments as public sector employees, teachers' unexplained absenteeism and the high turnover of students. Schools-based WASH programmes, like CURE's intervention, can act as an enabling factor to mitigate these barriers, maximising their long-term positive impact through engagement with the local community and particularly through their work with school staff to increase their motivation for supporting children's adoption of positive WASH behaviours.

Finally, the third research question (section 4.4) considered the effect of socio-economic status on children's WASH behaviours. WASH in the household environment plays a key role alongside the school environment in ensuring children live in healthy and safe spaces. Children who have the opportunity to practise WASH behaviours from a young age at home through access to safe sanitation solutions and consistent potable water provision are more able to develop the capability and motivation to do so before starting school. The data revealed considerable inequalities in WASH access resulting from socio-economic status, following inconsistencies in schools-based WASH outcomes and provision identified in the first two research questions. These are reflected in the household testimonies from parents of children at the four participating schools and in the relationship between children's WASH behaviours and socio-economic factors. Schools-based interventions could play a role in narrowing the WASH access gap through building parents' capability, opportunity and motivation during intervention BCC activities and through pupil-parent transfer of WASH knowledge. However, more research is necessary to clarify how this is most effectively put into practice.

Figure 50 Summary of research findings
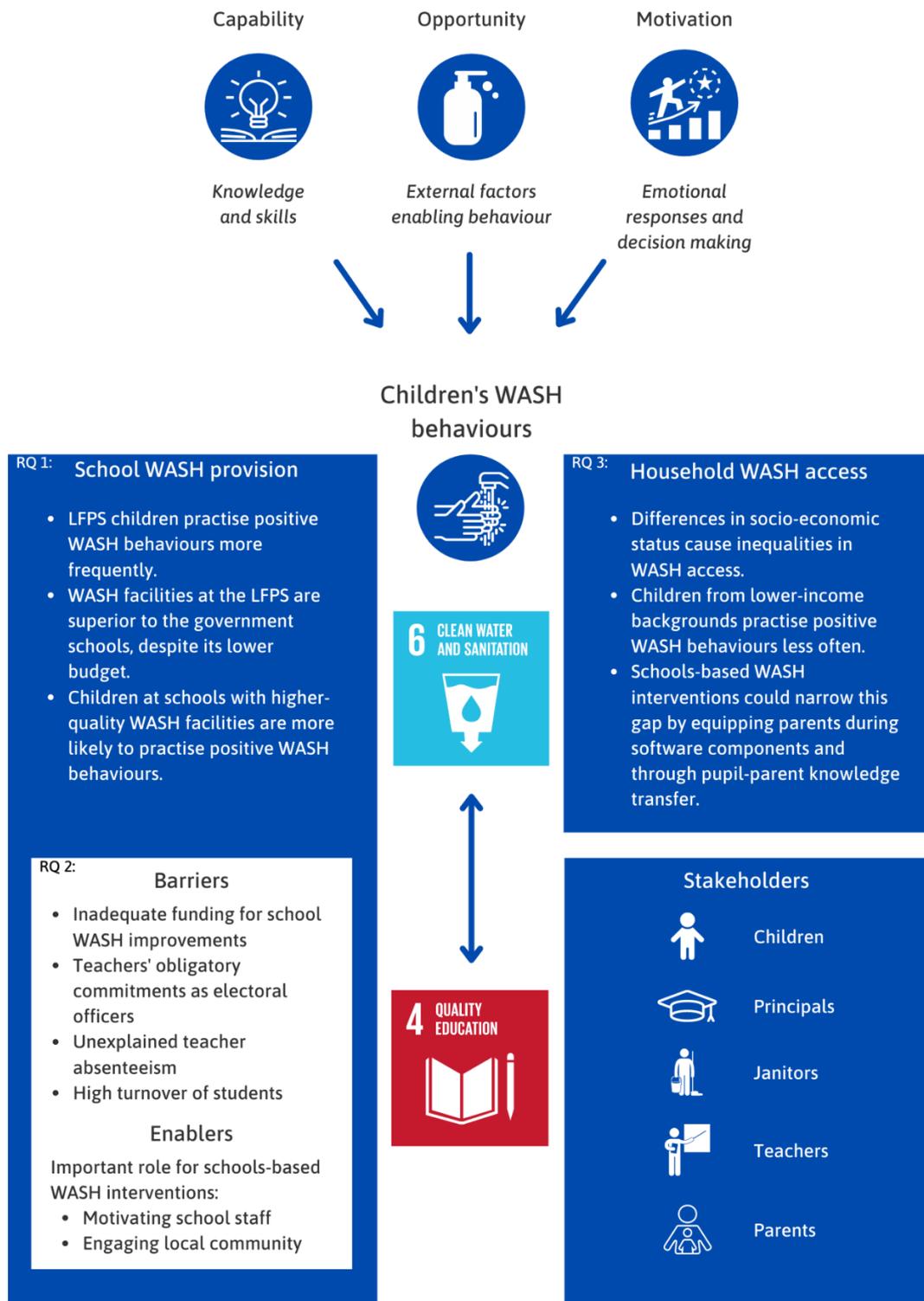
Figure 50 presents a summary of the research findings. Overall, it is clear that school WASH provision, both in terms of facilities and staff input, is a driving factor affecting children's WASH behaviours in these East New Delhi primary schools. Schools-based WASH interventions incorporating complementary hardware and software elements can

address the barriers to children's adoption of positive WASH behaviours caused by inadequate school WASH provision. This can be particularly effective by motivating school staff and engaging the local community to uphold and sustain intervention outcomes in the long term post-implementation. Schools-based WASH interventions especially have the potential to reduce inequalities in WASH access precipitated by differences in socio-economic status, another major driving factor affecting children's WASH behaviours. Children from lower-income backgrounds practise positive WASH behaviours less frequently than their wealthier peers. If standards were raised in government schools through schools-based WASH interventions to match those in LFP schools, government school children whose families are unable to afford fee-paying education could develop the capability, opportunity and motivation to adopt sustained positive WASH behaviours.

Chapter Five: Discussion

5.1 Introduction

This chapter presents an overview of the findings presented in Chapter Four and situates the core contribution to knowledge (see section 1.9) that this research provides in the context of the wider literature. The findings build on previous studies, adding clarity to what is understood regarding how the school environment and socio-economic status shape children's sustained adoption of positive WASH behaviours. They also contribute valuable insight into the role of schools-based WASH interventions within this. The structure of this chapter follows the path set out by the three research questions (listed in section 3.1.1) in Chapter Four, each of which combine to identify the driving factors affecting children's WASH behaviours in East New Delhi primary schools. The chapter concludes with consideration of the limitations of the current study and the possibility for future research in the area of schools-based WASH provision.

5.2 School WASH provision and children's WASH behaviours

1. How does school WASH provision in differing school types affect children's WASH behaviours?

The literature reviewed in section 2.2.2 highlights the global problem of children's susceptibility to WASH-related diseases (Jasper et al., 2012; Khalil et al., 2018) which can negatively impact their cognitive development (Wierzba and Muhib, 2018). Returning to the capability approach outlined as a foundational approach to development in section 1.1, Sen (2001) argues that the issue of poverty is more complex than a mere indicator of basic income. Avoiding preventable diseases is a key 'functioning' (ibid., p75) for people to attain in order to build 'substantive freedoms' in life (ibid. p87) and WASH has an integral role to play in this worldwide. Previous WASH studies (reviewed in section 2.3.1) address this by evaluating WASH interventions, similar to CURE's programme, which seek to improve children's WASH behaviours and their health outcomes by reducing their exposure to WASH-related diseases (Hetherington et al., 2017; Chard et al., 2018; Vally et al., 2019; Shrestha et al., 2020b). The first research question in this

study followed this by investigating the effect of school WASH provision across different school types on children's WASH behaviours which, in theory, affect their WASH-related health outcomes.

Pertaining to children's capability and opportunity to practise positive WASH behaviours, it aimed to reveal the true picture that lies behind the partial narrative on school WASH put forth in publications like the Economic Survey of Delhi 2019-2020 (Government of NCT of Delhi, 2020). This states that gender-separate toilets and drinking water facilities are universally accessible in Delhi schools but fails to mention the extent to which they are maintained and used correctly.

5.2.1 *Differences in children's WASH behaviours between school types*

First, children's WASH behaviours were compared between school types in section 4.2.1. There was no statistically significant difference in students' stated *Hygiene Practices* (e.g. WASH behaviours such as HWWS, teeth brushing) between GISA-B and the GNIS. While this implies that the schools-based WASH intervention did not bring about the desired changes in this area, the qualitative analysis revealed children's enthusiasm for pursuing healthy WASH behaviours at GISA-B, particularly in terms of their understanding of the importance of drinking clean water regularly throughout the day and their willingness to fulfil WASH-related tasks such as emptying bins in the school compound.

These insights contribute evidence towards the argument proposed in the literature (section 2.3.2) for increased focus on environmental topics in the primary school curriculum, affirming Manisha's (2015) argument for more WASH input at primary school level, as well as Akhand and Sunder's (2019) research which was conducted with the same year group age of children in India as the current research. They find that teachers' prioritisation of environmental studies builds children's environmental awareness and Laiphrakpam et al. (2019) (also based in India) add to this by stating that this environmental awareness leads directly to behaviour change. This could serve as a low-cost method for increasing children's motivation to adopt positive WASH behaviours. Building children's motivation in school to overcome WASH challenges through appropriate WASH education could equip them to face water insecurity,

meeting their own needs and those of others, regardless of their household situation. This need to involve and equip children is recognised in the literature by those who advocate increased community participation in WASH intervention design and implementation (Sommer, 2010; de Albuquerque, 2014; Sahin, 2015).

The lack of statistically significant difference between the government school types contrasts with previous studies (section 2.3.1) which found that schools-based WASH interventions lead to a positive change in children's WASH behaviours (Saboori et al., 2013; Boubacar Maïnassara and Tohon, 2014; Vally et al., 2019). However, some of these studies compared intervention outcomes with baseline data rather than control schools and if this method had been available during this current research, positive intervention outcomes could have emerged more clearly. Other previous studies benefited from a longitudinal design which enabled them to track outcomes; this is particularly clear in Chard and Freeman (2018). Approaches that could build on this current thesis study are explored in greater detail at the end of this chapter.

Meanwhile, LFPS students' reported WASH behaviours were statistically significantly more frequent than those of their government school counterparts. Previous studies of LFP schooling (section 2.3.5) largely focus on learning outcomes rather than WASH. One example though is a Kenya-based study (Girod et al., 2017) where MHM provision was found to be greater in government schools (where menstrual materials were distributed free of charge) than in private schools (where there was no similar scheme). However, the literature does highlight that many LFP schools are not accessible to the poorest families (Day Ashley et al., 2014; Singh and Bangay, 2014; Ezaki, 2020). Therefore, this research sheds light on WASH inequalities between contrasting school types which further disadvantage children from lower-income backgrounds. These findings related to children's WASH behaviours raise the question as to why these results are better for children in the LFPS than in the government schools and part of the answer lies in school WASH provision.

5.2.2 *Differences in school WASH provision between school types*

Inconsistencies in WASH facilities provision between school types and how these enable or impede children's development of the capability and opportunity required to adopt positive WASH behaviours were revealed during analysis. Statistically significant results from one-way ANOVA tests revealed stark differences in children's perception of their school's WASH facilities. Students at GISA-B thought it was of a higher standard than students at the GNIS. This implies that CURE's intervention contributed towards positive outcomes at GISA-B. This adds to the findings of previous studies (section 2.3.1) which consider schools-based WASH interventions which specifically address school WASH provision through a similar comparative design. Some of these also find that WASH provision is superior at intervention schools (Bieri et al., 2013; Karon et al., 2017) while others are inconclusive (Dujister et al., 2017). LFPS students, who overall came from a higher-income background than the government school students, were more positive about their school's WASH facilities than the other two groups, thus highlighting how inconsistencies in school WASH provision between the participating schools further aggravate inequalities that already exist. It also sheds light on why parents who can afford LFP schools choose them: there is a perception that government schools are unsatisfactory so parents seek cleaner, safer alternatives (Härmä, 2013; Endow, 2018; Mousumi and Kusakebe, 2019).

Considering these differences in children's WASH behaviours and school WASH provision between school types, it was therefore pertinent to investigate the effect of the latter on the former. The largest correlation was between *School Facilities* and *Hygiene Practices*, indicating that differences in school WASH facilities between the participating schools are a driving factor in enabling or impeding children to have the opportunity to pursue healthy WASH behaviours. The SEM diagram (Figure 21) reinforced this, revealing that improvements in WASH facilities mean that children are more likely to practise positive WASH behaviours and that schools are more likely to build their students' WASH capability through teaching about health issues including handwashing and common infectious diseases. These findings reinforce the conclusions of previous studies which cite the widespread positive impact that high standards in school WASH provision can have (Cronk et al., 2015; McMichael, 2019; Snyder et al., 2020).

Children's WASH-related *Health Outcomes* were also included in the SEM and the fact that the impact of *School Facilities* was considerably less on *Health Outcomes* than *Hygiene Practices* is reflected in the wider literature (Saboori et al., 2013; Boubacar Maïnassara and Tohon, 2014; Dujister et al., 2017; Humphrey, 2019). Looking to the previous literature to explain this, Gitore et al. (2020) cite a number of non-school factors affecting children's STH infection such as number of people in household and Ghanim et al. (2016) find that parents are a more common source of hygiene knowledge than teachers. It is recognised that children's susceptibility to WASH-related health issues is affected by a large number of variables, of which school-related variables (e.g. WASH facilities) constitute a part. This demonstrates how the critical realist theory of emergence (section 3.3.1) is a useful model for understanding the different factors at play in schools-based WASH. Although the relationship with their WASH-related health outcomes was less clear, school WASH facilities emerged as a driving factor in facilitating children's opportunity to adopt positive WASH behaviours. This finding justifies the SDG 4 target to 'Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all' with basic drinking water, single-sex sanitation facilities and basic handwashing facilities included as specific indicators (UNGA, 2015, p19).

As Chatterley et al. (2018) explain, 'Children spend a significant part of their day at school where WASH services can improve educational opportunities and decrease the potential for disease transmission' (p596). School WASH facilities can be an enabling factor, providing the opportunity for children to put their capability (skills and knowledge) and motivation (emotional responses and decision making) into practice with regards to positive WASH behaviours. However, they can also act as an impeding factor with substandard WASH provision, even if newly installed, increasing the dangers posed by infectious diseases (Greene et al., 2012). This research reveals an inconsistency in school WASH provision; differences in WASH facilities between participating schools serve to heighten pre-existing inequalities as the LFPS' WASH provision is superior to that of the government schools (Tooley et al., 2010), particularly in terms of monitoring the maintenance of WASH facilities. For example, dirty and unhygienic school toilets such as those observed at the GNIS can be associated with increased student

absenteeism (Dreibelbis et al., 2013b). Disparity in school WASH provision puts children from lower income backgrounds who live in overcrowded conditions at further risk of contracting the WASH-related infectious diseases delineated in Chapter Two (Troeger et al., 2017; Khalil et al., 2018), to which COVID-19 can also be added (Das et al., 2020; Kamath et al., 2020).

Qualitative analysis in section 4.2.3 revealed a shortfall in WASH facilities provision, particularly evident at the GNIS, with faulty water access, an inadequate number of handwashing stations and dirty toilet blocks with no running water. This is of particular concern as a lack of water supply correlates strongly and positively with helminth infection and diarrhoea prevalence, to a greater extent than other WASH indicators (Dreibelbis et al., 2014; Freeman et al., 2014; Freeman et al., 2015). Furthermore, these issues point to slow progress on SDG 4 targets to 'Build and upgrade education facilities that are child, disability and gender sensitive' (UNGA, 2015, p19) and deny children the opportunity to practise positive WASH behaviours in the school environment, even if they have the capability and motivation to do so. Literature presented in Chapter Two also pointed to the impact of inadequate school WASH provision on children's WASH behaviours (Boubacar Maïnassara and Tohon, 2014; Vally et al., 2019). Gender-related barriers to WASH access highlighted by Mchenga et al. (2020) are of particular concern as the SEM (Figures 26-27) showed a greater impact of *School Facilities* on *Hygiene Practices* and *Health Knowledge* for girls than for boys. This builds on previous research revealing the current inadequacy of schools worldwide to provide a safe space for girls to manage menstrual hygiene (Ellis et al., 2016; Sommer et al., 2020; Mchenga et al., 2020). According to the UNGA 64/292 Resolution recognising water and sanitation as human rights highlighted in section 1.5, they are 'essential for the full enjoyment of life and all human rights' (2010, p2) and intrinsically linked to gender equality. Inadequate provision of school WASH facilities compromises these human rights, placing a particular burden on girls, and could contribute towards widening the worldwide gender education gap even further.

5.2.3 *Water and sanitation for all*

Inconsistencies in school WASH facilities, with superior provision at the LFPS in comparison to the government schools, aggravate pre-existing socio-economic inequalities as children from lower-income backgrounds whose parents cannot afford LFPS fees subsequently have less capability and opportunity in the school environment to access safe WASH facilities which facilitate healthy WASH behaviours. This has ramifications for the attainment of SDG 6 which issues a clarion call for 'water and sanitation for all' (UNGA, 2015, p20). There is a clear connection here to the United Nations General Assembly's Resolution 64/292 adopting water and sanitation as human rights (2010) explored in section 1.5. At national or local governance levels, if the human right to water and sanitation is to be realised in schools such as those participating in this research where WASH coverage is inconsistent, regulatory frameworks aligned with SDG criteria (Giné-Garriga et al., 2017) are required to apply the concept of progressive realisation mentioned by Tiboris (2019), allowing schools the flexibility to work towards targets incrementally. However, Giné-Garriga et al. (2017) also conclude that the SDGs are ineffectual in monitoring how the needs of vulnerable groups are met; this must be addressed in the post-2030 agenda for sustainable development.

It is also possible that Heller's (2015) point that states are obligated to provide water and sanitation for the population, who then hold the government to account, can be applied at the grassroots level in schools. Children could be equipped to hold their schools or local education leaders to account through student council initiatives which would also enable them to develop into 'informed citizens who are capable of defining problems, fostering solutions, and enacting those solutions' (Hollstein and Smith, 2020, p228), as per the aims of environmental education discussed in section 2.3.2 and CURE's class monitor system. However, some argue that children should not be expected to fulfil the role of change agent, citing the UN's Convention on the Rights of the Child (Joshi et al., 2016).

5.3 Particular barriers and enablers to provision of safe school WASH facilities

2. What are the barriers and enablers to school management providing adequate school WASH facilities?

The first research question investigated the role of school WASH facilities as a driving factor affecting children's WASH behaviours. The second analysed qualitative data to explore this area in greater depth, identifying the specific enabling and impeding factors that school management experience in the provision of school WASH facilities which facilitate children's development of capability, opportunity and motivation to adopt WASH behaviours. This follows previous WASH-focused studies highlighted in section 1.8.3 which apply the COM-B model to identify barriers to the adoption of targeted behaviours and which recommend the use of this framework for devising and evaluating interventions (Okello et al., 2019; Ellis et al., 2020; McGuinness et al., 2020b).

5.3.1 *WASH funding, teacher absenteeism and transient student populations*

Four barriers to the provision of adequate school WASH facilities arose from the qualitative analysis to address this. The first was a barrier to children's opportunity to practise positive WASH behaviours in school; principals require easier access to sufficient funding to address WASH facilities and maintenance staffing issues. This will be particularly true when Delhi schools reopen following COVID-19 closures to limit the spread of the virus as much as possible. The other three pertain to children's capability (in the COM-B model sense – their skills and knowledge) to practise healthy WASH behaviours. The teacher absenteeism that results from teachers' secondary employments as public sector employees needs to be decreased by hiring specific employees for electoral administration roles (Mitul and Agha, 2018). Furthermore, teachers were often absent from classrooms at the government schools even when they were not required to be for their electoral responsibilities. Further monitoring and dialogue with teaching staff is required to understand why teachers are not in classrooms when they are meant to be. Finally, in order to support children who arrive at schools after interventions have ended, teachers should be equipped and motivated to continue BCC activities post-intervention in an ethical manner (František and

Novotný, 2019), running WASH-themed after-school clubs or receiving time set aside for WASH education in the curriculum, as in the Project SHINE intervention (Hetherington et al., 2017).

Considering these barriers in the context of Sen's capability approach (2001) assists in situating them and further understanding the structure of these issues in the participating schools. Nussbaum describes 'central capabilities' (2011, p17), emphasising that 'the most important elements of people's quality of life are plural and qualitatively distinct: health, bodily integrity, education, and other aspects of individual lives cannot be reduced to a single metric without distortion' (ibid., p18). In the case of these barriers, they are impeding children at the participating schools in building 'central capabilities' (ibid., p17) which lead to these quality of life elements. Without adequate school funding or teachers, children will not adopt the positive WASH behaviours which lead to key 'functionings' (Sen, 2001, p75) such as living life with dignity or accessing clean water. Nussbaum (2011) gives the example of women who work in employment during the day and return home to fulfil their domestic duties, impeding their 'employment opportunities, political participation, physical and emotional health' (p36). The same can be said of children who are denied a safe, healthy and secure learning environment; they may experience difficulties in attaining 'functionings' (Sen, 2001, p75) such as physical health, future employment opportunities, dignity and positive interaction with nature (Nussbaum, 2011). At the same time, there may be reasons relating to limits on capabilities which cause these barriers in the first place. For example, teachers may be absent from school to earn extra income elsewhere so they can attain 'central capabilities' (Nussbaum, 2011, p17) such as 'to love those who love and care for us' (ibid., p33) and 'having property rights on an equal basis with others' (ibid., p34). In seeking solutions, it is important to include all stakeholders in discussions to come to realistic conclusions, leading to high-quality learning environments. In particular, teachers need adequate pay, as well as the freedom to fulfil their school roles without compulsory secondary commitments which remove them from the classroom.

5.3.2 *Ensuring sustained behaviour change following schools-based WASH*

interventions

The reliance on CURE implied by staff comments in qualitative data showed that
increasing adherence to programme recommendations post-intervention is vital for
addressing these barriers and sustaining outcomes. This is also an issue that arose
during the literature review, as explored in section 2.4.2 (Garn et al., 2017;
Madziyauswa, 2018; Humphrey, 2019; Ejelonu et al., 2020). Further input, independent
of CURE, was required from school staff in the long term to sustain intervention
outcomes, something that Chard and Freeman (2018) and Humphrey (2019)
acknowledge as a particular challenge. School staff at GISA-B had a positive outlook on
CURE's work, including qualitative evidence of increasing school attendance and
supporting girls in MHM, thus diminishing the gender-related barriers outlined in section
1.6 (Ellis et al., 2016; Agol and Harvey, 2018). This finding is shared with the evaluation
of the Project SHINE WASH programme in Tanzania conducted by Hetherington et al.
(2017) where one positive outcome was that teachers were enthusiastic and engaged
with the participatory approach. However, one difference between the two programmes
is that while staff from GISA-B praised the programme outcomes, they did not express
enthusiasm for upholding these outcomes themselves moving forwards and expressed
reliance on CURE for this. This could be why the WASH hardware improvements did not
translate into sustained behaviour change to the extent that it could have done.

The lack of sustained behaviour change is a lesson that can be learnt on a national scale
from the TSC (Barnard et al., 2013) and SBA (Jain et al., 2018; Mohapatra, 2019) national
campaigns critiqued in section 1.8. It is also an issue highlighted by Saboori et al. (2013)
and according to Humphrey (2019), the main reason why smaller scale WASH
interventions do not result in improved health outcomes. It is significant as school staff,
particularly teachers, can fulfil an important role in sustaining positive behaviour change
in the long term if they have the capability, opportunity and motivation (are enthused,
trained and incentivised) to do so (Rosen et al., 2009; Michie et al., 2011; Hetherington
et al., 2017; La Con et al., 2017; Harahap et al., 2018). CURE did hold a one-off training
session for teachers from participating schools (section 4.3.1) but they would have

benefited from an additional, continual schedule of sessions relating to national schools-based WASH policy, as recommended by Deroo et al. (2015), to foster enthusiasm for securing the students' long-term behaviour change.

The question is raised then as to how to ensure that positive Intervention outcomes endure over time. Staniford and Schmidtke (2020) argue that hygiene interventions are most successful in securing and sustaining their targeted outcomes when the three domains of the COM-B model – capability, opportunity and motivation – are integrated equally into intervention design. This is attested by previous WASH-related literature applying the COM-B model; Arriola et al. (2020) employ it to design a WASH and nutrition-related intervention and produce a specific, targeted programme which is also broad and comprehensive. Several studies use it to identify different key determinants of WASH behaviour change (Okello et al., 2019; Ellis et al., 2020; McGuinness et al., 2020b). Previous schools-based research identifies a key role for school staff in securing children's WASH behaviours following interventions (Saboori et al., 2013; Agol and Harvey, 2018). In a Kenya-based study, Garn et al. (2016) report that the rate of diarrhoea infection decreased as adherence to intervention recommendations increased.

With regards to what is arguably the most damaging widespread negative WASH behaviour, little evidence during data collection pointed to widespread OD in the participating schools. Faecal matter was discovered in the corridor at GISB and this was attributed to very young students who have not yet developed the capability to use school toilet facilities correctly. This is a consideration which supports Wagner and Samuelsson's (2019) advocacy of particular WASH input at pre-school level. A number of GISA staff also reported children misusing the toilet blocks by defecating anywhere in the block rather than in the toilet itself. OD persists more in rural India (Mara, 2017; Coffey and Spears, 2017) and it is possible that the reasons for OD continuation outlined in section 2.2.1 are not as applicable in Delhi, where OD has allegedly significantly reduced in recent years (Rahman et al., 2020). Households participating in surveys were largely found to have either an interior toilet or access to community toilets in the

proximity of the home. It is also clear that school students and staff would be unlikely to admit that OD is a persisting issue at their school, particularly school management.

Interventions such as CURE's can address these barriers to the provision of safe school WASH facilities by focusing particularly on more disadvantaged schools, attended by children who often rely on the school environment for secure access to piped, potable water, safe sanitation and regular HWWS opportunities. As CURE's intervention aimed to do this through its selection of the participating schools, it was pertinent to analyse the intervention as an enabling factor in school management's provision of adequate school WASH facilities. While the quality of WASH provision at the LFPS exceeded that of the three government schools, WASH provision at GISA-B was superior to that of the GNIS, even though there was no statistically significant difference between the two types of government school relating to children's WASH behaviours. This suggests that the intervention brought about positive WASH hardware change, following the precedent set by previous similar interventions (Erismann et al., 2017; Chard et al., 2018; Shrestha et al., 2020b). However, to provide children with the capability, opportunity and motivation to adopt sustained, positive WASH behaviours, future interventions should engage school staff over a long period of time, providing engaging, regular WASH education training, and motivation and support to uphold intervention recommendations.

Assisting teachers in fulfilling their role as supportive role models for children can help to meet the long-term aims of the WASH software components in schools-based interventions to bring about sustained positive WASH behaviour change. However, this is only achievable if teachers are motivated to do so. Thus, the COM-B model is applied to school staff as well as children. It is possible that teachers receive the capability (e.g. skills and training) and opportunity (e.g. employment) to fulfil this important role but this research shows that the third domain of the model, motivation, is equally vital in achieving the intervention aim of sustained WASH behaviour change. Humphrey explains that the low rate of success for small-scale WASH interventions can be attributed to 'their requirement for high user adherence to consistent sustained behaviour change' (2019, p1158) and this is pertinent to the role of teachers in schools

participating in WASH interventions. In an effort to address this, Garn et al. (2017) recommend long-term post-implementation engagement with WASH interventions to emphasise the importance of adherence to outcomes. Children should not have to assume sole responsibility for bringing about WASH behaviour change (Joshi et al., 2016) and they require support in building the capability, opportunity and motivation to do so. Therefore, collaboration with school staff on a regular basis post-implementation should be built into the programme design of schools-based WASH interventions to ensure children's adoption of positive WASH behaviours. Finally, the longitudinal methods of regular behavioural observation recommended by Martin et al. (2018) should be employed to measure the outcome of these efforts to improve adherence to intervention recommendations.

5.4 Socio-economic status and children's WASH behaviours

3. How are children's WASH behaviours affected by their socio-economic status?

One of the principal aims of CURE's intervention was 'creating a seamless link between school and home sanitation practices' (CURE, 2020, 'What We Do – School Water and Sanitation'). Therefore, the third research question considered socio-economic status and WASH access in the households of participating students as a possible driving factor affecting their WASH behaviours, shedding light on potential WASH-related inequalities faced by students outside of the school environment.

5.4.1 *Inequalities in household WASH access according to school type*

Significant inequalities between government school students and their private counterparts emerged from both the quantitative and the qualitative data. Government school parents alluded to the burden of providing for their families and the mental health issues related to this. These inequalities were evident when comparing parents' income across school types, as well as household indicators such as number of rooms, number of household inhabitants and overcrowding. They were also apparent when discussing with parents the fragile nature of their household WASH access, something that has taken on renewed significance during the COVID-19 pandemic with so much

focus on HWWS (Ray, 2020), particularly considering that parents are often a major source of hygiene knowledge for children (Ghanim et al., 2016).

A number of factors enabling and impeding children's opportunity to practise positive WASH behaviours were highlighted by parents explaining their experiences of household WASH access. Some of the previous literature surveyed in sections 1.2 and 1.7 relating to WASH definitions and household water security offers recommendations and insights relating to these. GISA parents shared comments about dirty piped water from the Delhi *Jal* Board and the necessity to collaborate with other households in investing in a shared borewell. Narain and Singh (2017) recommend that interventions should take into account such informal solutions like household cooperation. Contamination of allegedly 'improved' water sources is also a problem reported in the literature (Bain et al., 2014; Cronk et al., 2015) with Headey and Palloni arguing that 'the official definition of "improved water" may need to be revisited' (2019, p732) to include water quality in addition to factors already considered such as consistency of provision.

Parents also described the regular process of receiving water from neighbours as a way to mitigate water insecurity. This sense of cooperation and sharing arose frequently during household interviews and focus group discussions and is alluded to in the literature as a short-term solution to water insecurity at the community level (Brewis et al., 2019b). It can also exacerbate existing inequalities if instances of negative reciprocity occur and people attempt to take advantage of their position (Wutich et al., 2018). Some parents mentioned buying packaged water from a local business when Delhi *Jal* Board piped provision is interrupted or dirty. A centrally located community toilet block was commonly used by some participants and the Indian community-led approach to shared sanitation is apparently one to be followed in urban areas of other Global South countries (Mara, 2016). Buckley and Kallergis (2019) argue that community toilets should count towards 'improved' facilities but this one closed at 11pm. Community toilets are a viable, inexpensive way to increase opportunity to practise positive WASH behaviours but the fact that this facility was not open at night meant that those practising OD during hours of darkness were particularly vulnerable to GBV, a problem highlighted by Cavill et al. (2016) and Kulkarni et al. (2017).

Qualitative data from GISB parents indicated that WASH provision is marginally more stable in this area. Respondents mentioned seasonal variations in water access, with water more intermittent in the summer months, leading to increased anxiety relating to water security at these times (Brewis et al., 2019b; Stoler et al., 2019). During these interruptions, they can also order packaged water. One parent's concerns about her inability to do laundry due to water shortages lent context to GISB staff's remarks about students' cleanliness. GISB respondents added to the theme of collective community responsibility mitigating the effects of water insecurity through a WhatsApp group used to warn local residents of water being turned off by Delhi *Jal* Board. Wutich et al. (2017) state that organised schemes like this can be affected by pre-existing inequalities, resulting in marginalised groups being excluded, so it is important that these are not manipulated by actors to gain power over others. GNIS households also relied on packaged water during water interruptions. One parent highlighted the challenges of community water access, sharing a local borewell with 500 people which results in long queuing times. This is an issue that could be addressed by the Delhi-based 'water ATMs' scheme investigated by Sarkar (2019) which is a private alternative to the Delhi *Jal* Board's government provision. However, Sarkar (ibid.) also indicates that this scheme can serve to further disadvantage communities which are already marginalised, introducing an additional financial barrier to the opportunity to access clean water consistently.

Meanwhile, every LFPS parent interviewed bypassed the Delhi *Jal* Board network entirely by owning a RO system and private borewell, allowing for safe, clean, regular water regardless of interruptions to the public provision. This shows that socio-economic status is a significant factor in ensuring the opportunity to practise healthy WASH behaviours (Freeman and Clasen, 2011) and reinforces Härmä's (2013) observation that in the Global South, many parents opting to send their children to LFP schools also access water privately. Thus, some of the inequalities at play in access to schooling are mirrored in the WASH context, as outlined in section 2.4.1. The element of collective community spirit that was evident during discussions of water insecurity with parents from GISA-B and the GNIS did not arise in interviews with LFPS parents, presumably because ownership of private connections negated the need for this.

However, they did acknowledge the rapid depletion of Delhi's groundwater. There is a disconnect at play here as although RO systems are effective in providing access to safe water, they contribute towards water insecurity in the long term as the process is highly wasteful (Garcia-Suarez et al., 2019) and is inaccessible to the majority of low-income Indian households (Koshy, 2020). Two GNIS mothers explained their differing approaches to water resilience with regards to RO systems. The first explained that for her, an RO system is not necessary because she decontaminates water by boiling it and stores it for emergency use when the piped water is turned off. The second did own an RO system but said that she conserves water by using the wastewater from the appliance for non-drinking purposes such as cleaning. These resilient micro-solutions at the household level are vital, given the established negative impact of water insecurity upon mental health (Shrestha et al., 2018; Brewis et al., 2019a; Stoler et al., 2019).

5.4.2 *Socio-economic status is a driving factor affecting children's WASH behaviours*

The literature (Joshi and Amadi, 2013; Hutton and Chase, 2017; Gitore et al., 2020), as well as the stark contrast revealed by the qualitative data between the WASH provision in the household contexts of children attending government and private schools justified analysis of socio-economic status as a driving factor affecting children's WASH behaviours. Interviews revealed some individual testimonies of the disparities between government school and private school students' experiences, with one LFPS parent intimating that the reason why his child attended the 'secure atmosphere' of the LFPS was because government school students were from impoverished Muslim communities.

The SEM diagram in section 4.4.3 (Figure 46) indicated that children from wealthier households had more opportunity to practise healthy WASH behaviours, and to a lesser extent had better WASH-related health outcomes. This fits with the findings from schools-based WASH research in Indonesia; students who had access to improved sanitation at home due to their higher socio-economic status were less likely to practise OD at school (Karon et al., 2017). While WASH-based inequalities exacerbate pre-existing income inequalities, these pre-existing income inequalities also appear to aggravate WASH-based inequalities, both in terms of facilities access and practice of

behaviours. Spearman's rank correlations and independent-samples t-tests reinforced these findings by considering the relationship between the socio-economic status variables and children's WASH behaviours. This was particularly pertinent because the literature indicates that low-income families may consider the installation of WASH facilities to be prohibitively expensive, even if that is not the case (Coffey et al., 2014; Sinha and Chaudhry, 2019). Father's employment category and the number of rooms in students' homes were both correlated with students' *Hygiene Practices* at a statistically significant level ($p < 0.01$). Students with a toilet and separate kitchen inside their home were also slightly more likely to have healthier *Hygiene Practices*. Thus, household WASH access is a driving factor affecting children's opportunity to practise positive WASH behaviours. More broadly, WASH access in both the household and school environments is central to achieving the SDGs and not leaving the poorest communities behind (Milan, 2017).

Again, considering this in light of Sen's capability approach, 'judging individual advantage in terms of the capabilities that a person has…the substantive freedoms he or she enjoys' (2001, p87) allows for a clear observation of how socio-economic status interacts with children's WASH behaviours. Understanding poverty as the 'deprivation of basic capabilities' (ibid.) demonstrates that children from a higher socio-economic status face fewer barriers in building the capability, opportunity and motivation they need to attain the 'combined capabilities' (Nussbaum, 2011, p21) which dictate key 'functionings' (Sen, 2001, p75) like living life free from disease and accessing adequate nutrition. For example, a child from a higher socio-economic status does not only come from a household with more income. They may attend a school with clean, well-maintained WASH facilities and consistently present teachers. They may enjoy a constant supply of potable water at home through the use of a reverse-osmosis purification system. They may not need to travel to use community toilets because they have adequate facilities in their home. The consistent presence of these 'substantive freedoms' (ibid., p87) means that for children from a higher socio-economic status, positive WASH behaviours are more in reach.

5.4.3 *Schools-based WASH interventions can mitigate the effect of socio-economic status on children's WASH behaviours*

Finally, the response to this third research question considered pupil-parent knowledge transfer and to what extent schools-based WASH programmes could mitigate WASH-related inequalities by bridging the gap between the school and the community with regards to WASH knowledge, attitudes and practices. This concept was explored in section 2.3.4 and is mentioned in the literature as a common aim of schools-based WASH interventions (Ejelonu et al., 2020). There is some evidence for its success (Bresee et al., 2016; Karon et al., 2017) but encouraging children to play a role in building the capability of their community to adopt sustained WASH behaviour change is not reliable; the passing of knowledge from children to parents does not necessarily result in behaviour change (Freeman and Clasen, 2011). Furthermore, it is important to note that in light of the UN's Convention on the Rights of the Child, children should not be burdened with the sole responsibility of fulfilling the role of change agents (Joshi et al., 2016).

The findings from this thesis study correspond with the previous literature as although some evidence for pupil-parent knowledge transfer was apparent in an interview with a member of CURE staff, teachers were unable to provide specific examples and few parents of children attending intervention schools were familiar with the programmes implemented in the schools. Further research is required to ascertain the extent to which pupil-parent knowledge transfer is a viable way of bringing about sustained adoption of positive WASH behaviours. If pupil-parent knowledge transfer is to be successful, children need support in developing the capability, opportunity and motivation to enact it (Michie et al., 2011; Staniford and Schmidtke, 2020). Bresee et al. (2016) found that children were motivated to share knowledge with their parents and that mothers trusted children to do so accurately. However, the authors concluded that children need a supportive framework of set resources and structured activities (e.g. the capability and opportunity) to do so.

5.5 Limitations

There are a number of limitations that were encountered during this study that affected the research design, data collection, analysis and reporting. Price and Murnan (2004) highlight the importance of reporting limitations, defining them as 'the systematic bias that the researcher did not or could not control and which could inappropriately affect the results' (p66). In the current study, the number of schools participating is small (4); this was due to constraints on time, financial resources and the difficulties inherent in gaining access to Indian government schools for research purposes. The researcher only had limited access to GISB and the GNIS, especially GISB where the boys' principal did not give permission for any of the data collection to go ahead, despite official letters of agreement from CURE and the EDMC education department (Appendix 3). This meant that the same types of data were not collected at each school. Recruitment of a higher number of participating schools, particularly LFP schools charging even lower fees than the 2,000 Rs (20 GBP) per month charged by the participating LFPS, would have enabled deeper insight into the different factors affecting children's WASH behaviours between differing school management types. Statistically significant relationships and other findings presented in this research should be interpreted with caution, particularly those relating to comparisons between school management types. It is not possible to generalise these findings to contexts other than equivalent schools in the Delhi region (Bogdan and Biklen, 1992).

The children self-reported information including their recent WASH behaviours and health outcomes. Therefore, it is important to consider the validity of the data in light of this. This is a common limitation of schools-based WASH research (Sclar et al., 2017). In line with stratification in the critical realist approach (Bhaskar, 2013), more empirical methods of observation that were unavailable to the researcher, such as stool analysis (Chard et al., 2019; Gitore et al., 2020), dried blood spot testing (Chard et al., 2018) and continual observation of WASH facilities usage (Martin et al., 2018), would allow for a more direct and reliable examination of children's WASH behaviours and health outcomes. Social desirability response bias and ecological validity (section 3.10.1) may have affected children's responses, although these limitations were addressed through the triangulation of other data sources such as staff interviews and photography.

Regarding the qualitative data, the language barrier during focus group discussions, school staff interviews and household interviews was a limitation (section 3.9.2). As the interpreter was unable to relay verbatim everything that was stated by participants, it is inevitable that some of the data were lost. The researcher did not have the resources to remunerate a native Hindi speaker to transcribe and translate the audio recordings so relied on the English provided by the interpreter on the recordings, resulting in the '"transmuted texts,"…[which] reflect the original, but have been recreated' described by Halai (2007, p344). Therefore, during qualitative analysis, it was important for the researcher to code data into common themes pertinent to the research questions while keeping in mind that they were permeated with the interpreter's thoughts and preconceptions. All the participant quotations included in the study should be viewed through the lens of the interpreter's translation skills, as well as his prioritisation of the most important information to convey.

5.6 Considerations for future research

There are a number of justifiable directions for further investigation which emerge from the findings of the current study. For example, future research could include a greater number of schools and a wider variety of LFP schools, especially those with lower fees aligning with Tooley and Longfield's (2016) definition, for comparison between parents who choose these schools over the equivalent government schools. Following the approach of Arriola et al. (2020), an updated, theory-based intervention programme could be designed, informed by the findings from the application of the COM-B model in the current research.

Further research could complement the findings from each of the three research questions. For the first research question, future research would benefit from a design which relies less on self-reported data, resulting in more robust data on children's WASH behaviours. More objective methods of health outcome measurement such as stool analysis would allow for sophisticated analysis of the impact of children's WASH behaviours on their WASH-related health outcomes and COVID-19 infection could be incorporated here. More objective data would be particularly useful in the context of the longitudinal design that Martin et al. (2018) recommend for WASH intervention

evaluation, the likes of which was not logistically possible for this thesis study. With regards to the second research question, it would be useful to include the voices of local government education officials to explore the regulation of WASH in schools and investigate why the quality of WASH provision in schools does not appear to match the monthly per child budget. Regarding the third research question, a larger sample of household surveys would enable quantitative analysis of the Households Water Insecurity Experiences (HWISE) scale which is validated for global use (Young et al., 2019). This would allow for wider analysis of the challenges households face in consistent access to safe water.

5.7 Summary

This chapter has presented a summary of findings from each of the three research questions, considering how these relate to the previous literature reviewed in Chapter Two. The findings complement the literature in revealing inconsistencies and inequalities in children's capability, opportunity and motivation to adopt positive WASH behaviours in the participating schools and in the wider communities in which they are situated. They also highlight the particularly key role that school WASH provision plays as a driving factor affecting children's sustained adoption of positive WASH behaviours. They interrogate the role that schools-based WASH interventions play and how to increase adherence to their recommendations in the long term. The pervading response to the overarching research aim of investigating the driving factors affecting children's WASH behaviours in East New Delhi primary schools is the following. School WASH provision, if maintained to a high standard and supported by continual input and reinforcement from school staff, can be a significant tool for equipping children with the capability, opportunity and motivation they need to pursue long-term adoption of positive WASH behaviours. Thus, it can afford a safe space to children to live healthy lives, regardless of their socio-economic status, background or the type of school they attend.

Chapter Six: Conclusion

This final chapter provides an overview of the thesis before outlining possible steps that stakeholders in East New Delhi primary schools could take to increase children's sustained adoption of positive WASH behaviours, thereby driving progress towards SDG 6.

6.1 Thesis overview

The objective of this research has been to identify the driving factors affecting children's WASH behaviours in East New Delhi primary schools. Chapter One situated the current research in the wider view of global development research, highlighting Sen's capability approach which positions poverty as 'the deprivation of basic capabilities' (2001, p87), the integral position of WASH in the SDGs and the vast inequalities that remain in WASH access worldwide. It considered WASH through the lens of human rights, showing that although water and sanitation are designated as human rights, progress towards universal WASH coverage is too slow (Cavill et al., 2016), particularly with regards to women's experiences. It introduced the issue of water security and presented a critique of previous nationwide WASH intervention programmes in India aiming to bring about sustained WASH behaviour change, linking this to existing research which applies the Capability, Opportunity, Motivation Behaviour (COM-B) model in the context of WASH interventions. Previous research presented in Chapter Two demonstrated that children, particularly girls, are vulnerable to the dangers posed by substandard WASH access. The spread of COVID-19 has reiterated the crucial importance of this, particularly in low-income areas where regular HWWS and social distancing are not necessarily possible. It was hypothesised that the school environment can play a key role in narrowing WASH-based inequalities, offering safe, secure WASH access for children that they do not access elsewhere. The literature showed that while schools-based WASH hardware and software interventions worldwide do bring about positive changes in WASH behaviours, this does not necessarily translate into health outcomes and these behaviour changes tend to be short-lived as intervention outcomes are not sustained in the long term (Humphrey, 2019). Chapter Two concluded by outlining the challenges involved in progressing towards SDG 6 in the school context, including inequalities in access and

sustainability of hardware and software provision, and highlighting some common WASH software intervention approaches such as behaviour change communication (BCC).

Chapter Three outlined the ontological and epistemological basis of this thesis, presenting the case for the critical realist and postpositivist approach to observing reality and acquiring knowledge. It also described the mixed methods research design, including the three research questions, and how the challenges of data collection and analysis were addressed, as well as ethical considerations. Chapter Four presented descriptive statistics to provide background on the setting of the research before answering each of the research questions in turn, investigating different possible driving factors affecting children's WASH behaviours. These were school WASH provision, more specifically the enabling and impeding factors affecting school principals' provision of adequate school WASH facilities, and socio-economic status. Finally, Chapter Five served to summarise the main findings and consider how they build upon the conclusions of the literature explored in Chapter Two. It also considered the limitations of the study and possibilities for future research.

This research offers a core contribution to knowledge by investigating the factors affecting children's WASH behaviours, and therefore progress towards SDG6, in East New Delhi primary schools. Through the literature review, the school environment and socio-economic status were highlighted as possible driving factors. Empirically, this research provides a unique addition to the literature by using statistical methods such as SEM in combination with analysis of qualitative data to investigate these factors. Conceptually, it addresses a gap in the literature by applying the COM-B model (Michie et al., 2011) in this context to identify impeding and enabling factors affecting children's capability, opportunity and motivation to adopt positive WASH behaviours and build 'combined capabilities' (Nussbaum, 2011, p21) which dictate key 'functionings' (Sen, 2001, p75) developing quality of life. It also contributes useful insights with regards to school WASH provision and the role of schools-based WASH interventions in improving sustained adoption of positive WASH behaviours. The following concluding sections

outline the possible action that stakeholders could take to accelerate progress towards SDG 6 for the children attending the participating schools.

6.2 Possible approaches for school stakeholders in driving progress towards SDG 6

- Mitigating WASH-based inequalities in the community environment

This research revealed WASH-related inequalities in the communities surrounding the participating government schools (section 4.4.2). Families face dangerous water insecurity on a daily basis, particularly in the summer. Although most have water piped into their home classified as 'improved' water access (WHO and UNICEF, 2019), this is intermittent and sometimes dirty (Ray, 2020). SDG 6 (Clean Water and Sanitation) is intrinsically linked to SDG 4, which specifically targets WASH coverage in schools. Therefore, progress towards the SDG 4 target to provide 'safe, non-violent, inclusive and effective learning environments for all' (UNGA, 2015, p19) can provide a healthy environment for children who do not access this consistently at home. This could mitigate WASH-based inequalities and narrow the gap between low-income households and wealthier households who can afford private solutions such as RO systems.

- Addressing barriers impeding WASH provision in schools

However, this research also revealed a number of issues impeding access to high-quality WASH provision in the participating government schools (section 4.3.1). The first of these is inadequate funding for WASH provision which raises the question as to why EDMC school management were unable to access funds to arrange much-needed improvements such as increased numbers of cleaning staff and disability-access toilet facilities. Secondly, teachers' secondary commitments as election officers compromise their ability to fulfil their obligations to their students. Specific employees should be recruited by the government to carry out this role so that teachers can focus on meeting their commitments to the children they teach. Thirdly, the extent of unexplained absenteeism shows that some teachers do not fulfil their classroom commitments, as demonstrated by the observation during data collection of classes with no teacher for the full day and teachers leaving the premises immediately after assembly, before lessons even began. Schools-based WASH interventions rely on teachers for adherence

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to outcomes beyond the end of the intervention and teacher absenteeism will compromise this. The sustainability of the intervention outcomes is made particularly challenging by the high turnover of students in these schools thus it is doubly important that teachers with the capability (training) and opportunity (employment) to fulfil this role also have the motivation to do so, perhaps through discussion regarding their needs, incentives or more stringent accountability measures.

- Ensuring that intervention benefits are sustained in the long term

This research shows that schools-based WASH interventions can bring about positive changes (section 4.3.2). Staff at GISA-B mentioned a number of these including decreased student absenteeism, girls learning about safe MHM and decreases in illness, although these were not verified through quantitative analysis and a systematic review concluded that the link between school sanitation and student absenteeism is ambiguous (Sclar et al., 2017). However, some staff comments also indicated a reliance on CURE. Illness may have decreased as a result of CURE's engagement with the community but if this contact is not followed up by school staff following the intervention, the outcomes are not sustained. In fact, with some unsafe environmental WASH factors persisting at GISA-B, school staff need to be motivated to assist in sustaining the intervention outcomes. The LFPS offers a blueprint for achieving this with sufficient investment in janitorial staff, an accountability system in the form of regular inspection of WASH facilities and staff-supervised HWWS and water replenishment. The government schools run by the AAP Delhi government have also built success on robust accountability measures (BBC News, 2018; Biswas, 2020). Removal of teachers' external electoral responsibilities, clarification of the reasons for unexplained teacher absenteeism and the inclusion of WASH issues in the curriculum such as water conservation, care for the environment and even COVID-19 prevention would also help to ensure that intervention adherence can be sustained beyond the end of implementation. Finally, schools-based WASH intervention designs should employ a theoretical framework of behaviour change such as the COM-B model to ensure detailed consideration of how to bring about sustained adoption of positive WASH behaviour change (Martin et al., 2018), how to evaluate it (Ginja et al., 2021) and how to provide

resources and motivation for schools to maintain their WASH hardware and software

provision in the long term (Garn et al., 2017).

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Appendices

Appendix 1 Questionnaires (English versions)[9]

1. School-based questionnaire

You, Your Family and Your Home Life

INSTRUCTIONS

- Below is a questionnaire all about you, your family and your home life. Answer according to what is true for you by put a ✓ in the box or by writing the response on the line.
- Please respond to ALL questions.
- This is not a test. Your response will not contribute to the grades of any of your subjects. Please respond to the statements as truthfully as possible.

About you						
1	Name					
2	Father's name					
3	Age	_____ years				
4	Gender (Please tick)		Male (0)		Female (1)	
5	Name of your school:	_____				
6	Which grade are you in?	_____				
7	How many years have you been in school?		_____ years			
8	How many brothers and sisters do you have?		_____ brothers		_____ sisters	
About your mother and father						
9	Does your father (male guardian) have an income? (Please tick)		Yes (1)		No (0)	
10	Does your mother (female guardian) have an income? (Please tick)		Yes (1)		No (0)	
11	What does your father (male guardian) do as a job?		_____			
12	What does your mother (female guardian) do as a job?		_____			
About your home						
13	How many rooms in the home does your family have for their own use?			_____		
14	What type of building is your home? (Please tick)					
	Brick or concrete building (0)					
	Semi-permanent building (1)					
	Wood and tin sheet building (2)					
	Mud building (3)					
	Other (please explain) (4)	_____				
15	How do you access water in your home? (Please tick)					
	Public tap water outside the home (0)					
	Piped drinking water into the home (1)					
	Public well or spring (2)					
	Other (please explain) (3)	_____				

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[9] Due to the reduction in the number of research questions included in the final thesis, some data were collected, such as *Water Attitudes* and *Self-Efficacy*, which were not included in the final analysis. These data were retained for future use.

16	What is the floor in your home made of? (Please tick)				
	Earth floor (0)				
	Cement / concrete / wood (1)				
	Carpet / tiles (2)				
	Other (please explain) (3)	_____			
17	Does your home have a toilet? (Please tick)				
	Within the premises	Yes (1)		No (0)	
	Outside the premises	Yes (1)		No (0)	
18	Does your home have a separate kitchen for your family to use? (Please tick)	Yes (1)		No (0)	
19	How many people live in your home, including yourself?	_____			

Health

INSTRUCTIONS

- Below is a questionnaire all about health in your school.
- The rating scale is divided into three levels – Yes, No and Don't know – for some questions.
- For other questions, the rating scale is divided into four levels.
- For each question, tick ONE box according to what is true for you. Please answer ALL questions.

	Health and sanitation facilities at your school	Yes (2)	Don't know (1)	No (0)
20	Is there enough drinking water at your school?			
21	Does your school have toilets?			
22	Do boys and girls have separate toilets?			
23	Is there water available in or next to the toilets?			
24	Is there a place to wash your hands after using the toilet?			
25	Is there a place to wash your hands before eating?			
26	Is there enough water to wash your hands?			
27	Is there soap to wash your hands?			
28	Is there an after-school club for nutrition, water and sanitation?			
29	Is there teaching about health or health-related activities?			

	Health knowledge in your school	Yes (2)	Don't know (1)	No (0)
30	Were you taught the benefits of healthy eating?			
31	Were you taught the importance of handwashing?			
32	Were you taught about the importance of cleaning your teeth?			
33	Were you taught how to avoid worm infections?			
34	Were you taught where to get treatment for a worm infection?			
35	Were you taught about any other infectious diseases like diarrhoea, cough, cold, typhoid, eye infections?			
36	Were you taught in any of your classes about anaemia and its prevention?			
37	Were you taught in any of your classes about iodine deficiency and its prevention?			
38	Were you taught in any of your classes about night blindness and vitamin A?			

	Your hygiene practices	Never (0)	Rarely (1)	Sometimes (2)	Always (3)
39	During the past 30 days, how often did you wash your hands before eating at school?				
40	During the past 30 days, how often did you wash your hands after using the toilet or latrines at the school?				
41	During the past 30 days, how often did you use soap when washing your hands at school?				

		Never (0)	Not regularly (1)	Once a day (2)	Twice a day (3)
42	During the past 30 days, how often did you brush your teeth?				
Health outcomes		**Never (0)**	**Sometimes (1)**	**Most of the time (2)**	**Always (3)**
43	During the past 12 months, how often did you have a toothache or feel discomfort because of your teeth?				
			Yes (2)	**Don't know (1)**	**No (0)**
44	During the past 30 days, did you suffer from diarrhoea or dysentery?				
45	During the past 30 days, did you suffer from worm infestation?				

Water Attitudes

INSTRUCTIONS

- Below is a questionnaire all about water. Decide how much you agree with the statement. Put a ✓ next to the response that best shows your feeling or opinion towards the particular statement. Only tick ONE box per question.
- The rating scale is divided into four levels – Strongly disagree, Disagree, Agree, Strongly agree. Please respond to ALL questions.

	Statement	Strongly Disagree (0)	Disagree (1)	Agree (2)	Strongly Agree (3)
46	It is alright to keep tap water running when brushing teeth (R).				
47	Using high quality water or safe water for gardening is wasteful.				
48	It is important not to dirty drains, rivers, lakes or the sea.				
49	I should report cases of water pipe leakage, water pump or any sanitation facility defects to my teachers or parents.				
50	I would report water theft if I saw it.				
51	Only people who cannot afford to pay their water bill should try to save water (R).				
52	I read books or follow news about water issues.				
53	It is not necessary to discuss the values of water in school (R).				
54	I like to share my knowledge about how to save water.				
55	Water is cheap, we do not have to try hard to save it.				
56	I have the responsibility to save water even if there is enough for use.				
57	I would like to participate in a water-saving campaign.				
58	I would like to work together with others to clean wells, sinks or other sanitation facilities.				
59	Maintaining cleanliness of the toilet is too difficult. I can leave it to my parents, family or school staff to do that (R).				
60	I would persuade others to save water even though I have to try very hard.				
61	Tampering with a water meter is wrong.				
62	I appreciate the beauty of lakes, rivers and the sea.				
63	The water cycle stabilises our environment.				
64	Water is important to health.				
65	Since there is no shortage of water in my school or home, I do not have to take much care about saving water (R).				
66	Supplying water to homes is the responsibility of the government only.				

67	Even if there is enough water now, we should save water for future use.				
68	Rich and poor people should be charged the same price for water.				
69	It is important for girls to have the same proper water supply and sanitation facilities as boys.				
70	I often make facilities clean for the next users.				
71	I like to spend time in clean and green places.				
72	It is better not to report cases of water theft. One theft case does not cost much (R).				
73	It is as important for the poor to have proper water supply and sanitation facilities as for the rich.				

Self-Efficacy

- Below is a questionnaire all about your tasks. Decide how much you agree with the statement. Put a ✓ next to the response that best shows your feeling or opinion towards the particular statement. Only tick ONE box per question.
- The rating scale is divided into four levels – Strongly disagree, Disagree, Agree, Strongly agree. Please respond to ALL questions.

	Statement	Strongly Disagree (0)	Disagree (1)	Agree (2)	Strongly Agree (3)
74	I will be able to achieve most of the goals that I have set for myself.				
Example	*You have lots of aims in school and at home and are confident that you will achieve nearly all of them.*				
75	When facing difficult tasks, I am certain that I will accomplish them.				
Example	*You have a really difficult maths question but you are sure that you will complete it successfully.*				
76	In general, I think that I can obtain outcomes that are important to me.				
Example	*You are confident that you can succeed in your favourite activities, both at school and at home.*				
77	I believe I can succeed at any endeavour to which I set my mind.				
Example	*When you try a new activity, sport or piece of work, you think you will do well in it.*				
78	I will be able to successfully overcome many challenges.				
Example	*When you find your schoolwork difficult, you believe that you will work it out by putting a lot of effort in.*				
79	I am confident that I can perform effectively on many different tasks.				
Example	*You think that you are good at a number of different things, not just one or two things.*				
80	Compared to other people, I can do most tasks very well.				
Example	*You think that you are better than other people at different tasks and activities.*				
81	Even when things are tough, I can perform quite well.				
Example	*Imagine that you are going through a difficult time at school or at home. In this situation, you still think that you will succeed in what you are aiming to do.*				

The following three questionnaires were used as catalysts for discussion and observation tools during household and school staff interviews, rather than the quantitative analysis for which they were originally designed.

2. Households Water Insecurity Scale (HWISE, Young et al., 2019)

Each item is phrased to capture experiences that anyone in the household has had in the last four weeks. Responses to items are: never (0 times), rarely (1–2 times), sometimes (3–10 times), often (11-20 times), and always (more than 20 times). Never is scored as 0, rarely is scored as 1, sometimes is scored as 2, and often/always is scored as 3.

LABEL		ITEM	SCORE
	Worry	In the last 4 weeks, how frequently did you or anyone in your household worry you would not have enough water for all of your household needs?	
	Interrupt	In the last 4 weeks, how frequently has your main water source been interrupted or limited (e.g. water pressure, less water than expected, river dried up)?	
	Clothes	In the last 4 weeks, how frequently have problems with water meant that clothes could not be washed?	
	Plans	In the last 4 weeks, how frequently have you or anyone in your household had to change schedules or plans due to problems with your water situation? (Activities that may have been interrupted include caring for others, doing household chores, agricultural work, income-generating activities, sleeping, etc.)	
	Food	In the last 4 weeks, how frequently have you or anyone in your household had to change what was being eaten because there were problems with water (e.g., for washing foods, cooking, etc.)?	
	Hands	In the last 4 weeks, how frequently have you or anyone in your household had to go without washing hands after dirty activities (e.g., defecating or changing diapers, cleaning animal dung) because of problems with water?	
	Body	In the last 4 weeks, how frequently have you or anyone in your household had to go without washing their body because of problems with water (e.g., not enough water, dirty, unsafe)?	
	Drink	In the last 4 weeks, how frequently has there not been as much water to drink as you would like for you or anyone in your household?	
	Angry	In the last 4 weeks, how frequently did you or anyone in your household feel angry about your water situation?	
	Sleep	In the last 4 weeks, how frequently have you or anyone in your household gone to sleep thirsty because there wasn't any water to drink?	
	None	In the last 4 weeks, how frequently has there been no useable or drinkable water whatsoever in your household?	

	Shame	In the last 4 weeks, how frequently have problems with water caused you or anyone in your household to feel ashamed/excluded/stigmatized?	
		TOTAL	

3. Core questions for monitoring WASH in schools in the SDGs (WHO/UNICEF, 2018a)

1. What is the main source of water for the school?		
Source	Currently Available	Main source of drinking water (choose one)
Piped	[ ] Yes [ ] No	[ ] Yes [ ] No
Protected well/spring	[ ] Yes [ ] No	[ ] Yes [ ] No
Unprotected well/spring	[ ] Yes [ ] No	[ ] Yes [ ] No
Rainwater	[ ] Yes [ ] No	[ ] Yes [ ] No
Packaged bottled water	[ ] Yes [ ] No	[ ] Yes [ ] No
Tanker-truck or cart	[ ] Yes [ ] No	[ ] Yes [ ] No
Lake/River/Stream	[ ] Yes [ ] No	[ ] Yes [ ] No
No water source	[ ] Yes [ ] No	[ ] Yes [ ] No

2. What type of student toilets/latrines are at the school? (Tick one – most common)	
Flush / Pour-flush toilets	
Pit latrines with slab	
Composting latrines	
Pit latrines without slab	
Hanging latrines	
Bucket latrines	
No toilets or latrines	

3. How many toilets/latrines are at the school?			
	Girls' only toilets	Boys' only toilets	Common use toilets
Total number			
Number that are usable (available, functional, private)			

4. Are there handwashing facilities at the school?	
Yes	
No	

5. Are both soap and water currently available at the handwashing facilities?	
Yes, water and soap	
Water only	
Soap only	
Neither water or soap	

4. Core questions on WASH for household surveys (WHO/UNICEF, 2018)

Name:		Child's name (if applicable):	
1. What is the main source of drinking water for members of your household?			
Source			
Piped into dwelling	[ ]	Piped into compound	[ ]
Piped to neighbour	[ ]	Public tap	[ ]
Borehole	[ ]	Covered well	[ ]
Uncovered well	[ ]	Protected spring	[ ]
Unprotected spring	[ ]	Rainwater collection	[ ]
Tanker-truck	[ ]	Cart with tank/drum	[ ]
Bottled water	[ ]	Sachet water	[ ]
Surface water (eg river)	[ ]	Other (please specify)	

2. What is the main source of water used by members of your household for other purposes, such as cooking and handwashing? *(Only for users of packaged water).*			
Piped into compound	[ ]	Piped to neighbour	[ ]
Public tap	[ ]	Borehole	[ ]
Covered well	[ ]	Uncovered well	[ ]
Protected spring	[ ]	Unprotected spring	[ ]
Rainwater collection	[ ]	Tanker-truck	[ ]
Cart with tank/drum	[ ]	Bottled water	[ ]
Sachet water	[ ]	Surface water (eg river)	[ ]
Other (please specify)			

3. Where is that water collected from? *(Skip if Q1/Q2 is piped on premises).*	
In own dwelling	[ ]
In own compound	[ ]
Elsewhere (specify)	

4. How long does it take to go there, get water, and come back? *(Skip if Q1/Q2 is piped on premises).*	
Household don't collect	[ ]
Number of minutes	[ ]
Don't know	[ ]

5. What kind of toilet facility do members of your household usually use?			
Flush to piped sewer	[ ]	Flush to septic tank	[ ]
Flush to pit latrine	[ ]	Flush to open drain	[ ]
Flush to don't know where	[ ]	Pit latrine with slab	[ ]
Open pit latrine	[ ]	Twin pit with slab	[ ]
Twin pit without slab	[ ]	Other composting toilet	[ ]
Container-based sanitation	[ ]	Hanging toilet	[ ]
No facility (OD)	[ ]	Other (please specify)	

6. Do you share this facility with others who are not members of your household?
[   ] Yes   [   ] No

7. Where is this toilet facility located?			
In own dwelling	[ ]	In own compound	[ ]
Elsewhere (specify)			

8. Has your (pit latrine or septic tank) ever been emptied? *(Only for on-site storage).*
[   ] Yes   [   ] No   [   ] Don't know

9. The last time it was emptied, where were the contents emptied to?	
Removed by service provide to treatment plant	[ ]
Buried by service provider in covered pit	[ ]
Removed by service provider to don't know where	[ ]
Buried by household in covered pit	[ ]
Emptied by household to uncovered pit, open ground, water body, elsewhere	[ ]
Other (please specify)	
Don't know	[ ]

10. Can you show me where members of your household most often wash their hands?	
Fixed facility (eg tap) observed in dwelling	[ ]
Fixed facility in compound	[ ]
Bucket/jug/kettle (eg mobile object)	[ ]
No handwashing place in dwelling/compound	[ ]
No permission to see	[ ]
Other (please specify)	

11. Observe availability of water at the place for handwashing.	
Water is available	[ ]
Water is not available	[ ]

12. Observe availability of soap or detergent at the place for handwashing.	
Soap or detergent available	[ ]

Soap or detergent not available	[ ]

Appendix 2 CURE intervention activities

WASH hardware elements:

1. A rainwater harvesting system was installed on site at participating schools to increase water resilience.
2. Anaerobic wastewater treatment and subsequent reuse of wastewater allows for recycled water to be used for watering on-site gardens, boosted by the newly installed compost pits.
3. Dark, unkempt areas of the school compound were cleared and replaced with saplings and shrubs which were fenced to allow access for staff and older students.
4. Broken fences, bricks and waste storage structures were repurposed as fencing and area demarcation for the revitalised school compound.
5. Drinking water blocks were renovated with taps repaired and fittings replaced and cleaned. Plants growing around the blocks that attracted insects were removed.
6. Toilet blocks, including handwashing stations, were renovated with new toilet seats installed, new water pipes as required, new outflow drains for urinals and toilets and the unblocking of drains.

WASH software elements:

1. Resource mapping activities: Similar to Lennon's (2011) mapping approach, CURE liaised with teaching staff to create a map of the school compound marking the location of toilets, drinking water facilities and bins. The children later recreated a giant version of the map in the school compound, reinforcing awareness of these facilities and thus encouraging usage.
2. School waste audit: CURE worked with teachers and cleaning staff to identify the different types of waste generated at the school, before pinpointing accessible and visible locations for different bins. School staff and students received seminars on the segregation of biodegradable and non-biodegradable waste. The children created posters reinforcing their learning.

3. Information, education and communication (IEC) materials: Posters were placed in key locations in the school to encourage adoption of positive behaviours such as correct waste disposal and compost.

4. Building parents' capacity: CURE conducted household visits to talk to parents about children's WASH-related behaviour change and invite the parents to workshops to learn to make brooms, soap and disinfectant at a cheaper price than buying these products at the market.

5. PTAs: These were established to invite parents to have a voice in the process of CURE's work and create a link between the school staff and parents, thus strengthening the likelihood that the behaviour change would last long-term.

6. Class monitor roles: Children were assigned roles at random every two months to monitor five areas of their classmates' behaviour – toilet, water, food, health and discipline. CURE's report does not give any further information regarding the specific nature of these roles.

7. Child-based participatory activities: CURE ran art and drama activities and games in the participating schools. Children were invited to decorate the compost pits with colourful handprints with the aim of involving them in the development of the school compound. This also aimed to create a nudge effect by making the compost pits attractive thus encouraging usage. Children were taught how to grow a small plant using a seed and a plastic bottle before being invited to take responsibility for new plants growing in the school compound. Other activities taught children about water conservation, the water cycle, OD, handwashing and reducing infection.

Appendix 3 Permission documents

1. Researcher's letter of agreement with CURE

CENTRE FOR URBAN AND REGIONAL EXCELLENCE

Date: 9 May 2019

To,
Mr. Jack Charnley
Newcastle University

Subject: Regarding the Letter of Agreement between Newcastle University and Centre for Urban and Regional Excellence

Dear Mr. Charnley,

Following our correspondence, I am writing to confirm our agreement to collaborate with you and Newcastle University on your doctoral research measuring the impact of the Centre for Urban and Regional Excellence's School Sanitation Project. As research partners on Newcastle University's Sustainable Water Hub, funded by the Global Challenges Research Fund, we welcome collaboration to conduct research evaluating the impact of our projects.

We look forward to your preliminary visit in August and hope that we can work together to ascertain the extent to which the School Sanitation Project has brought clean water and toilet access and usage to the schools' students and the communities in which they live.

With Regards,

Dr. Renu Khosla
Director

Address: 4, Zamroodpur Commercial Complex, IInd Floor, Greater Kailash, New Delhi - 110048
Ph. : 011-29242272 • Email: info@cureindia.org, Website: www.cureindia.org

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2. CURE's permission letter from EDMC for schools-based WASH activities

EAST DELHI MUNICIPAL CORPORATION
EDUCATION DEPARTMENT: H.Q.
419-UDYOG SADAN, PATPARGANJ
INDUSTRIAL AREA, DELHI-110092

No.: D/ADE/Project/HQ/EDMC/2018/904   Dated: 02.07.2018

To,
Ms Renu Khosla
Director, Centre for Urban and Regional Excellance (CURE, India)
302, Building No.3,
Sona Apartment, Kaushalya Park,
Hauz Khas-110016

Subject :-   **Permission for Behaviour Change Communication (BCC) Activities**

This has reference to your letter on the subject cited above. In this regard I am directed to convey you that Commissioner, EDMC has accorded permission for conducting Behaviour Change Communication Activities among students, studying in following Schools w.e.f 02.07.2018 to 31.03.2019 :

1.	EDMC Primary School	Shah. South
2.	EDMC Primary School	Shah. South
3.	EDMC Primary School	Shah. South
4.	EDMC Primary School	Shah. South
5.	EDMC Primary School	Shah. South
6.	EDMC Primary School	Shah. South
7.	EDMC Primary School	Shah. South
8.	EDMC Primary School	Shah. South
9.	EDMC Primary School	Shah. South
10.	EDMC Primary School	Shah. North
11.	EDMC Primary School	Shah. North
12.	EDMC Primary School	Shah. North
13.	EDMC Primary School	Shah. North

Permission is subject to under mentioned conditions :
1. No separate room will be provided to CURE, NGO in the schools.
2. All the activities for students will be performed in the school premises under supervision of Principal of school at assembly time.
3. There should not be any disturbance in the school administration, discipline, routine, activities and study work of the children in schools.
4. Facilitators of CURE, NGO will have to comply with the directions of Principal of the School.
5. CURE, NGO will have to take care of safety and security of children in the school & ensure that the property of the school should not be destroyed or defaced in any manner. In such circumstances CURE, NGO, will be held responsible.
6. EDMC will not have any financial implication for CURE, NGO, project Intended to work in above mention Schools.
7. The NGO will strictly follows all the Rules & Regulations made applicable thereto & undertake to follow all the Rules & Regulations for the time being in force.
8. CURE, NGO will have to submit the Quarterly progress report of programme to the concerned Zonal ADE and ADE, Project, HQ.
9. EDMC will not responsible for any act of negligence committed by the NGO and NGO will indemnify the EDMC in case any loss or injury is caused to any person or property by the NGO.
10. For any untoward incident NGO will be responsible. EDMC will not have any liability.
11. Permission granted can be withdrawn at any time without assigning any reason thereto.
    You are directed to contact ADE, Shah. South and ADE, Shah. North in this reference.

ADE/Project

Copy to:-

1. **ADE/Shah. South**
2. **ADE/Shah. North**
   (with request to extend your cooperation and issue necessary directions to ensure all necessary precautions, coordination and supervision in the matter. It must be ensured by the Principals and Zonal authorities through regular supervision & monitoring that the school and the students are being benefited from this Programme. Impact assessment report in this regard may be forwarded to ADE, Project with your firm recommendations accordingly.)
3. **All Concerned Principals Through Concerned Zonal DDE/ADE**

Appendix 4 Participation information forms (English versions)

1. School principals

Jack Charnley
School of Education, Communication
and Language Sciences
Email: j.charnley1@ncl.ac.uk

Participant Information – Head Teacher

This is an invitation for children and staff from your school to take part in a research study. Please read the information carefully and consider it, before you decide to take part. You may wish to discuss this information with colleagues before you decide whether or not to give your consent in writing.

This study is part of a Newcastle University doctorate programme undertaken by Jack Charnley. It investigates the impact of the water and sanitation project that took place in your school and others in East Delhi. The project, implemented by the Centre for Urban and Regional Excellence (CURE), aimed to progress schools towards zero-waste status. This was through the installation of hand-washing stations, wastewater recharging, rainwater harvesting, compost facilities and green areas.

The study investigates children's awareness of water issues, their health behaviours, their self-efficacy (belief in their own ability to succeed in tasks) and their socio-economic background. It also explores the school environment and the perceptions of school staff like yourself relating to water, sanitation and hygiene. This why you have been invited to take part in the study.

It will use questionnaires and interviews to look at children's awareness of water issues, their health behaviours, their self-efficacy and their socio-economic background. It will explore two of these factors – children's awareness of water issues and their health behaviours – through observations of the school environment as well. The study will also seek to clarify the availability and status of water and toilet facilities in the school environment through observation and photography of the infrastructure developments.

Questionnaires: Children asked to participate in the questionnaire component will have the aims of the study explained to them and will receive an information sheet. They will be informed that they have the choice whether or not to be involved in the research and will be given a consent form as part of the questionnaire booklet. They will be free to end their involvement at any time during the process. All children will receive a certificate and small prize (please state what this would be) thanking them for taking part.

Interviews: Following the questionnaire component, small groups of some children and school staff will be invited to participate in the interview component. They will again be reminded of the aims of the project and will receive another information sheet relating to the interview process. They will be reminded that they have the choice whether or not to participate, that their decision will have no impact on their school experience and that they can withdraw at any time. They will receive a second consent form for the interview component. For more information, the researcher can give you the information sheet prepared for the children and their parents.

Observations and photography: All children will be informed that the researcher is present in the school to observe the school environment. No children or staff will appear in any of the photos – these will just include images of the school infrastructure and surroundings.

Participation is confidential – all identifiable data will be anonymous in the final report and the researcher will not withhold information from participants prior to the research. No names will be used to identify participants in the final report. Once the results have been analysed, all participants, including staff and children will have access to a short user-friendly report that provides details about the project outcomes. This short report will contain the contact details of the researcher.

Thank you for considering this information.

2. School staff

Jack Charnley
School of Education, Communication
and Language Sciences
Email: j.charnley1@ncl.ac.uk

Participant Information Sheet – School Staff

This is an invitation for you to take part in a research study. Please read the information carefully and consider it, before you decide to take part. You may wish to discuss this information with colleagues before you decide whether or not to give your consent in writing.

This study is part of a Newcastle University doctorate programme undertaken by Jack Charnley. It investigates the impact of the water and sanitation project that took place in your school and others in East Delhi. The project, implemented by the Centre for Urban and Regional Excellence (CURE), aimed to progress schools towards zero-waste status. This was through the installation of hand-washing stations, wastewater recharging, rainwater harvesting, compost facilities and green areas.

The study investigates children's awareness of water issues, their health behaviours, their self-efficacy (belief in their own ability to succeed in tasks) and their socio-economic background. It also explores the school environment and the perceptions of school staff relating to water, sanitation and hygiene. You have been invited to take part in this study because your views on these topics will be useful in informing its outcomes.

It will use questionnaires and interviews to look at children's awareness of water issues, their health behaviours, their self-efficacy and their socio-economic background. It will explore two of these factors – children's awareness of water issues and their health behaviours – through observations of the school environment as well. The study will also seek to clarify the availability and status of water and toilet facilities in the school environment through observation and photography of the infrastructure.

Questionnaires: Children in your school will be asked to participate in a questionnaire component relating to the topics listed above.

Interviews: For this component, school staff members like yourself will be invited to participate because we want to hear about the experiences of all members of the school community around water and sanitation. If you decide not to take part, <u>there will be no impact on your role in the school and you can withdraw at any time</u>. It will take about 20 minutes of your time. If you decide to take part, what we discuss will be recorded to help analyse the information.

Observations and photography: The researcher will be present in the school to observe the school environment and photograph school infrastructure. No children or staff will appear in any photos.

Participation is confidential – all identifiable data will be anonymous in the final report and the researcher will not withhold information from participants prior to the research. All physical data (questionnaire papers, observation sheets) will be stored securely in a locked cabinet. All digital data (interview recordings) will be stored on a password-protected hard-drive. No one will access the data apart from the researcher at any point in the process. No names will be used to identify participants in the final report. Once the results have been analysed, all participants, including staff and children will have access to a short user-friendly report that provides details about the project outcomes. This short report will contain the contact details of the researcher.

Thank you for reading this information.

Jack Charnley
School of Education, Communication
and Language Sciences
Email: j.charnley1@ncl.ac.uk

Participant Information Sheet (Students)

PROJECT TITLE: Your Experience of Water and Toilets in Your School

INTRODUCTION
My name is Jack Charnley and I am a researcher from Newcastle University in the United Kingdom. My university is carrying out some research in India. I am interested in improving access to water and toilets and the overall school experience for children all across the world.

WHAT IS THE STUDY ABOUT?
You are invited to take part in a project looking at water, toilets and health in your school. If you take part in the study, your name will not appear in the final report. No one will know that you took part. At the end of the study, we will give your school some information about what we found out, which they will share with you. So please take the time you need to discuss the study with anyone you wish to, especially your parents. The decision to join or not is up to you. You can withdraw at any time! Deciding not to take part or choosing to leave the study will not result in any negative consequences at school or home. It will not harm your relationship with your teachers. Participation in this study is voluntary.

WHAT IS INVOLVED IN THE STUDY?
If you decide to take part you will be asked to take part in a group session in a classroom where you will answer written questions in four sections: (1) You, your family and your home life, (2) Health, (3) Water and (4) Self-confidence in achieving tasks.

My colleague and I will always be in the classroom to help you at all times. Depending on how long the session takes, it is possible that you may miss some of your lesson time. If you decide to take part but then change your mind, you can ask to be taken out of the study at any time. If you decide to stop, you will not lose any benefits. Some of you will also be invited to join in with group discussions. If you choose to participate, you will be asked questions and what you say in the discussions will be recorded. These are optional and if you are asked to take part, you can say no. You can change your mind at any time during the interviews and leave the activity.

BENEFITS TO TAKING PART IN THE STUDY?
We can't guarantee that you will personally experience benefits from taking part in this study. However, others may benefit in the future from the information we find in this study.

CONFIDENTIALITY
We will take steps to keep information about you confidential, and to stop anyone finding out that you took part. When we write up what we found out all results will be given numbers or letters – they will have no names and there will be no way of finding out who did what. We need to protect who you are and your results so all the information will be kept on a computer that is password-protected.

INCENTIVES
If you participate we will give you a certificate and a small prize to celebrate taking part.

Thank you for taking the time to read this sheet.

Jack Charnley
School of Education, Communication
and Language Sciences
Email: j.charnley1@ncl.ac.uk

Participant Information Sheet for Discussions (Students)

PROJECT TITLE: Your Experience of Water and Toilets in Your School

INTRODUCTION
My name is Jack Charnley and I am a researcher from Newcastle University in the United Kingdom. My university is carrying out some research in India. I am interested in improving access to water and toilets and the overall school experience for children all across the world.

WHAT IS THE STUDY ABOUT?
You are invited to take part in a project looking at water, toilets and health in your school. If you take part in the study, your name will not appear in the final report. No one will know that you took part. At the end of the study, we will give your school some information about what we found out, which they will share with you. So please take the time you need to discuss the study with anyone you wish to, especially your parents. The decision to join or not is up to you. You can withdraw at any time!

WHAT IS INVOLVED IN THE STUDY?
If you decide to take part you will be asked to join in a group session in a classroom where you will answer written questions in four sections: (1) You, your family and your home life, (2) Health, (3) Water and (4) Self-confidence in achieving tasks.

My colleague and I will always be in the classroom to help you at all times. Depending on how long the session takes, it is possible that you may miss part of one of your lessons. If you decide to take part but then change your mind, you can ask to be taken out of the study at any time. If you decide to stop, you will not lose any benefits.

You are also invited to join in with group interviews. If you choose to participate, you will be asked questions and your voice will be recorded. These are optional and if you are asked to take part, you can say no. You can change your mind at any time during the interviews and leave the activity.

INTERVIEWS

The purpose of the interviews is to hear your story, views and opinions about water, toilets and sanitation in school. If you agree to take part in the interview, you have the freedom to talk about what you want to talk about. If I ask a question that you do not want to answer, you can just say that you do not want to answer the question. If you change your mind during the interview and want to leave the process, you can end your involvement without giving a reason. Simply indicate to me that you no longer want to take part.

Thank you for reading this sheet.

Newcastle University

Jack Charnley
**School of Education, Communication
and Language Sciences**
Email: j.charnley1@ncl.ac.uk

Participant Information – Households

This is an invitation for you to take part in a research study. Please consider the information carefully, before you decide to take part. You may wish to discuss this information with others before you decide whether or not to give your consent in writing.

This study is part of a Newcastle University programme undertaken by Jack Charnley. It investigates the impact of the water and sanitation project that took place in some schools in East Delhi, including one close to your home. The project, implemented by the Centre for Urban and Regional Excellence (CURE), aimed to improve the school environment. This was through the installation of hand-washing stations, wastewater recharging, rainwater harvesting, compost facilities and green areas.

The wider study considers children's awareness of water issues, their health behaviours, their self-efficacy (belief in their own ability to succeed in tasks) and their home background. The household part of the study investigates community members' experiences of water and their access to water, sanitation and hygiene facilities. You have been invited to take part in this study because we want to hear about the experiences of local community members who live close to the schools around water and sanitation.

If you decide to take part, you will be invited to complete a questionnaire about water access and the researcher will ask some questions about your access to water, sanitation and hygiene and your experiences of activities such as handwashing.

Questionnaires: You will be asked 12 questions about your experiences of water access and use in the last four weeks. During the questionnaire, you will be free to end your involvement at any time.

Interviews: Following the questionnaire component, you will be invited to take part in an interview with the researcher at your home about your experiences of water, sanitation and hygiene access in your local community Again, you have the choice to withdraw at any time during the interview process and without giving a reason. If you decide to take part, what we discuss will be recorded to help analyse the information.

Observations: With your permission, we would like to visit your home so that we can gather information about water, sanitation and hygiene facilities such as water pipes, water buckets, latrine facilities and cooking utensils. Even if you agree to participate in the questionnaire and interview, you can still decline this part of the research.

Participation is confidential – all identifiable data will be anonymous in the final report and the researcher will not withhold information from participants prior to the research. All physical data (questionnaire papers, observation sheets) will be stored securely in a locked cabinet. All digital data (interview recordings) will be stored on a password-protected hard-drive. No one will access the data apart from the researcher at any point in the process. No names will be used to identify participants in the final report. Once the results have been analysed, all participants, including staff and children will have access to a short user-friendly report that provides details about the project outcomes. This short report will contain the contact details of the researcher.

Thank you for reading this information.

Appendix 5 Consent forms (English versions)

1. Adults

**Jack Charnley
School of Education, Communication
and Language Sciences
Email: j.charnley1@ncl.ac.uk**

Participant Consent Sheet

PROJECT TITLE: Measuring the Impact of a School Water, Sanitation and Hygiene (WASH) Project in East Delhi

Please read the sentences below and tick the boxes if you agree.

1. I confirm that I have read the information document for the above study. I have had the opportunity to consider the information and ask questions. The researcher has given me answers I am happy with. ☐

2. I understand that taking part is voluntary and that I am free to withdraw at any time without giving a reason. ☐

3. I understand that the information collected about me will be stored securely and no one will be able to find out that I have taken part. ☐

4. I give permission for the information collected about me to be used for further research in the future. ☐

5. I agree to take part in the study. ☐

Name: _____

Signature: _____

Date: _____

Researcher's name: Jack Charnley

Researcher's signature: _____

Date: 18th November 2019

2. Children

**Jack Charnley
School of Education, Communication
and Language Sciences
Email: j.charnley1@ncl.ac.uk**

Participant Consent Sheet - Students

**PROJECT TITLE: Measuring the Impact of a School Water, Sanitation and Hygiene
(WASH) Project in East Delhi**

Please read the sentences below and tick the boxes if you agree.

1. I understand what the study is about. I have received answers to any questions I
   wanted to ask.

2. I understand that I do not have to take part and that I am free to quit at any
   time without giving a reason.

3. I understand that no one apart from the researcher will have access to the
   information collected about me and no one will be able to find out that I have
   taken part.

4. I give permission for the information collected about me to be used for further
   research in the future.

5. I agree to take part in the study.

Name: _____

Signature: _____

Date: _____

Researcher's name: Jack Charnley

Researcher's signature: _____

Date: 18th November 2019

Appendix 6 Participation certificate

Appreciation Award

THIS CERTIFICATE IS PRESENTED TO

for participating in Newcastle University's research about water and sanitation in schools.

Jack Charnley

Postgraduate Researcher

Appendix 7 Data management plan

Date and version of plan:

(4th draft) 16th August 2021

Researcher:

Jack Charnley

Project Title:

An investigation of the driving factors affecting children's Water, Sanitation and Hygiene (WASH) behaviours in East New Delhi primary schools

Project Context:

This doctoral project is being conducted within the School of Education, Communication and Language Sciences. It investigates the role of Water, Sanitation and Hygiene in different types of schools in East Delhi and the key drivers affecting children's WASH behaviours. Although there are aspects of the study that may be of interest to interdisciplinary researchers within the Newcastle University Water Hub, it is an individual-based project and is not carried out in collaboration with another department.

1. What data will you be working with?

Questionnaire data: I am working with non-digital survey data in the form of Likert-scale questionnaires. These were digitised by being coded into variables and input into SPSS as quantitative data. The raw data was retained in case of any digital data loss.

Interview recordings: These digital data were transcribed and translated by a native Hindi speaker.

Consent forms: These count as sensitive data as they include confidential information in the form of participants' names.

Observation notes: Notes from school-based research did not include any identifiable information. Notes from household-based research included information on water and sanitation facilities present in homes but these were not identifiable.

Digital data (photography, interview recordings, typed observation notes) were stored in password-protected cloud storage (Onedrive) and backed up on an external hard drive as well as a local machine. While in India, these were kept on portable storage devices (recording device and laptop) locked securely in my key-protected accommodation. On return to the UK, they were removed from these portable devices and backed up in the secure locations mentioned above. I planned to keep these in a locked cabinet in a University office that is protected by a keypad at night. However, I have worked from home since returning from India due to the COVID-19 pandemic so all data are stored at my home address.

Physical data was collected during school visits and household visits in the form of classroom questionnaires, household questionnaires and written observation notes. During the visit to India, these were kept locked in my accommodation. On return to the UK, they were kept at my home address due to the COVID-19 lockdown. Physical data were retained to protect against the unlikely case of loss of digital data. They will also be retained for potential use in future research – this is included on participant consent forms.

2. How will you organise and describe your data?

The data files were organised into digital folders corresponding to the research questions. They were sub-categorised into folders within these corresponding to the different measures used to collect the data (e.g. questionnaires). The coded names for the different variables in SPSS were recorded to avoid confusion during data analysis.

3. How will you store and back-up your data during the project?

The data were stored on a cloud storage system (Onedrive) and on my external hard drive back-up. It was also stored locally on my computer for back-up. All of these storage options are password-protected – the physical data were stored securely at my home address. The data analysis on SPSS and any other software packages (eg NVivo) was backed up regularly. To manage version control, new versions were saved with the date in the file name.

4. Legal, security, ethical and/or commercial questions to consider during your project

Participants were identifiable from their data through their names included on questionnaires and consent forms. However, no names were included in the final report. Any data used on the project will result from informed consent – all participants will have the opportunity to opt out before, during and after data collection. For more information, see ethics form submission.

5. What data will you keep after the project? How long and where will they be archived?

Data will be retained after the project in case there are opportunities for further analysis or collaborations with fellow researchers in the Newcastle University Water Hub. Permission was sought for this on the consent forms. The digital files will be retained in a password-protected, designated folder and the physical data will be retained securely at my home address.

6. How will others learn that your final datasets exist? How will they be able to access them?

The final thesis will be stored in the Newcastle University library system and will be openly available for staff and students. Participants will be offered a user-friendly leaflet outlining the main findings of the project. There are no funding body or institutional requirements regarding data sharing.

Appendix 8 Diamond ranking: focus group discussion elicitation activity
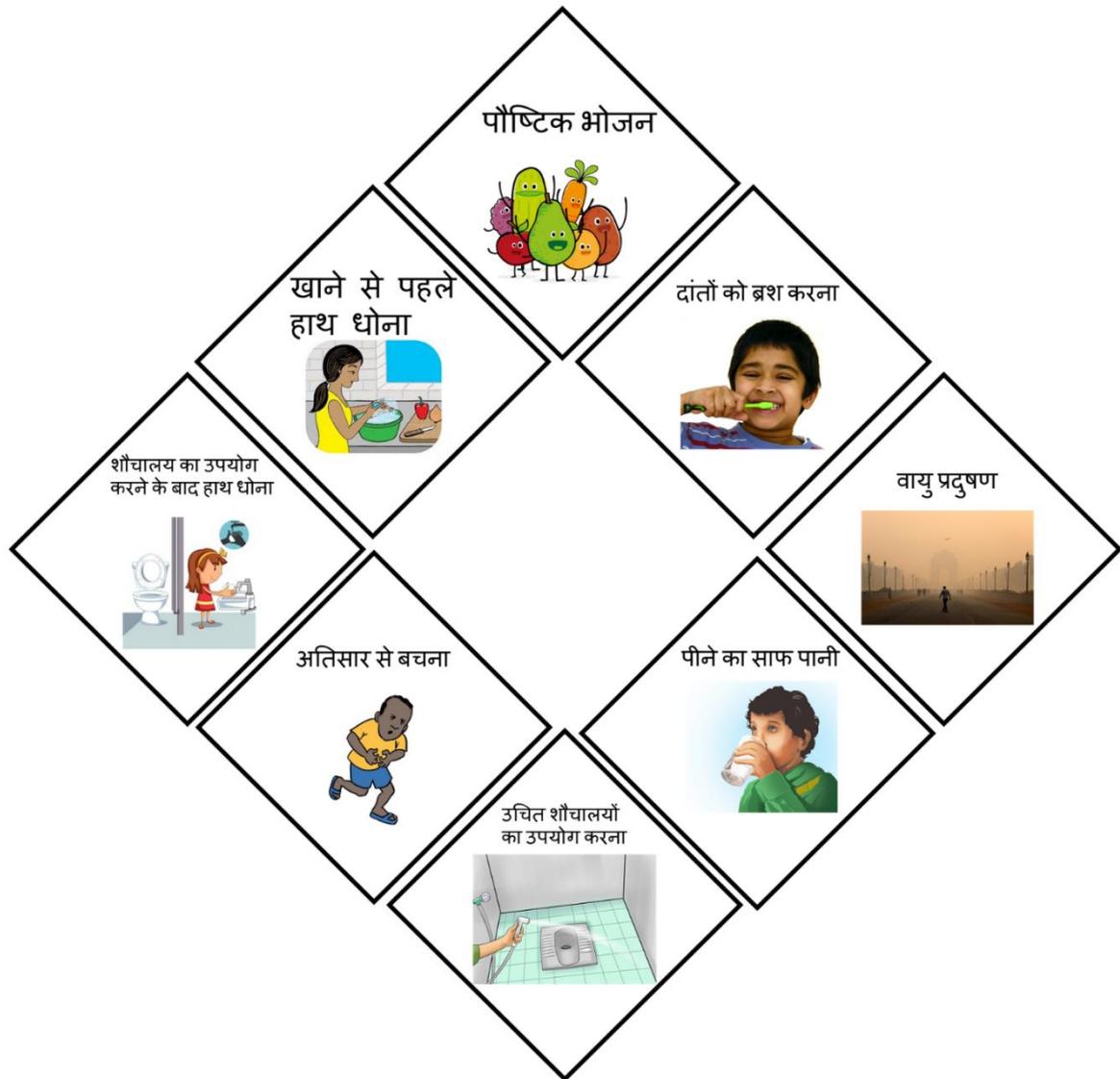
Appendix 9 Interview questions

1. Household interviews

<u>Interview Questions – Households and Parents</u>

1. Please tell us a bit more about yourself and your family.
2. What is your household's main source of income?
3. Are you aware of the work done by CURE in the primary school near your home?
4. What do you think are the main problems facing your community?
5. What are the main problems facing children in your community?
6. Do you have any problems relating to water and toilet provision?
7. Would you mind showing us around your home and explaining to us how you use water in your home please?
8. If you could improve your community in one way, what would it be?

Questions if the household includes a child who attends the CURE school:

1. Have you perceived any sort of difference in your child or their school as a result of CURE's work?
2. Do you think CURE's work has helped to bring solutions to problems faced by children and staff at the school?
3. Is there anything about CURE's work that you would change or want to improve?
4. What would you say is the most significant change that has happened in the school as a result of CURE's work?
5. What would you say is the most significant change for the children?
6. Do you think that CURE's work in this school has had any impact on the local community? Could you explain this please?

2. School staff interviews

<u>Interview Questions – School staff (principal, teachers, cleaners)</u>

Thank you very much for taking the time to speak to us. Just a reminder, we are representatives of Newcastle University conducting an independent evaluation of the work that was done in your school by the Centre for Urban and Regional Excellence, and

we want to hear your views and opinions on the impact it has had on the school. So please feel free to speak your opinions to us.

1. Please tell us a bit more about your role at the school. What do you do day to day?

2. How long have you worked at the school for?

3. Can you explain to us a bit more about the work CURE has done in the school?

4. Do you think CURE's work has helped to bring solutions to problems faced by children and staff at your school?

5. What sort of impact do you think that CURE's work has had on the school? How come?

6. Is there anything about CURE's work that you would change or want to improve?

7. What would you say is the most significant change that has happened in the school as a result of CURE's work?

8. What would you say is the most significant change for the school children?

9. Do you think that CURE's work in this school has had any impact on the local community? Could you explain this please?

Appendix 10 Focus group discussion questions

School Facilities

1. Have the toilets changed at all during your time at the school? How has this made you feel any differently about school?
2. Do you think it is important that when you are in the toilet, you are able to lock it? Why / why not?
3. Are you involved in responsibilities for maintaining the cleanliness of the school at all?
4. Does your school recycle waste? Do you think this is important? Why/why not?
5. *For students attending intervention schools* – What do you think has been the most significant change as a result of the work done by CURE? Why?
6. Do you like school? Why/why not?
7. Is having separate toilets for boys and girls important for you? Why/why not?
8. Is there an after-school club for water, sanitation and hygiene at your school? If there was, would you go? Why/why not?
9. If you could change one thing about your school, what would it be?

Household WASH

1. What do you use water for at home?
2. Do you have access to water in your home or do you have to travel to get it? How far do you travel?
3. If you have water access in your home, does it ever run out? How do you feel when this happens?
4. Do you always feel like you have enough water? If yes, would you consider giving some to other people who don't have enough? Why / why not?
5. If you could make any change to your home, what would it be? Why?
6. Do you have a toilet in your home? Why / why not? If yes, how do your family keep it clean? Do you think it is important to have a toilet in your home? Why / why not?
7. If no, where do you go for the toilet? How far do you travel to go to the toilet? Do you feel safe when you travel to use the toilet out of your home?
8. Do people in your area defecate in the street? Why / why not? Have you ever defecated in the street? Why / why not?
9. Do you think it is important to have soap in the house? Why / why not?

Children's WASH behaviours and attitudes

1. Do you drink the drinking water provided in your school? Why/why not?
2. Do you use the toilets in your school? Why/ why not?
3. Do you wash your hands after using the toilet at school? Why/why not?
4. If yes, do you use soap? Why/why not?
5. Do you think it is important to save water? Why / why not?
6. Do you think water should be free for everyone or do you think everyone should have to pay for it? Why/why not?
7. If you think it should be free, how will it be paid for?
8. Would you empty your toilet straight into a river? Why/why not?
9. Would you like to learn more about water in school? Why/why not?
10. Do you think it is important that girls and boys have the same access to water and toilet facilities?

Appendix 11 Focus group discussion and interview transcript examples

<u>GISA girls focus group transcript – 02/02/2020</u>

The girls have drawn their home lives with specific uses of water.

Can you explain what is happening in your drawing? (Student #1)

They are giving water to the trees and cleaning utensils. Washing hands and washing dishes.

Ok that's some uses of water we have at home. What about your drawing? (Student #2)

Giving water to the plants, washing the dishes, washing clothes.

Which person at your home does these jobs?

My mother, my sister and me.

How many people are in your home?

5.

You, your mother, your sister, who are the others?

My father and brother.

Does your brother do these jobs?

He gives water to the plants but he doesn't wash clothes or do the dishes.

What about your drawing? (Student #3)

3 jobs – giving water to plants, filling the bucket and washing rice. I also wash dishes, as well as my mother.

Where do you get the water to wash rice?

From the tap, the connection. We have a motor, a water pump and we get water from there.

Why do you need to wash rice?

Before cooking, because it is dirty.

Ok. Let's talk about your drawing (student #4)

This is the toilet, outside the home.

Is it far?

Not too far, 5 minute walk.

Public toilet?

Yes.

If you want to go to the toilet and it's night, how do you get there?

The community toilet closes around 11 at night. So I would go in the open in the open ground with my mother.

Do any of you have toilets in your home?

Students raise hands.

Ok so 1 out of 5. So you 4 you use community toilets. What about you 3?

We go in the evening so we don't have to go in the night. If I need in the night, I will go along with my mother.

In your community when you use the community toilets, or when you go in the open at night, do you always feel safe?

Yes we feel safe.

Can you tell us about any time when you didn't feel safe?

Sometimes I feel unsafe and fear when I have to go to the community toilets. If it is dark and sometimes there are boys aged 15 or 16 or men standing there. They are fighting each other. The men are sometimes drunk, some of them are married. If there is no one in the community toilets, they will go there and drink inside. If there is no security guard there, the men come there and drink alcohol inside.

Can you tell us about your drawing? (Student #4)

Giving water to the plants.

Is this a job you do at home?

Yes.

What are your favourite activities to do when you are out of school?

Sleeping! I don't sleep at all but I enjoy sleeping.

Why don't you sleep a lot?

I don't feel like sleeping.

Watching TV, cartoons after school.

Are there any activities that you want to do but you don't have time for or you can't currently do it?

After school, after 12.30, I go home. I undress my brother and watch a TV show. Around 4 o'clock, I go to tuition.

What happens in your extra tuition classes?

We learn social science, Hindi, English. Whatever we do at school, we do at tuition as well.

If you have school, why do you go to tuition?

Whatever work we get in the school, I am not able to do it fully so I go to tuition. I take my work from school.

How much does it cost?

400 Rs per month per person.

Another student – I pay 100 Rs per month. My 2 sisters come along so it's 300 Rs total.

Are there any changes you would like to make in the school?

Two things. I want the school more clean. Students do not use the dustbin properly. They litter nearby which makes the place dirty. Also lots of students fight with each other.

Can you tell us what you were talking about?

I want cleaner toilets. Some children go to the toilet but they do not flush properly which is a problem. Some children do not close the tap which makes the water tank empty and we won't have enough water.

GISA girls' principal interview – 16/01/2020

Thank you very much for agreeing to talk to us today. Could you please tell us a bit more about your role at the school and what you do day to day?

My role is totally for the school, with every situation – studying, discipline, cleanliness, concerns with students, safety, security as well. I handle all of that.

Could you tell us a bit more about how the cleanliness of the school would impact your role?

I have the cleaning staff who do the cleaning work but my role is to supervise and observe them – to keep them accountable.

Are you satisfied with the role that the cleaning staff are playing in the school?

I am satisfied but the school is so big and the number of cleaning staff is inappropriate for such a big school. There is a shortage.

How long have you worked here for?

I have worked for the MCD for 30 years and this school, for 5 years.

And can you explain to us a bit more about the work that CURE has done at this school?

First of all, hand washing. How to use the toilets properly because before, students did not sit on the toilet seats properly. Now they are doing that properly. They have taught the students how to sit properly.

Ok so renovating the infrastructure and teaching the children?

Yes. Both of these CURE have done.

And do you think that CURE's work has had a positive impact on the school?

Definitely.

Can you give examples of problems that the school had before that CURE have addressed successfully?

The _____ colony students, these students do not have toilets and they defecate in the open. They do not wash their hands after defecation. CURE taught how to use the toilets, how to wash the hands, how to use the toilets seats properly. Through sports day, drawing competition, drama.

So did the students used to defecate in the school grounds?

No, not in the open. They would use the toilet but they didn't know how to use the toilet. They would just shit everywhere.

Could you tell us some specific examples about how CURE's work has improved the school?

CURE has collected fallen leaves and have taught how to make compost from it. And also how to use waste paper for compost.

And do children use the compost facilities well?

Children don't use the compost facility because there are insects there. The cleaning staff, teachers and security guards – all the adults use it.

Do the adults use the compost facilities correctly?

Yes.

Can you think of anything about the work that CURE has done that you would change or improve?

How can students take care of the green areas, how to plant trees, how to take care of the plants. And same for the water – how to conserve water.

Are you saying that the children don't yet understand how to take care of the greenery and how to conserve water?

They're not fully understanding it 100%. The teachers are making the students aware on a daily basis but yet the students are not fully aware.

On a scale of 0 to 10, how would you rate the children's understanding of water conservation and other things CURE have taught?

 7 or 8.

Ok so good but not perfect. Has CURE's work improved attendance in the school?

Yes definitely. CURE people went to visit the parents of students and through various activities they have connected with them. They have worked in the communities and collected students to bring them to school.

Do you think CURE's work has had an impact on academic performance?

CURE people have not made them study. They have started various activities – students are more excited and encouraged specifically for these activities. So CURE's work in this way increased attendance because students were more keen to be here. Students are happy to work with activities like cleaning or planting a tree.

What about when CURE's activities are not happening? They have finished now – are the children still enthusiastic?

The elder students in big classes are trained. But the younger classes are new so they need more encouragement.

Are there any plans for CURE's activities to continue?

Definitely.

What about outside in the local community – do you think there has been any impact of CURE's work outside the school?

CURE people have taught the communities how to work, to make alternative income.

Interpreter: In one of the household surveys, the father showed photos on his phone of a bag made of beads that his daughter had made. CURE taught the fifth class children how to make those bags which could then be sold.

They taught them how to make brooms which is cheaper than buying one.

Last question. What do you think are the problems that children are facing in this school now?

The main one is poverty, the main reason. Students go with the parents to earn money begging, to work on the farms. They miss school and this makes attendance lower.

How do you think that this problem could be addressed?

One of the main things is CURE acts as an interface between the school and the community. So the dropouts from school, CURE brings them back.

At the end of the interview, the principal asked us to send CURE back to the school.

Are there no official plans for CURE to come back?

Last year, CURE worked very enthusiastically but this year it is very low because they are not officially attached. But still they do work, but less.

GISB parent interview – 14/01/20

My name is Reena and I have 6 children. 4 of them are in the school.

Are you aware of the work done by CURE at the school?

No.

What do you think are the main problems for children in your community?

They are not getting proper education in the school. The teachers do not teach the students properly. They give their tasks to young girls.

Are there any problems in your community relating to water and toilets?

In the summers, we have a problem with water. For 2 to 3 days, there would be no water.

How do you solve this problem?

Sometimes we call a tanker from Delhi Jal Board who comes and gives water to every household.

How often is there no water in the community?

A few times a month in the summer.

If you could improve your community in one way what would it be?

Water is the main issue. If this is solved, it could solve other things as well. The school could be better.

If the water issues were solved, what problems would that improve?

There would be cleanliness.

Appendix 12 Example screen captures of NVivo analysis

Codes			
Name	Files	References	Created on
Children's attitudes	3	4	01/06/2020 15:31
Community impacts	2	2	29/05/2020 09:20
Community inequalities	3	8	29/05/2020 09:33
CURE intervention	14	48	29/05/2020 09:38
Behaviour Change Communication (BCC)	3	9	29/05/2020 09:07
Future possibilities	5	6	29/05/2020 09:20
Intervention impacts	10	22	29/05/2020 09:17
Intervention sustainability	7	11	29/05/2020 09:25
Household sanitation	9	14	29/05/2020 09:43
GISA	7	11	29/05/2020 09:59
GISB	3	3	29/05/2020 09:55
Household wealth indicators	7	7	29/05/2020 09:45
Parental perception of schools	4	6	29/05/2020 09:31
Pupil-parent transfer	3	4	29/05/2020 09:23
Questionnaire - Health	4	9	01/06/2020 15:35
Research Design	1	1	01/06/2020 16:10
School attendance	4	6	29/05/2020 09:24
School contexts	10	33	01/06/2020 15:31
GISA	8	15	01/06/2020 15:31
GISB	2	5	01/06/2020 16:06
GNIS	2	6	01/06/2020 16:18
LFPS	1	7	03/06/2020 09:17
School Inequalities	3	3	01/06/2020 15:10
School sanitation	5	14	01/06/2020 15:11
School staff issues	4	11	01/06/2020 15:12
Water security	8	36	29/05/2020 09:33
Community water security	4	23	29/05/2020 09:37
GISA households	2	9	29/05/2020 09:50
GISB households	2	7	29/05/2020 09:51
GNIS households	2	6	03/06/2020 10:26
LFPS households	1	1	03/06/2020 09:40
School water access	6	13	29/05/2020 09:32
GISA	2	3	29/05/2020 09:53
GISB	2	4	29/05/2020 09:54
GNIS	3	4	01/06/2020 16:26
LFPS	2	2	03/06/2020 09:32

First panel

Codes — Search Project

Name	/ Files	References
Children behaviour	2	5
Children's attitudes	3	4
Community impacts	2	2
Community inequalities	3	8
CURE intervention	14	48
Behaviour Change Communication (BCC)	3	9
Future possibilities	5	6
Intervention impacts	10	22
Intervention sustainability	7	11
Household sanitation	9	14
GISA	7	11
GISB	3	3
Household wealth indicators	7	7
Parental perception of schools	4	6
Pupil-parent transfer	3	4
Questionnaire - Health	4	9
Research Design	1	1
School attendance	4	6
School contexts	10	33
GISA	8	15
GISB	2	5
GNIS	2	6
LFPS	1	7
School Inequalities	3	3
School sanitation	5	14
School staff issues	4	11
Water security	8	36
Community water security	4	23
GISA households	2	9
GISB households	2	7
GNIS households	2	6

○Household sanitation

<Files\\ notes> - § 3 references coded [3.21% Coverage]

Reference 1 - 0.59% Coverage

I visited some ▓▓ local public toilets as in one area we were in, people don't have toilets in their homes. The public toilets were very clean and although there was not enough soap, the attendant said it was getting replenished the following day.

Reference 2 - 1.44% Coverage

Househould visit with ▓▓ – Pit latrine, liquids flow into open drain and solids into pit – truck takes away for payment when full. She shares her own toilet facilities with her neighbour for free. She has had a pit latrine for 3 years, since she bought the house. Before the new pipeline from the government, the pipes were cracked and water from the open drain would seep in, making the pipe water dirty. New pipeline water is protected and cleaner. Two years ago, water was a problem here but it has since improved. ▓▓ used to use borewell water which was salty and not potable.

Reference 3 - 1.18% Coverage

Household visit with ▓▓ – If water is scarce, she also goes to the temple like ▓▓ Her piped connection hasn't worked for a year. She uses public toilets and these close 11pm-4am. When it's closed they defecate in the open on nearby public ground but they've never encountered problems. If children need to go at night, the parents go with them. 2 months ago, dirty water was coming into neighbour's connection so they purchased water from the filter business owner.

<Files\\Focus Group Discussions\\ boys focus group 1 transcript> - § 1 reference coded [18.04% Coverage]

Reference 1 - 18.04% Coverage

I clean my own toilet, I do my part of it. I will take care for others too. People near where I live use the community toilets. If it is not clean, I will take a mug of water to flush it to make it clean before I use it. If I will not do that, there will be worms there and no one will use it and it will not be good.

<Files\\Focus Group Discussions\\ boys focus group 2 transcript> - § 3 references coded [22.41% Coverage]

Second panel

Codes — Search Project

Name	/ Files	References
Community inequalities	3	8
CURE intervention	14	48
Behaviour Change Communication (BCC)	3	9
Future possibilities	5	6
Intervention impacts	10	22
Intervention sustainability	7	11
Household sanitation	9	14
GISA	7	11
GISB	3	3
Household wealth indicators	7	7
Parental perception of schools	4	6
Pupil-parent transfer	3	4
Questionnaire - Health	4	9
Research Design	1	1
School attendance	4	6
School contexts	10	33
GISA	8	15
GISB	2	5
GNIS	2	6
LFPS	1	7
School Inequalities	3	3
School sanitation	5	14
School staff issues	4	11
Water security	8	36
Community water security	4	23
GISA households	2	9
GISB households	2	7
GNIS households	2	6
LFPS households	1	1
School water access	6	13
GISA	2	3
GISB	2	4
GNIS	3	4

○Household sanitation   ○Questionnaire - Health   ○School water access

Reference 6 - 0.93% Coverage

According to the two interviewed teachers, the biggest problem for children at the school is the faulty reverse osmosis water purification system. It was received from the government education department 5 years ago but is not working properly. Drinking water is a problem here – they tell students to bring water from their homes. I did see some students with reusable sturdy plastic water bottles.

Reference 7 - 0.32% Coverage

▓▓ children are maybe not ware of their responsibility to conserve water because it is provided so freely by the school.

<Files\\Focus Group Discussions\\Focus group – Transcript> - § 2 references coded [8.80% Coverage]

Reference 1 - 5.26% Coverage

What do you think is the main problem for children in your school?

Violence between students. People destroy the desks as well. Sometimes there is no drinking water and none in the toilets. We do not have water in the flush.

Reference 2 - 3.53% Coverage

Is there drinking water in the school?

Yes but sometimes there is no drinking water. In the toilets, we don't have water. We bring a bottle from home.

<Files\\Household Interviews\\Household - transcript> - § 1 reference coded [29.88% Coverage]

Reference 1 - 29.88% Coverage

I believe that both of these are necessary. My children take drinking water with them to school. Sometimes the school water doesn't come in the morning because it is turned off. The school works in two shifts, morning and afternoon. So the problem is who is responsible for turning on the water pump motor to fill the water tank – it is the security guard. Sometimes this gets missed and the children do not have water. Also, in the second shift, children use the water and the tank is empty. So it has to be filled in the morning and it is the security guards who do this job. If they don't do it, there is no water.

Top panel - Codes list:

Name	/ Files	References
⊕ Name	/ Files	References
Children behaviour	2	5
Children's attitudes	3	4
Community impacts	2	2
Community inequalities	3	8
CURE intervention	14	48
⃝ Behaviour Change Communication (BCC)	3	9
⃝ Future possibilities	5	6
⃝ Intervention impacts	10	22
⃝ Intervention sustainability	7	11
Household sanitation	9	14
⃝ GISA	7	11
⃝ GISB	3	3
Household wealth indicators	7	7
Parental perception of schools	4	6
Pupil-parent transfer	3	4
Questionnaire - Health	4	9
Research Design	1	1
School attendance	4	6
School contexts	10	33
⃝ GISA	8	15
⃝ GISB	2	5
⃝ GNIS	2	6
⃝ LFPS	1	7
School Inequalities	3	3
School sanitation	5	14
School staff issues	4	11
Water security	8	36
Community water security	4	23
⃝ GISA households	2	9
⃝ GISB households	2	7
⃝ GNIS households	2	6
⃝ LFPS households	1	1

Top panel - right side (tabs: Household sanitation, Questionnaire - Health, School water access, Intervention sustainability):

Reference 1 - 0.58% Coverage

The head of ▢ mentioned that she would like CURE to get more funding so they can do more work on the infrastructure of the school. However she saw that even when the funding ends, the children still have their knowledge so it is sustainable.

<Files\\Focus Group Discussions\\ ▢ boys focus group 5 transcript> - § 1 reference coded [31.17% Coverage]

Reference 1 - 31.17% Coverage

We can improve the school by planting trees. We will get oxygen and there will be more green cover. The younger children, they just destroy the plants. The teachers put up a fence but the kids just took it away. Some people at the back of the school throw stones into the school compound. Someone threw a stone on someone's head. I also got hit by one. Both children and adults throw them.

<Files\\Focus Group Discussions\\ ▢ girls focus group transcript> - § 1 reference coded [6.20% Coverage]

Reference 1 - 6.20% Coverage

I want cleaner toilets [at school]. Some children go to the toilet but they do not flush properly which is a problem. Some children do not close the tap which makes the water tank empty and we won't have enough water.

<Files\\School Staff Interviews\\Headteacher - ▢ transcript> - § 3 references coded [10.41% Coverage]

Reference 1 - 5.29% Coverage

CURE has collected fallen leaves and have taught how to make compost from it. And also how to use waste paper for compost. Children don't use the compost facility because there are insects there. The cleaning staff, teachers and security guards – all the adults use it.

Reference 2 - 2.18% Coverage

The elder students in big classes are trained. But the younger classes are new so they need more encouragement.

Bottom panel - Codes list:

Name	/ Files	References
⊕ Name	/ Files	References
Children behaviour	2	5
Children's attitudes	3	4
Community impacts	2	2
Community inequalities	3	8
CURE intervention	14	48
⃝ Behaviour Change Communication (BCC)	3	9
⃝ Future possibilities	5	6
⃝ Intervention impacts	10	22
⃝ Intervention sustainability	7	11
Household sanitation	9	14
⃝ GISA	7	11
⃝ GISB	3	3
Household wealth indicators	7	7
Parental perception of schools	4	6
Pupil-parent transfer	3	4
Questionnaire - Health	4	9
Research Design	1	1
School attendance	4	6
School contexts	10	33
⃝ GISA	8	15
⃝ GISB	2	5
⃝ GNIS	2	6
⃝ LFPS	1	7
School Inequalities	3	3
School sanitation	5	14
School staff issues	4	11
Water security	8	36
Community water security	4	23
⃝ GISA households	2	9
⃝ GISB households	2	7
⃝ GNIS households	2	6
⃝ LFPS households	1	1

Bottom panel - right side (tab: Pupil-parent transfer):

<Files\\Ethnographic Notes\\Ethnographic notes> - § 2 references coded [1.27% Coverage]

Reference 1 - 0.48% Coverage

According to the Seemapuri head, children are going home and passing on their knowledge to parents eg. how to wash hands. Academic achievement has apparently improved because attendance is less sporadic.

Reference 2 - 0.79% Coverage

Kusum (Seemapuri parent) reported that her daughter (5th grade) has taught her about handwashing. She attended a drama at the school about plastic bag usage and as a result, she now uses newspapers to distribute her flower garland business instead of plastic bags (although both newspaper and plastic bags were present next to the flowers).

<Files\\School Staff Interviews\\Headteacher boys – Dilshad Garden transcript> - § 1 reference coded [8.12% Coverage]

Reference 1 - 8.12% Coverage

These children are from the backward and very poor class families. So definitely what they see here, they don't see at home. So definitely more than half of the time they be with their parents, so whatever the things we teach here, whatever we do with them, they don't follow at home. If their families are quite healthy and very much comfortable to afford everything, definitely the change would have been better, it would have come earlier. This takes time.

<Files\\School Staff Interviews\\Teacher Interview – Dilshad Garden – Girls Shift Transcript> - § 1 reference coded [7.28% Coverage]

Reference 1 - 7.28% Coverage

Do you think the children with what they have learnt through CURE, do you think the children have passed this onto their parents?

I can make this out because the children are cleaner when they are coming to the school. Most of the students are now coming in a very clean way so maybe they told their parents about the cleanliness and that is why they are cleaner when they come to school.

Appendix 13 Explanation of statistical procedures

1. Descriptive statistics

Pie charts, bar charts, measures of central tendency, frequency tables and frequency distributions were used to present relevant information relating to the context in which the research took place. Measures of central tendency (e.g. mean, median and mode) represent the central value of a given variable, such as participating children's age. Frequency tables display the number of times a certain value occurs in the data. For example, a frequency table could show how many children there are of each age. Frequency distributions display these data in visual form; in this research, bar charts were used.

2. One-way analysis of variance (ANOVA)

This statistic is used when comparing the mean values of more than two different populations (e.g. GISA, GISB, GNIS, LFPS). It establishes whether there are any differences between these groups for certain variables. In the current thesis, it was used to compare the mean values of different variables between school types such as fathers' income category, children's views on their school's WASH provision, their reported WASH behaviours and their health outcomes.

The Scheffe test is a post hoc test used in the one-way ANOVA which reveals which mean differences are statistically significant. It produces multiple comparisons and homogeneous subsets tables which give the researcher a clear idea of statistically significant differences in the mean values. The confidence intervals in the multiple comparisons table of the Scheffe test show the values within which the true value is thought to lie. Box plots were also used alongside the Scheffe test in this research to give a visual representation of the differences resulting from the independent variable (e.g. school type).

3. Independent-samples t-test

As with the one-way ANOVA, the independent-samples t-test compares mean differences but it is used when the variable is dichotomous (e.g. when it is binary, such as whether a home has an inside toilet or not). Independent-samples t-tests were used during this thesis research when comparing dichotomous variables including male and female students, homes with and without inside toilets, and homes with and without inside kitchens.

4. Spearman's rank correlation coefficient (Spearman's rho)

Spearman's rho indicates the direction, strength and statistical significance of associations between two variables. In this research, it was applied to variables such as children's WASH behaviours, school WASH provision, father's employment category, home factors such as number of rooms, the water attitudes factors and the theme of self-efficacy. It was selected instead of Pearson's correlation because it is more resistant to outliers in the data.

5. Structural equation modelling (SEM)

SEM is a multivariate technique used to analyse the path relationships between different observed variables and latent variables. It is an appropriate method for investigating relationships between multivariate data (Bentler and Yuan, 1999). Observed variables are those which are present in the dataset, such as gender or frequency of children's WASH behaviours. Latent variables are factors, themes or concepts which cannot be observed directly but can be constructed from the data using exploratory factor analysis.

SEM has two objectives. First, through the construction and evaluation of linear equations, SEM enables the researcher to investigate connections between observed and latent variables, resulting in a deeper understanding of the intricate relationships inherent in the data (Lee et al., 2016; Humble, 2020). Secondly, the researcher seeks to account for as much of the variance in these variables as possible (Kline, 2015).

SEM diagrams provide a visualisation of regression coefficients (single-headed arrows) and error terms (small circles pointing to observed variables) between variables, offering

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a statistical explanation of how phenomena arise supported by theory and previous literature. For example, it is reasonable to hypothesise that father's job category, number of rooms in home, presence of an inside toilet and presence of an inside, separate kitchen are all indicators of socio-economic status. Therefore, these constitute the latent factor in Figure 46 which, according to the structural equation model, affects children's *Hygiene Practices* and *Health Outcomes*. There is some evidence in the literature that these two variables are correlated so this is included in the model, represented in the diagram as a double-headed arrow. One strength of SEM is that the likelihood of links between variables is immediately clear from the diagram with the error term (ε) denoting how much of the variance is caused by other factors.

In SEM, variables with no path directed towards them (such as *School Facilities* in Figure 21) are defined as exogenous variables, while those with one path or more directed towards them (the other three variables in Figure 21) are defined as endogenous variables. This is because using the terms dependent and independent is confusing when there are multiple pathways included in the model (Huber, 2016). The values included on the straight arrow paths, which represent direct relationships between variables, are equivalent to regression coefficients. The higher the value, the stronger the relationship.

Goodness-of-fit indices are used to assess whether the data are suited to SEM and they measure how close the observed data are to the prediction of the structural equation model. Goodness-of-fit indices included in this thesis study are the Root Mean Square Error of Approximation (RMSEA), the Standardised Root Mean Square Residual (SRMR), the Coefficient of Determination (CD), the Tucker-Lewis Index (TLI) and the Comparative Fit Index (CFI). In addition, the χ^2/*df* ratio was used. According to Hoyle (2015), a general guideline is that if the χ^2/*df* ratio is lower than 3, this provides evidence towards the model being a good fit for the data. The regression functions from each of the structural equation models included in the analysis for this thesis are given in Appendix 16.

Appendix 14 *Health Outcomes* analysis

The analysis of the *Health Outcomes* factor was not included in the responses to the three research questions so is presented here, providing additional insight into the analysis process. The fourth category of the health section of the school-based questionnaire related to students' *Health Outcomes (*Q43-45), specifically tooth-related discomfort in the last year, diarrhoea or dysentery in the last month and worm infestation in the last month. A maximum total score across the three items of 7 indicated that a student never encountered any of these symptoms within those timeframes while a score of 0 indicated that they encountered all of them. Figures 51-52 show the distribution of children's *Health Outcomes* scores across the four schools (GISA, GISB, the GNIS and the LFPS). Overall, students at the participating schools reported rarely experiencing the symptoms included in these items, with government school students experiencing them slightly more than LFPS students

Figure 51 Frequency distribution of students' total Health Outcomes scores across school types
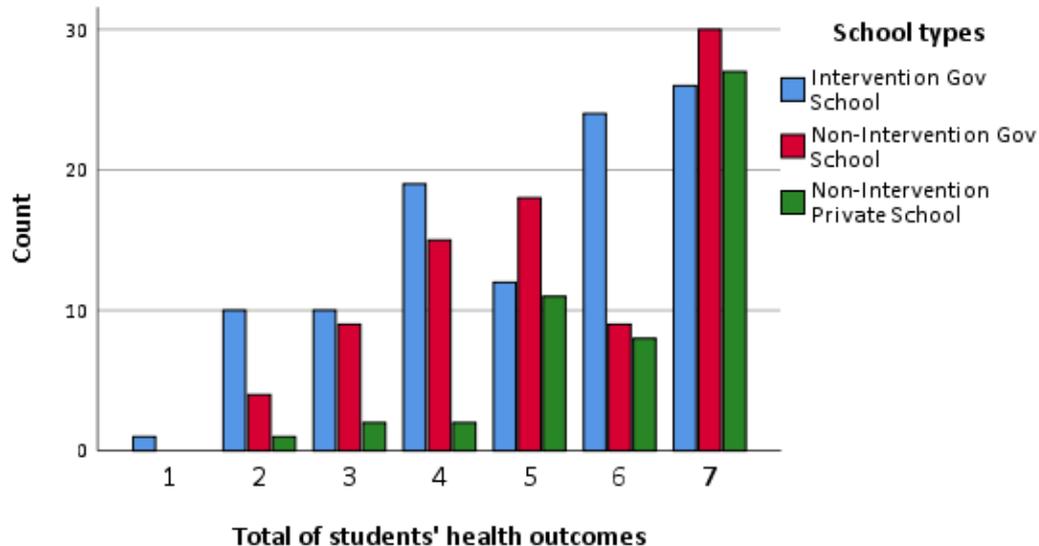
As with the *Hygiene Practices* questions, the mean total score for these questions was statistically significantly different between the LFPS and the government schools but not between GISA-B and the GNIS, $P[F(2, 235) = 7.076]$ <0.001. The largest and most statistically significant difference was 1.01 between the LFPS and GISA-B (p = 0.05, 95% CI, 0.34 to 1.67). The difference between the LFPS and GNIS was 0.76 (p < 0.05, 95% CI,

0.07 to 1.44) (Tables 21-23). In keeping with the *Hygiene Practices* questions, LFPS students reported better health outcomes (i.e. fewer instances of the conditions listed above) than government school students.

Table 21 Health questionnaire: Children's Health Outcomes

	Int	Non-Int	Priv	All types	Int – Non-Int	Int - Priv	Non-Int - Priv
					p-values of differences		
Items	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)			
Toothache or tooth discomfort	2.47 (0.54)	2.67 (0.5)	2.78 (0.42)	2.61 (0.51)	-0.2**	-0.31***	-0.11**
Diarrhoea or dysentery	1.25 (0.95)	1.24 (0.97)	1.49 (0.88)	1.29 (0.94)	0.01	-0.24*	-0.25**
Worm infection	1.31 (0.91)	1.38 (0.93)	1.76 (0.65)	1.43 (0.88)	-0.07	-0.45***	-0.38***
N	102	86	51	239			

p***<0.001, p**<0.01, p*<0.05

Table 22 Health Outcomes: Multiple comparisons for one-way ANOVA post hoc test

Scheffe

(I) School Types	(J) School Types	Mean Difference (I-J)	95% Confidence Interval	
			Lower Bound	Upper Bound
Interv Gov	Non-Interv Gov	-0.25	-0.82	0.32
	Private	-1.01*	-1.67	-0.34
Non-Interv Gov	Interv Gov	0.25*	-0.32	0.82
	Private	-0.76*	-1.44	-0.07
Private	Interv Gov	1.01*	0.34	1.67
	Non-Interv Gov	0.76*	0.07	1.44

*. The mean difference is significant at the 0.05 level.

Table 23 Health Outcomes: Homogeneous subsets

Scheffe [a, b]

School Types		Subset for alpha = 0.05	
	N	1	2
Interv Gov	102	5.03	
Non-Interv Gov	85	5.28	
Private	51		6.04
Sig.		0.625	1.000

Means for groups in homogenous subsets are displayed.
   a.   Uses Harmonic Mean Sample Size = 72.857
   b.   The group sizes are unequal. The harmonic mean of the group sizes is used.
        Type 1 error levels are not guaranteed.

Comparing *Health Outcomes* for male and female students across participating schools, female students (5.47 ± 1.54) reported a marginally lower incidence of the included symptoms than male students (5.14 ± 1.71). However, this was not statistically significant.

Appendix 15 Post hoc results for children's background variables

Table 24 Number of people living in home: Multiple comparisons for one-way ANOVA post hoc test

Scheffe

(I) School Types	(J) School Types	Mean Difference (I-J)	95% Confidence Interval	
			Lower Bound	Upper Bound
Interv Gov	Non-Interv Gov	0.54	-0.03	1.12
	Private	0.95*	0.28	1.62
Non-Interv Gov	Interv Gov	-0.54	-1.12	0.03
	Private	0.41	-0.28	1.10
Private	Interv Gov	-0.95*	-1.62	-0.28
	Non-Interv Gov	-0.41	-1.10	0.28

*. The mean difference is significant at the 0.05 level.

Table 25 Number of people living in home: Homogeneous subsets

Scheffe [a, b]

School Types		Subset for alpha = 0.05	
	N	1	2
Interv Gov	102	5.39	
Non-Interv Gov	86	5.80	5.80
Private	51		6.34
Sig.		0.300	0.124

Means for groups in homogenous subsets are displayed.
  a. Uses Harmonic Mean Sample Size = 73.100.
  b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type 1 error levels are not guaranteed.

Table 26 Number of rooms in home: Multiple comparisons for one-way ANOVA post hoc test

Scheffe

(I) School Types	(J) School Types	Mean Difference (I-J)	95% Confidence Interval	
			Lower Bound	Upper Bound
Interv Gov	Non-Interv Gov	0.05	-0.37	0.48
	Private	-1.61*	-2.11	-1.11
Non-Interv Gov	Interv Gov	-005	-0.48	0.37
	Private	-1.66*	-2.17	-1.15
Private	Interv Gov	1.61*	1.11	2.11
	Non-Interv Gov	1.66*	1.15	2.17

*. The mean difference is significant at the 0.05 level.

Table 27 Number of rooms in home: Homogeneous subsets

Scheffe [a, b]

School Types		Subset for alpha = 0.05	
	N	1	2
Interv Gov	102	2.67	
Non-Interv Gov	86	1.73	
Private	51		3.33
Sig.		0.966	1.000

Means for groups in homogenous subsets are displayed.
    a.   Uses Harmonic Mean Sample Size = 73.100.
    b.   The group sizes are unequal. The harmonic mean of the group sizes is used.
        Type 1 error levels are not guaranteed.

Table 28 Extent of overcrowding in household: Multiple comparisons for one-way ANOVA post hoc test

Scheffe

(I) School Types	(J) School Types	Mean Difference (I-J)	95% Confidence Interval	
			Lower Bound	Upper Bound
Interv Gov	Non-Interv Gov	0.25	-0.38	0.89
	Private	2.60*	1.86	3.34
Non-Interv Gov	Interv Gov	-0.25	-0.89	0.38
	Private	2.34*	1.58	3.11
Private	Interv Gov	-2.60*	-3.34	-1.86
	Non-Interv Gov	-2.34*	-3.11	-1.58

*. The mean difference is significant at the 0.05 level.

Table 29 Number of people living in home: Homogeneous subsets

Scheffe [a, b]

School Types		Subset for alpha = 0.05	
	N	1	2
Interv Gov	102	1.94	
Non-Interv Gov	86		4.28
Private	51		4.54
Sig.		1.000	0.68

Means for groups in homogenous subsets are displayed.
    a.   Uses Harmonic Mean Sample Size = 73.100.
    b.   The group sizes are unequal. The harmonic mean of the group sizes is used.
        Type 1 error levels are not guaranteed.

Table 30 Water access at the home: Multiple comparisons for one-way ANOVA post hoc test

Scheffe

(I) School Types	(J) School Types	Mean Difference (I-J)	95% Confidence Interval	
			Lower Bound	Upper Bound
Interv Gov	Non-Interv Gov	-0.04	-0.12	0.03
	Private	-0.08	-0.17	0.01
Non-Interv Gov	Interv Gov	0.04	-0.03	0.12
	Private	-0.04	-0.13	0.06
Private	Interv Gov	0.08	-0.01	0.17
	Non-Interv Gov	0.04	-0.06	0.13

*. The mean difference is significant at the 0.05 level.

Table 31 Water access at the home: Homogeneous subsets

Scheffe [a, b]

School Types		Subset for alpha = 0.05
	N	1
Interv Gov	102	0.92
Non-Interv Gov	86	0.97
Private	51	1.00
Sig.		0.078

Means for groups in homogenous subsets are displayed.
  a. Uses Harmonic Mean Sample Size = 73.100.
  b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type 1 error levels are not guaranteed.

Table 32 Toilet access at the home: Multiple comparisons for one-way ANOVA post hoc test

Scheffe

(I) School Types	(J) School Types	Mean Difference (I-J)	95% Confidence Interval	
			Lower Bound	Upper Bound
Interv Gov	Non-Interv Gov	-0.22*	-0.33	-0.11
	Private	-0.25*	-0.37	-0.12
Non-Interv Gov	Interv Gov	0.22*	0.11	0.33
	Private	-0.02	-0.15	0.11
Private	Interv Gov	0.25*	0.12	0.37
	Non-Interv Gov	0.02	-0.11	0.15

*. The mean difference is significant at the 0.05 level.

Table 33 Toilet access at the home: Homogeneous subsets

Scheffe [a, b]

School Types		Subset for alpha = 0.05	
	N	1	2
Interv Gov	102	0.75	
Non-Interv Gov	86		0.98
Private	51		1.00
Sig.		1.000	0.894

Means for groups in homogenous subsets are displayed.

    a.   Uses Harmonic Mean Sample Size = 73.100.

    b.   The group sizes are unequal. The harmonic mean of the group sizes is used. Type 1 error levels are not guaranteed.

Appendix 16 Regression tables for structural equation models

Table 34 Regression table for health questionnaire SEM (Figure 21)

```
Structural equation model                    Number of obs     =         227
Estimation method  = ml
Log likelihood       = -1981.9264
```

		OIM				
Standardized	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Structural						
TotalHealthKnowl						
TotalSchFac	.2936005	.0593295	4.95	0.000	.1773168	.4098842
_cons	1.587746	.4621153	3.44	0.001	.6820163	2.493475
TotalHygiPrac						
TotalHealthKnowl	.1113085	.0637965	1.74	0.081	-.0137304	.2363473
TotalSchFac	.3360067	.0592183	5.67	0.000	.2199409	.4520726
_cons	2.387585	.490657	4.87	0.000	1.425915	3.349255
TotalHealthOutc						
TotalHealthKnowl	.1095507	.0658643	1.66	0.096	-.0195409	.2386423
TotalHygiPrac	.2776796	.0657624	4.22	0.000	.1487876	.4065716
TotalSchFac	.0087282	.06957	0.13	0.900	-.1276264	.1450829
_cons	1.527459	.4939455	3.09	0.002	.5593436	2.495574
var(e.TotalHealthKnowl)	.9137987	.0348384			.8480056	.9846965
var(e.TotalHygiPrac)	.8527483	.0420531			.7741837	.9392857
var(e.TotalHealthOutc)	.8956939	.0383612			.8235765	.9741264

```
LR test of model vs. saturated: chi2(0)   =       0.00, Prob > chi2 =      .
```

Table 35 Regression table for health questionnaire (male students) SEM (Figure 26)

```
Structural equation model                    Number of obs     =         227
Grouping variable  = Gend                    Number of groups  =           2
Estimation method  = ml
Log likelihood       = -1944.6665

Group            : Male                      Number of obs     =          93
```

		OIM				
	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Structural						
TotalHealthKnowl						
TotalSchFac	.1175061	.1019098	1.15	0.249	-.0822333	.3172456
_cons	2.373969	.7357316	3.23	0.001	.931962	3.815977
TotalHygiPrac						
TotalHealthKnowl	.1247069	.0968762	1.29	0.198	-.065167	.3145807
TotalSchFac	.3200111	.0902034	3.55	0.000	.1432158	.4968065
_cons	1.328675	.7369329	1.80	0.071	-.1156864	2.773037
TotalHealthOutc						
TotalHealthKnowl	.1034762	.0965879	1.07	0.284	-.0858325	.292785
TotalHygiPrac	.2977036	.0981985	3.03	0.002	.1052381	.4901691
TotalSchFac	.1270634	.1004278	1.27	0.206	-.0697715	.3238983
_cons	.8373495	.7170863	1.17	0.243	-.5681139	2.242813
var(e.TotalHealthKnowl)	.9861923	.02395			.9403507	1.034269
var(e.TotalHygiPrac)	.8726623	.0629717			.7575707	1.005239
var(e.TotalHealthOutc)	.8461113	.0684716			.7220112	.9915419

Table 36 Regression table for health questionnaire (female students) SEM (Figure 27)

```
Group            : Female                   Number of obs    =        134
```

	Coef.	OIM Std. Err.	z	P>|z|	[95% Conf. Interval]	
Structural						
TotalHealthKnowl						
TotalSchFac	.3981657	.0697509	5.71	0.000	.2614564	.5348749
_cons	1.260801	.5904951	2.14	0.033	.103452	2.41815
TotalHygiPrac						
TotalHealthKnowl	.0210132	.0869764	0.24	0.809	-.1494575	.1914838
TotalSchFac	.3742114	.0793428	4.72	0.000	.2187025	.5297203
_cons	4.789144	.7489478	6.39	0.000	3.321233	6.257055
TotalHealthOutc						
TotalHealthKnowl	.1458737	.0900962	1.62	0.105	-.0307117	.3224591
TotalHygiPrac	.2352371	.0880938	2.67	0.008	.0625764	.4078978
TotalSchFac	-.0952226	.0964538	-0.99	0.324	-.2842686	.0938234
_cons	1.888659	.7673571	2.46	0.014	.3846665	3.392651
var(e.TotalHealthKnowl)	.8414641	.0555448			.7393464	.9576861
var(e.TotalHygiPrac)	.8532624	.0543715			.7530823	.9667692
var(e.TotalHealthOutc)	.93085	.0422903			.8515457	1.01754

```
LR test of model vs. saturated: chi2(0)   =       0.00, Prob > chi2 =      .
```

Table 37 Regression table for socio-economic status and health factors SEM (Figure 46)

```
Structural equation model              Number of obs    =        228
Estimation method  = ml
Log likelihood     = -1696.9721

( 1)  [FathJobCat]Socioeconomic = 1
```

Standardized	Coef.	OIM Std. Err.	z	P>|z|	[95% Conf. Interval]	
Measurement						
FathJobCat						
Socioeconomic	.5213721	.0716611	7.28	0.000	.3809189	.6618254
_cons	3.238798	.165499	19.57	0.000	2.914425	3.56317
HmRm						
Socioeconomic	.3887102	.0759712	5.12	0.000	.2398095	.537611
_cons	1.507961	.0968126	15.58	0.000	1.318211	1.69771
InsToil						
Socioeconomic	.5799987	.0675114	8.59	0.000	.4476788	.7123186
_cons	2.915476	.1517442	19.21	0.000	2.618063	3.212889
SepKitch						
Socioeconomic	.6538289	.0678355	9.64	0.000	.5208738	.786784
_cons	2.016598	.1153434	17.48	0.000	1.790529	2.242667
TotalHealthOutc						
Socioeconomic	.2641452	.0784768	3.37	0.001	.1103336	.4179569
_cons	3.33601	.1696808	19.66	0.000	3.003441	3.668578
TotalHygiPrac						
Socioeconomic	.3763825	.0776806	4.85	0.000	.2241313	.5286337
_cons	5.33643	.2585277	20.64	0.000	4.829725	5.843135
var(e.FathJobCat)	.7281711	.0747242			.595503	.8903954
var(e.HmRm)	.8489043	.0590615			.7406915	.9729267
var(e.InsToil)	.6636015	.078313			.526569	.836295
var(e.SepKitch)	.5725078	.0887056			.4225659	.7756547
var(e.TotalHealthOutc)	.9302273	.0414585			.8524179	1.015139
var(e.TotalHygiPrac)	.8583362	.0584753			.7510489	.9809494
var(Socioeconomic)	1	.			.	.
cov(e.TotalHealthOutc,e.TotalHygiPrac)	.1753021	.068393	2.56	0.010	.0412542	.30935

```
LR test of model vs. saturated: chi2(8)   =      17.99, Prob > chi2 = 0.0213
```