



Evaluating the associations between WASH-related safety, maternal anxiety, and child nutritional status in informal settlements in Soweto

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Declaration

I, Bongiwe Nkambule, declare that this Dissertation is my own, unaided work. It is being submitted for the Degree of Master of Science in Medicine at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

A handwritten signature in dark ink, appearing to read 'Bongiwe Nkambule', written over a horizontal line.

Signature

Signed on the 22nd of April 2025

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Abstract

Introduction:

Violence against women has serious psychological consequences, which often lead to women experiencing depression, post-traumatic stress, anxiety, and suicidality. Women and girls have been excessively affected by poor WASH infrastructure, affecting their physical health as well as their psychological health. In informal urban settlements, inadequate water, sanitation, and hygiene (WASH) infrastructure poses significant risks to the health and well-being of women and children. Women often experience heightened anxiety and perceived threats to their safety when accessing communal WASH facilities, which may compromise caregiving practices and, in turn, affect child health outcomes. Poor WASH facilities are generally linked to a multitude of health burdens, and particularly childhood morbidity, under-5 mortality, as well as stunting. Maternal mental health plays a significant role in child nutritional status in so far as maternal anxiety may hinder adequate hygiene practices as well as maintenance of adequate personal and household hygiene, which may result in child illness. Child malnutrition affects physical growth, increases risk of morbidity and mortality, reduces physical work capacity, human capital, as well as cognitive development. While both WASH conditions and maternal mental health have independently been associated with child nutrition, the interrelated effects of WASH-related safety, maternal anxiety, and child nutritional status remain underexplored in low-resource settings.

Aim:

The aim of this study was to evaluate the associations between WASH-related safety, maternal anxiety, and child nutritional status in informal settlements in Soweto.

Methods:

This study has drawn on cross-sectional data from a larger controlled before-and-after intervention study. A baseline survey was conducted at recruitment to collect data on socio-economic and demographic characteristics, access to WASH facilities, as well as perceived safety and age, height, and morbidity levels. Data were collected for both the women (n=200) and children <5 years of age in the household. Anthropometric measurements were done children < 5 years, their heights (or lengths) measured in centimetres. The baseline assessment of this study took place

In August 2021, South Africa was placed on lockdown alert level 1 at the time due to the COVID-19/Coronavirus pandemic. Descriptive statistics were used to describe and summarize characteristics, bivariate associations were explored utilizing the appropriate statistical techniques given the variable type. Finally, results were integrated with *a priori* hypotheses of key associations to estimate a multi-variable regression model.

Results:

Most women had completed high school education (91.0%) and were single (73.1%). Child health indicators revealed a mean HAZ score of -0.69, with 54 children aged 0-11 months and 107 aged 12-59 months. Women's mean age was 29.8 years, with a mean height of 157.2cm. WASH conditions showed limited access to piped water (1%), with most women relying on public taps (87%). Sanitation mainly consisted of portable toilets during the day (54.5%) and bucket/open defecation (28.5%). Perceived safety was low, with 91% feeling their neighbourhood was unsafe, and 86.5% reporting Nomzamo Park as unsafe. Safety was prevalent, with 72.5% feeling unsafe going to and from WASH facilities. A substantial proportion (32.5%) experienced moderate to high anxiety. Bivariate analyses found no significant association between women's anxiety and WASH characteristics or safety perceptions. However, child nutrition (HAZ score) was significantly associated with the type of water source and perceived neighborhood safety. Multivariate analyses revealed no significant association between maternal anxiety and WASH conditions or safety perceptions. However, child HAZ scores were significantly associated with perceived neighborhood safety and safety when accessing WASH facilities, indicating community characteristics' impact on child nutritional status.

Conclusion:

In informal settlements, limited access to clean water, sanitation, and hygiene facilities can lead to health issues, especially for mothers and children. Safety, or the lack thereof, in these areas worsens these problems and increases maternal anxiety, affecting caregiving practices and child nutrition. Socio-economic factors, like poor living conditions and lack of basic services, further impact maternal and child health. Child nutrition is closely tied to WASH conditions, with inadequate access contributing to malnutrition and poor health. Findings highlight the critical influence of environmental and perceived safety factors on child nutrition in informal settlements.

Although maternal anxiety was not directly associated with child HAZ scores, perceived community safety and night-time WASH access conditions were significant predictors. These findings underscore the need for integrated interventions that improve WASH infrastructure while also addressing the broader psychosocial and safety environments in which caregiving occurs. Researching these factors in places like Soweto is crucial for developing effective interventions to improve community health.

ACRONYMS

VAW – Violence Against Women

WASH – Water, Sanitation, and Hygiene

AAS – African Academy of Sciences

IDP – Internally Displaced Persons

UNHCR – United Nations High Commissioner for Refugees

LMIC – Low- and Middle-Income Countries

UNICEF –The United Nations Children's Fund

PTB – Pre-Term Birth

LBW – Low Birth Weight

ICT – Information Communication Technology

DPHRU – Developmental Pathways for Health Research Unit

FI – Food Index

HHI – Household Hygiene Index

HI – Hygiene Index

STAI – State-Trait Anxiety Inventory

NIDS – National Income Dynamics Study

LCS – Living Conditions Survey

HWI – Household Wealth Index

HREC – Human Research Ethics Committee

WHO – World Health Organization

SSS – Social, Support and Stress

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Chapter 1

1. Introduction

Violence against women (VAW) can be defined as any act of gender-based violence that results in sexual, physical, or psychological harm and suffering to women (1). VAW is one of the most widespread forms of violence worldwide and a violation of human rights, that negatively impacts women, and is a serious social and mental health problem (2). Violence against women takes place in the spaces and environments where women's general life experiences happen. Public spaces such as shared water, sanitation, and hygiene (WASH) facilities can be locations that pose a high risk of violence against women (3).

Access to safe water, sanitation, and hygiene (WASH) is a fundamental human right, yet over 2.5 billion people globally still lack access to improved WASH facilities. This issue disproportionately affects women and girls, particularly those living in informal settlements, where communal WASH infrastructure often fails to meet their basic needs for privacy, safety, and hygiene (4). In such environments, inadequate access to WASH facilities can expose women to a heightened risk of gender-based violence, further compounding their vulnerability and negatively impacting their physical and mental health (5).

Perceived safety is identified as a potential influencer between the mental health and well-being of women; therefore, perceived sense of safety is widely recognized as important influences on mental health and wellbeing. There are three components of mental health: emotional well-being, psychological well-being, and social well-being (6)(7). The perception of safety, or lack thereof when accessing WASH facilities can contribute significantly to maternal stress and anxiety. Women living in informal settlements may delay or avoid using sanitation facilities due to fears of harassment or assault, particularly at night. Women may experience feelings of anxiety and fear when they perceived the risks to their privacy and safety, and feeling shame, embarrassment, and sometimes a loss of dignity, when they experienced violation of their privacy and safety. Moreover, individual factors such as; gender identity, life stage, physical ability, residency status, and socioeconomic status, can further influence the perceptions and experiences women have around privacy and safety when accessing WASH facilities (8).

The health and psychosocial consequences of experiencing violence are therefore considered to have a significant detrimental effect on women. For instance, sexual assault or rape can lead to disability, death, or physical injury, requiring treatment and rehabilitation services. Victims, including women, could develop depression, anxiety and post-traumatic stress disorder that may require long-term treatment. Their potential lifetime achievement, daily functioning, contribution to society, and income may also be impeded (9). Such stressors are not only harmful to the women's psychological well-being but may also affect their caregiving practices, including hygiene maintenance and child feeding behaviours.

Exposure to maternal depression and anxiety has been shown to have a negative influence on child development in infancy, and in early childhood. Maternal depression has also been associated with poor birth outcomes, elevated stress responses, negative temperament, social, emotional, and behavioural problems, as well as impaired cognitive performance and compromised physical health for the child (10). Poor WASH facilities are generally linked to a multitude of health burdens, and particularly childhood morbidity, under-5 mortality, as well as stunting (11). Globally, pre-term birth (PTB) and low infant birth weight (LBW) are leading causes of maternal and child morbidity and mortality. Inadequate access to safe water and sanitation facilities are risk factors for PTB and LBW in low resource settings (12). Inadequate access to WASH facilities can increase the risk of diarrheal and other water-borne infections, as well as maternal malnutrition (12). Maternal mental health plays a significant role in child nutritional status in so far as maternal anxiety may hinder adequate hygiene practices as well as maintenance of adequate personal and household hygiene, which may result in child illness (13). In addition, anxiety in mothers of toddlers has the potential to influence parenting behaviors and has been associated with forceful feeding practices at 12 months of age (14). Child malnutrition affects physical growth, increases risk of morbidity and mortality, reduces physical work capacity, human capital, as well as cognitive development (15).

This study explores the complex interplay between WASH-related safety concerns, maternal anxiety, and child nutritional status in informal settlements in Soweto, South Africa. By examining these associations, the research aims to highlight the broader

health and psychosocial consequences of inadequate WASH access for vulnerable populations.

1.2. Problem Statement

Currently, WASH facilities, are not meeting the needs of women and the burdens placed on women and girls through unsafe, and unimproved facilities (16). Women residing in informal settlements face a disproportionate burden of poor water, sanitation, and hygiene (WASH) infrastructure, often having to navigate unsafe environments to access these basic services (5). Communal WASH facilities are frequently distant, inadequately maintained, and lack privacy and security features, exposing women to increased risks of harassment and violence. Women are often vulnerable to violence or harassment when they have to travel long distances to fetch water, use shared toilets, or practice open defecation. Women and girls often wait until nightfall to defecate, which increases the risk of being assaulted (17). These environmental stressors contribute to heightened levels of anxiety and psychological distress among women, particularly those who are pregnant or caring for young children (18).

Emerging evidence suggests that maternal mental health plays a critical role in child health outcomes. Anxiety and depression in mothers have been associated with impaired caregiving practices, poor hygiene behaviours, and adverse infant feeding patterns, all of which can affect child growth and nutritional status (19). In parallel, poor WASH conditions are independently associated with increased risks of diarrheal disease, undernutrition, and stunting among children under five years of age (20). However, the interaction between, how WASH-related safety concerns influence maternal mental health and, child nutritional status remains poorly understood (21), particularly in low-resource urban settings like Soweto.

Given the multidimensional nature of vulnerability in informal settlements, it is essential to explore the pathways through which environmental stressors such as unsafe WASH access contribute to maternal psychological distress and child health outcomes. This study responds to this gap by evaluating the associations between WASH-related safety, maternal anxiety, and child nutritional status in an informal settlement in Soweto, South Africa.

1.3. Research Question

Is there an association between WASH-related safety, maternal anxiety, and child nutritional status in informal settlements in Soweto?

1.4. Study aim

The aim of this study was to evaluate the associations between WASH-related safety, maternal anxiety, and child nutritional status in informal settlements in Soweto.

1.5. Study objectives

The objectives of this were:

- 1.5.1 To characterize the type and use of WASH facilities available to women in informal settlements in Soweto.
- 1.5.2. To describe perceived WASH-related safety of women living in informal settlements in Soweto.
- 1.5.3. To assess the association between perceived safety, WASH facility usage, and anxiety among women living in informal settlements in Soweto.
- 1.5.4. To assess the association between maternal anxiety, and nutritional status in children under the age of 5 years.

1.6. Literature Review

Introduction

Literature suggests conditions associated with WASH in low- and middle-income countries (LMICs), may be pose potential risk factors contributing to violence against women, and that this association may be more important in poorer communities. Without access to improved sanitation and hygiene facilities in informal settlements, women's experiences of violence, particularly verbal or emotional harassment continue to increase (17). This review explores the broader implications of WASH on maternal and child health outcomes, emphasizing studies from South Africa and other parts of Africa, while identifying significant research gaps.

WASH, Women's Safety and Maternal Health Outcomes

Women and girls continue to face an increased risk of violence, especially sexual violence, when using communal toilets, practicing open defecation and or when travelling to collect water (22). Violence against women has serious psychological consequences, which often lead to women experiencing depression, post-traumatic stress, anxiety, and suicidality (23). Women and girls have been excessively affected by poor WASH infrastructure, affecting their physical health as well as their psychological health (24).

Women and girls are responsible for fetching water in four out of five households where a drinking water source is off premises. This practice has implications for women's health in the form of spinal injury, neck pain, spontaneous abortion from heavy and awkward workloads, and caloric expenditure (25). These are some of the negative effects of poor WASH facilities on women's physical health. Additionally, Women and girls account for a higher number of deaths due to diarrheal diseases and higher disability adjusted life years (DALYs) caused by inadequate hygiene; contaminated drinking water and water carriage can induce complications during pregnancy, increase perinatal health issues, negatively affect menstrual health, and increase the incidence of reproductive tract infections in women (26). In South Africa, a study conducted in the Mangaung Metropolitan Municipality (Bochabelo) revealed that women in informal settlements frequently reported urinary tract infections (UTIs) due to the lack of available facilities or fear of violence while using communal spaces. These findings revealed the intersectionality of water and sanitation services with women's health, emphasising the need for solutions that consider privacy and hygiene in shared facilities (27).

Beyond the physical impacts of poor WASH facilities such as rape, assault, molestation, beating or fighting which often lead to serious injury and even death, these incidents have long-term psychological impacts associated with harassment, bullying, discrimination or marginalization, and psychosocial impacts, associated with the fear of these acts of violence (28). The experiences that women and girls have accessing water and sanitation, including vulnerability to violence, can put them at risk for negative psychosocial outcomes. These negative outcomes can be made severe when

the lack of appropriate and hygienic sanitation facilities, at home or in public places, forces women and girls to adopt a range of coping strategies (29).

Qualitative research has linked women's lack of household sanitation and clean water sources to a heightened fear of sexual violence (30). The lack of accessible water sources continues to force women to walk long distances on dangerous paths where they may experience physical harm or experience sexual assault (31). In rural Ethiopia for instance, findings from an ethnographic study that explored local experiences of water insecurity, documented multiple situations of violence that emerged in relation to water (5). A range of experiences were revealed, including women experiencing tension with husbands over the amount of water they brought home; women experiencing domestic violence over water; women experiencing the risk of rape while fetching water daily from distant water sources; and experiences of violence while standing in water queues (5).

In another study, a range of experiences were revealed, including women experiencing tension with their husbands over the amount of water they brought home; women experiencing domestic violence over water; women experiencing the risk of rape while fetching water from distant water sources; and experiences of violence while standing in water queues (32). Findings from another study examining a range of sanitation-related psychosocial stressors during routine practices in Odisha, India, confirmed that adolescent girls and young women, especially those residing in the local slums, were sexually victimized while accessing sanitation facilities (28). In the South African context, a study assessing the association between young (18 – 24 years old) women's access to toilets and non-partner rape experiences in deprived communities was conducted in four health districts in two provinces, namely, the City of Johannesburg and Ekurhuleni in Gauteng, and eThekweni and uMgungundlovu, in KwaZulu-Natal. Findings reported that women's experience of non-partner sexual violence was significantly associated with having a 'shared toilet' [Adjusted Odds Ratio (AOR: 1.45, 95% CI)], with just over a third of women reporting having to use these types of toilet facilities (33). This association is driven by having to walk to toilets, particularly at night, and the poor maintenance of shared facilities (lack of privacy/no lockable doors). Women who lived further away from shared toilets, and thus have to walk further, were much more at risk of experiencing non-partner rape, than those closer (33).

A United Nations Children's Fund (UNICEF) study of women and girls' WASH-related needs in internally displaced persons (IDP) or refugee camps in Somalia, Haiti, and the Philippines similarly identified communal latrines, along with bathing in the bush, as dangerous at night-time for meeting girls and women's water and sanitation related needs (34). A report from the United Nations High Commission for Refugees (UNHCR) and Save the Children, documented experiences of refugee children in camps in Liberia, Sierra Leone, and Guinea, with women and girls reporting experiences of rape, mostly when taking a bath and/or using the toilets (35). A study assessing the impact of the lack of private WASH facilities on women's experience of rape in a township in Cape Town, South Africa, suggested this contributed to an additional 635 sexual assaults per year (36).

WASH and Maternal Mental Health/Anxiety

The physical health challenges are compounded by psychological impacts. Fear of violence or harassment while accessing communal toilets has been identified as a significant source of anxiety among women in informal settlements. The psychological violence stemming from the lack of safety when accessing WASH facilities creates chronic stress among women, adversely affecting their mental health (7). Anxiety related to WASH is not limited to immediate risks but extends to broader caregiving responsibilities. Women often delay their own hygiene needs to prioritize the needs of their children, which may result in heightened psychosocial stress. Women living in female-headed households in informal settlements face additional challenges, as they often have lower incomes, limited access to resources, and heightened caregiving burdens. South African informal settlements have high rates of gender-based violence (GBV), further exacerbating the WASH crisis. Women face substantial risks of assault while accessing remote communal facilities or during water collection journeys, often traveling long distances in isolated areas (31). Female-headed households are disproportionately represented in poor, informal settlements, exposing them to structural inequalities that exacerbate mental health challenges (37).

A study conducted in Cape Town revealed that indoor toilet facilities and/or piped water were much more restricted in the poor district compared to the better-off

district, The average monthly income in the poor district was lower, more people on the lower end of the income distribution (< R6400) while it was quite evenly distributed in the richer district. Furthermore, there is discriminatory access to mental health services for female versus male (with greater stigma and discrimination for women being barriers to access mental health services), specialist mental health services were difficult to access, especially for deprived communities in informal settlements where mental health issues are particularly important (38). A study in rural Kenya reported psychosocial concerns related to lack of access to safe water and adequate sanitation included anxiety, frustration, negative place identity, marginalization, and embarrassment (39). In another study describing how lack of access to adequate sanitation facilities affect the lives of adolescent girls in Bengaluru (India) revealed that reported stressors included risk of attack from snakes and dogs, harassment from boys when caught in the 'act', and queuing to use toilet. Girls also reported shame and embarrassment caused by men loitering around defecation sites; discomfort from using dirty public toilets; and fear of sexual assault and increased anxiety (40).

The mental health of mothers is closely linked to the health and nutritional status of their children. In a recent study on problematic feeding behaviours in infants and the mental health of their caregivers in the Western Cape, 43% of infants scored as having severe feeding difficulties. 18% of mothers had severe anxiety symptoms, 25% with severe depressive symptoms and the suicide risk was high (50%). Infants with severe feeding difficulties were noted for 25% of mothers with severe depression and 32% of the mothers that screened in the suicidal risk category (41). Another study carried out in the peri-urban settlement of Khayelitsha revealed that maternal depression at 2 months was found to be associated with lower infant weight at 18 months. The rate of post-partum depression in Khayelitsha was around three times that found in British post-partum samples, and these depressions were strongly associated with disturbances in the mother- infant relationship (42).

Poor mental health, including anxiety and depression, may lead to inadequate feeding practices, reduced responsiveness during caregiving, and impaired maternal-child bonding (43). In South Africa, where stunting rates among children under five remain concerning, understanding maternal mental health's influence on caregiving is

crucial and may allude to the importance of sanitation and hygiene at household as well as community levels, transmitted through the mother or caregiver (44).

WASH and Child Health Outcomes

For children, the lack of adequate WASH facilities is closely associated with increased risks of malnutrition, diarrheal diseases, and stunting. Globally, diarrhoea remains a leading cause of mortality among children under five, accounting for approximately 525,000 deaths annually (12). Inadequate access to clean water and safe sanitation facilities directly contributes to repeated infections, undermining nutritional absorption and leading to stunted growth (20). In a study assessing the impact of access to improved water and sanitation on diarrhoea reduction among rural under-five children in low and middle-income countries, findings revealed that the prevalence of diarrhea among children under 5 years of age in rural LMICs was 11.02%. The probability of developing diarrhea among under-five children from households with improved sanitation and water was 16.6%. Access to improved water and sanitation is significantly associated with a 24.5% reduction of diarrheal disease among under-five children (45).

This study assessed correlations between environmental exposures (water source, water treatment, sanitation, refuse), diarrheal occurrences, and systemic inflammation proxies among children under five years of age in the Eastern Cape (South Africa). For diarrheal occurrences among children, an increase in local authority management of refuse (compared to household management), sharing sanitation facilities, and a decrease in the frequency of the treatment of drinking water were correlated with an increase in diarrhoea (46). Findings from the Soweto Baby WASH study in Johannesburg, revealed that household access to sanitation facilities that were not safely managed was associated with a decrease in HAZ (Height-for-age) scores at 1 and 6 months (but not at 12 months) with WAZ (weight-for-age) at all timepoints; and finally, with WHZ (Weight-for-height) scores at 12 months (but not at 1 or 6 months). The hygiene index was negatively associated with HAZ and WAZ scores at 1 month, but not at 6 or 12 months, or with WHZ scores at any of the timepoints. The evidence therefore suggests that the greatest impact relating to water is likely to affect WAZ around 12 months while the greatest impact of hygiene is around 1 month postpartum and is likely to affect HAZ and WAZ. Access

to safely managed sanitation facilities is critical throughout the first year and impacts HAZ, WAZ, and WHZ (44).

In 2015, over a quarter of all children under the age of five in South Africa were found to have stunted growth, additionally, the stunting prevalence in South Africa has remained persistently high since the 1990's, and stunting is worse for children in rural areas. Children who live in poor areas are therefore more likely to experience chronic diarrhoea and therefore have higher rates of stunting (47). The likelihood of diarrhoeal infection is determined by the environment and particularly by insufficient or unclean water, inadequate sanitation and poor hygiene (WASH). When children do not have access to safe drinking water, toilets and hygiene, their health, nutritional status and physical growth suffer. This may be at least partly explained by low levels of home hygiene. Evidence suggests that poor home hygiene is linked to knowledge and behaviour and has a weak relationship with formal housing, piped water and adequate sanitation (48). In a review of studies on the effects of inadequate provision of water and sanitation on children's health by Bartlett, it was found that child mortality rates in neighbourhoods with inadequate waste removal, drainage, piped water and sanitation were 10 to 20 times higher than the rates (around 10 per 1000 live births) in those with adequate provision (49). A study in Pakistan found that piped sewerage and flush to septic tanks reduced the odds of overweight and stunting among under-five children in Pakistan (50). A study conducted in a poor Peruvian peri-urban community revealed that inadequate sewerage was associated with a 0.9cm height deficit for Peruvian two-year-olds (51).

Covid19, WASH and Mental Health

The outbreak of the silent killer coronavirus disease 2019 (SARS-CoV-2) was declared to be a public health emergency by the World Health Organization (WHO 2020c) on 30 January 2020, following this on 11 March 2020, confirmed it to be a global pandemic. In South Africa, the National Institute for Communicable Diseases (NICD 2020) confirmed the first coronavirus disease 2019 (COVID-19) patient on 05 March 2020 (52). On 26 March 2020, the South African government imposed a national lockdown that prohibited citizens from leaving a strict quarantine except for food, medicine, and essential work. President Cyril Ramaphosa also banned in-country travel and the sale of alcohol and cigarettes (53).

The COVID-19 pandemic has highlighted important needs in water, sanitation and hygiene (WASH) services and standard practices for infection prevention and control in sub-Saharan Africa (54). The recent experiences and impact of the COVID-19 pandemic provide a valuable lens for understanding the vulnerabilities of informal settlements and how they are positioned to respond to other large-scale hazards. Pre-existing conditions such as overcrowding, poor infrastructure, inadequate housing, lack of appropriate sanitation and poor socioeconomic conditions increase the risks and vulnerability of informal settlements to pandemics, epidemics, natural disasters and associated impacts. Further, the vulnerability associated with poor living conditions and the dependence of these populations on informal economic activities impede the implementation of responses to the pandemic (55).

Women's mental health vulnerability, already a concern before the COVID-19 pandemic, has been exacerbated due to social isolation and restrictions on daily activities (56).

Gaps in Research

While the current literature highlights key correlations between WASH and adverse outcomes, several research gaps persist:

- **Mental Health Implications:** Studies explicitly linking maternal anxiety and mental health outcomes to inadequate WASH access in South Africa are scarce. Most existing research focuses on physical health metrics, neglecting psychosocial dimensions.
- **Child Health Beyond Nutrition:** While stunting and diarrheal diseases are well-documented, the broader developmental and cognitive impacts of poor WASH on children in South Africa remain underexplored.
- **Intersectionality:** Limited studies examine how socio-economic factors, gender inequalities, and systemic urban planning failures intersect to exacerbate WASH challenges.
- **Longitudinal Studies:** Few studies trace the long-term impacts of poor WASH infrastructure on maternal and child health outcomes over time, hindering efforts to design sustained interventions.
- **Localized Evidence:** While much evidence comes from sub-Saharan Africa broadly, fewer studies provide localized insights into unique challenges in South Africa's varied contexts, particularly informal settlements in urban areas.

Ethical Considerations in WASH Research

The World Health Organization (WHO) has developed ethical and safety recommendations for conducting research on sensitive issues, including gender-based violence and women's safety. These guidelines emphasize informed consent, confidentiality, and minimizing harm to participants while conducting ethical research (57).

Researchers must prioritize participant safety and assess the risks associated with participation. As noted by WHO (2007), studies on violence or safety must:

- Ensure informed and voluntary participation with clear information on potential risks and benefits.
- Maintain strict confidentiality to protect participants' identities.
- Employ well-trained staff capable of addressing distress during the research process.

Specific to South Africa, where informal settlements are characterized by high rates of gender-based violence, ethical considerations extend to employing field methodologies that respect cultural norms and reduce physical or psychological harm (57).

Conclusion

The association between WASH and health outcomes is profound, particularly for women and children in South Africa's informal settlements. While the physical health outcomes of poor WASH have received considerable attention, its broader psychosocial impacts, particularly maternal mental health (anxiety) and its effects on child health, require further exploration. Female-headed households in informal settlements represent a particularly vulnerable population, bearing disproportionate burdens of inadequate WASH and its consequences. Although studies have investigated the correlation between WASH and safety in South Africa, there's a notable absence of research focusing on its impact on maternal mental health and its association with children's nutritional status. Hence, this study aims to explore these connections and address some of the existing gaps in the literature.

Chapter 2 Methodology

2.1. Study Design and Setting

This study has drawn on cross-sectional data from a larger controlled before-and-after intervention study, entitled “A software platform to improve safety and utilization of sanitation and water source facilities among women in South African informal settlements” (See Appendix 1). Colloquially referred to as the amaWASHa study, the aim of which was to provide an ICT platform for mobile phones to enable women to empower each other with information to improve their safety when using latrines and improve accountability for latrine and water source maintenance. Participating women contributed to crowd-sourced data pertaining to the safety, cleanliness, and functionality of WASH facilities in their immediate community. All the participants were enumerated, screened, and recruited in the Nomzamo Park informal settlements in Soweto, Johannesburg. The name Soweto is a derivation of the name South Western Township, as the name indicates, Soweto lies south- west of the city of Johannesburg, and it is the largest black residential area in South Africa. The people of Soweto are predominantly black South Africans belonging to virtually all the indigenous groups found in South Africa. The population is estimated at 1.2, million with over 355 000 households of which 40,3% of households are headed by females. A large portion of households dwellings are backyard shacks being rented by households and informal settlements (58). Nomzamo Park informal settlement in Orlando East, Soweto, was established in 1990 and named in honour of Winnie Madikizela-Mandela (born Nomzamo Winifred). The densely populated informal settlement in the shadow of the Soweto Towers was established by people who left hostels in Johannesburg after the war with Inkatha before the end of the apartheid government. Nomzamo Park does not have any formal electrification, households share very few communal standpipes and toilets which are inconsistently cleaned.

2.2. Study Population and Sample

Participants of the amaWASHa study included one woman per household (female head of the household) with at least one child under the age of 5 years of age in the household. Based on enumeration, 220 households were randomly selected and approached to seek written consent to be part of the study, following which 200 women were enrolled in the study. Women were eligible for inclusion in the study if

they were ≥ 18 years of age at the time of screening, living in the identified informal settlement (Nomzamo Park informal settlement, Soweto) with at least one child under the age of 5 years of age in the household, and willing and able to give informed consent for participation in the study. Participants were not eligible if they were affected with physical, mental, or congenital disorders, did not live in the informal settlement, or did not give consent for participation in the study.

2.3. Data Collection

All data for Objectives 1, 2, 3 and 4 used data from the amaWASHa study. A baseline survey was conducted at recruitment to collect data on socio-economic and demographic characteristics, access to WASH facilities, as well as perceived safety, age, height, and morbidity levels. Data on mental health was collected in the form of the Social, Support and Stress survey to assess anxiety levels at baseline. The SSS questionnaire has five sections, namely, Social Support, Revised Life Orientation Test, Spielberger State Anxiety Scale, Stress, and Edinburgh Depression Scale. To capture maternal anxiety, data was drawn from the Social Support and Stress (SSS) questionnaire (See Appendix 4), specifically the six-item short-form of the state scale of the Spielberger State-Trait Anxiety Inventory (STAI). For the Spielberger State Anxiety Scale, participants were encouraged to indicate how they feel right now, that is, at that moment. Each question is rated on a 4-point scale (not at all, somewhat, moderately so, very much so). STAI scores are commonly classified as “no or low anxiety” (20–37), “moderate anxiety” (38–44), and “high anxiety” (45–80) (59).

Data were collected for both the women ($n=200$) and children <5 years of age in the household. Anthropometric measurements were done on children < 5 years, their heights (or lengths) measured in centimetres. All measurements and assessments were collected by the trained master’s student. The baseline assessment of this study took place in August 2021, South Africa was placed on lockdown alert level 3 at the time due to the COVID-19/Coronavirus pandemic. Lockdown alert level 3 did not have much impact on the collection of data as the movement of persons was permitted from 04H00 until 22H00. Participants were able to come to the research for the baseline survey as well anthropometric measurements, on condition that they were wearing a face mask.

2.3.1. Variables and source of data from amaWASHa Study

Variable Name	
Piped Shared Facility	Public tap
	Tanker/Cart
	Piped into yard/plot
Time for water collection (median, range)	Minutes
Interruption to water supply	Weekly
	Monthly
	Rarely
Type of sanitation (Day)	Basic Sanitation
	Pit Latrine
	Bucket/Open Defecation
Type of sanitation (Night)	Basic Sanitation
	Pit Latrine
	Bucket/Open Defecation
How often does the toilet get cleaned	Less than 3 times per week
	More than 3 times per week
Experienced problems with usage of WASH facilities	Toilet odour attracting insects/pests
	No tap for washing hands after latrine use
	Municipality informed residents about repair
	Problem not repaired within 5 days of report
Experienced problems with usage of WASH facilities	Unclean
	Not Private
	Unable to dispose of sanitary items
Spielberger State Anxiety Scale from the SSS	
Feel calm	Not at all
	Somewhat
	Moderately
	Very much so
Tense	Not at all
	Somewhat

	Moderately
	Very much so
Feel upset	Not at all
	Somewhat
	Moderately
	Very much so
Relaxed	Not at all
	Somewhat
	Moderately
	Very much so
Feel content	Not at all
	Somewhat
	Moderately
	Very much so
Worried	Not at all
	Somewhat
	Moderately
	Very much so
SSS Scored	Low Anxiety
	Moderate Anxiety
	High Anxiety
Perceived Safety	
Perception of neighbourhood safety	No
	Yes
Level of perceived neighbourhood safety	Safe
	Average
	Unsafe
Perceived safety walking at night in neighbourhood	Safe
	Unsafe
Perceived level of crime in neighbourhood	High
	Low
Safe going to and from WASH facilities	No
	Yes
	Safe

Level of perceived safety going to and from WASH facilities	Average
	Unsafe
Female Head of Household Characteristics	
Marital status	Married
	Single
	Cohabitation
Highest form of education	Primary
	High School
	Tertiary
Household income	Poorest
	Wealthy
Female Head of Household Age	
Age (Mean, SD)	Years
Child Age and Height-Length	
Age (mean, SD)	Months
Age Group (WHO)	00 – 05 months
	06 – 11 months
	12 – 23 months
	24 – 35 months
	48 – 59 months
Height-Length	HAZ (Mean, SD)

Objective 1 was drew data from the Water, Sanitation, and Hygiene (WASH) questionnaire (See Appendix 2) which was adapted from the World Health Organization and UNICEF Joint Monitoring Programme (JMP) Green Paper (60). Indices used in determining a composite WASH profile comprised three major components in line with the JMP indicators for monitoring drinking water, sanitation, and hygiene facilities. Variables about water sources have been aggregated into three categories, shared public tap, shared tanker/cart and piped into yard/plot. Variables including access to water sources, water treatment, and interruptions to water supply were also collected. Data on the type of sanitation infrastructure have been aggregated into 2 categories, type of sanitation facilities used during the day and the type of sanitation facilities used at night. Sanitation facilities comprised of

three types, basic sanitation (shared portable toilets), shared pit latrine and bucket or open defaecation.

Objective 2 has drawn on data from the Perceived Safety and Violence questionnaire (See Appendix 3). This questionnaire was previously used at the Developmental Pathways for Health Research Unit (DPHRU) and adapted for the amaWASHa Project. Variables have been used to describe perceived safety in the community and the neighbourhood when using outdoor public water and toilet facilities. One indice was included, namely, Perceived Safety. The indice was created, comprised individual items pertaining to general safety, danger, and crime to and from WASH facilities. Responses to the perceived safety item were scored between 1 and 3 ranging from unsafe (1), average (2), to safe (3). An index of anxiety developed from items adapted for use in this context has been used, namely the Spielberger State-Trait Anxiety Scale (61). Variables were used to describe how women feel at that time and items included feelings: calm, tense, worried, upset, relaxed and content. Responses were rated on a 4-point scale (not at all, somewhat, moderately so, very much so). STAI scores are commonly classified as “no or low anxiety” (20–37), “moderate anxiety” (38–44), and “high anxiety” (45–80)

The exposure/independent variables for objective 3 are those variables already described in Objective 2, namely, perceived safety, and WASH facilities. The outcome/dependent variable is maternal anxiety. To capture maternal anxiety, data was drawn from the Social Support and Stress (SSS) questionnaire (See Appendix 4), specifically the six-item short-form of the state scale of the Spielberger State-Trait Anxiety Inventory (STAI). The Spielberger State Anxiety Scale (STAI) is a commonly used measure of trait and state anxiety (62). This self-report measure indicates the intensity of feelings of anxiety; it distinguishes between state anxiety (a temporary condition experienced in specific situations) and trait anxiety (a general tendency to perceive situations as threatening) (63). It was originally developed as a research instrument to study anxiety in normal adult population samples, but it can also be used to screen for anxiety disorders and can be used with patient samples (64). The STAI-T scale consists of 20 statements that ask people to describe how they generally feel. The STAI-S scale also consists of 20 statements, but the instructions require subjects to indicate how they feel at a particular moment in time. The STAI-S scale can be used to determine the actual levels of anxiety intensity induced by

stressful procedures. Each question is rated on a 4-point scale (not at all, somewhat, moderately so, very much so). The range of possible scores for form Y of the STAI varies from a minimum score of 20 to a maximum score of 80 on both the STAI-T and STAI-S subscales. STAI scores are commonly classified as “no or low anxiety” (20–37), “moderate anxiety” (38–44), and “high anxiety” (45–80) (59).

The six-item short-form of the STAI produces scores similar to those obtained using the full 20-item STAI, it has acceptable reliability and produces scores that are similar to those produced with the full-form across subject groups manifesting normal and raised levels of anxiety (65). There are several advantages to using a brief questionnaire, it is likely to maximize response rates, and minimize the number of response errors and unanswered items, thus improving the validity and generalizability of any findings (65). State anxiety refers to transitory unpleasant feelings of apprehension, tension, nervousness or worry, it reflects how threatening a person perceives his environment to be. Trait anxiety is a personality disposition that describes a person’s tendency to perceive situations as threatening, and hence to experience state anxiety in stressful situations (64).

Covariates: to evaluate and control for key covariates data was drawn from the Socio-Economic Status and Demographics questionnaire (See Appendix 5). This questionnaire, previously used at DPHRU for studies conducted in Soweto, was developed through integrating aspects of the National Income Dynamic Survey (NIDS) (66), as well as the Living Conditions Survey (LCS) (67). The following have been extracted for inclusion in the descriptive statistics, bivariate analysis, and multi-variate regression models.

- Individual Factors
 - Age
 - Marital Status
 - Maternal Education
 - Maternal Employment
- Household Factors
 - Household Wealth Index - A Household Wealth Index (HWI), was calculated using latent household variables: household assets (bicycle,

motorcycle, motor vehicle, fridge, microwave, washing machine, landline telephone, camera, cell phone, television, DVD-player, paid television subscription, computer/laptop, internet access), housing characteristics (home ownership, land ownership, and main type of energy) (Rutstein and Johnson, 2004; Vyas and Kumaranayake, 2006). The HWI, will be built using principal component analysis (Vyas and Kumaranayake, 2006). Based on the HWI, the sample was divided in half into two categories (the richest and the poorest).

- WASH – as previously described

Objective 4 was drawn on data from the Social Support and Stress (SSS) questionnaire, specifically the six-item short-form of the state scale of the Spielberger State-Trait Anxiety Inventory (STAI), as described previously. Covariates: to evaluate and control for covariates related to HAZ scores, data was drawn from the Morbidity and Illness Assessment.

In addition, the infant nutritional status, measured by their HAZ scores at one time point, was used as the outcome variable. The WHO growth standards were used to calculate the Z-scores (height-for-age) for the WHO age and sex-adjusted reference. Height-for-Age Z-scores (HAZ) are likely presented as the primary outcome because they are a widely accepted and well-established indicator of chronic malnutrition and overall child health. HAZ reflects long-term nutritional status and growth retardation, typically resulting from prolonged food insecurity, poor maternal health, or inadequate WASH conditions during critical growth periods. The use of HAZ aligns with the study's objective to assess growth-related outcomes. Stunting (HAZ < -2 SD) is a key global health indicator that represents impaired growth and development. WASH factors are more closely associated with chronic conditions like stunting (measured by HAZ) than with acute outcomes such as weight-for-height Z-scores (WHZ), which indicate wasting, or weight-for-age Z-scores (WAZ), which combine chronic and acute malnutrition. Understanding the impact of WASH and maternal anxiety on stunting would naturally prioritize HAZ.

2.4. Data Management and Analysis

Data was collected and uploaded to a secure server at the DPHRU and, all information and files kept in locked premises. Each participant was given a unique identifier number. Required data for variables was extracted and cleaned by the student before analysis. Appropriate quality checks on the extracted data were done through data cleaning (checking for errors, duplications, and outliers), and addressing any discrepancies between captured data and what is on the physical files. Data was analyzed using the STATA version 14 software. In objectives 1, and 2, descriptive statistics were used to describe and summarize; WASH characteristics, female head of household characteristics, the six-item short-form of the state scale of the Spielberger State-Trait Anxiety Inventory (STAI), and perceived safety. For categorical variables, frequencies and proportions were reported. Continuous variables were tested for distribution, and for normally distributed variables, means and standard deviations were reported while median and range were reported for non-normally distributed variables.

In objectives 3 and 4, the association between dependent and independent variables described previously, along with the identified covariates was assessed. First, bivariate associations were explored utilizing the appropriate statistical techniques given the variable type (i.e., ANOVA, Wilcox rank sum test, chi-square test, linear regression, etc.). Results were integrated with *a priori* hypotheses of key associations to estimate a multi-variable regression model. For objective 3, the model assessed the association between the independent variables including perceived safety, and WASH facility usage and the dependent variable, mother's anxiety. Key covariates were included as warranted. The appropriate regression model and estimator was selected based on the final structure and distribution of the variables. For objective 4, the model assessed the association between the independent variable, mother's anxiety, and the dependent variable, child HAZ. Key covariates were included as warranted. The appropriate regression model and estimator was selected based on the final structure and distribution of the variables. Given this data is from a larger study, the original sample size selection was based on a power calculation for a different question. This study refers to p-values in statistical analyses used for testing the significance of associations. Results were considered statistically significant at thresholds of:

- $p \leq 0.05$: This indicates conventional statistical significance.

- $p \leq 0.01$: Indicates a stricter criterion for higher confidence in results.

These thresholds are explicitly mentioned in tables and analysis discussions in the dissertation.

2.5. Ethics Clearance

The amaWASHa study, from which data was drawn, received approval from the Human Research Ethics Committee (HREC)-Medical (Clearance Certificate: M00372). Furthermore, ethical approval from the HREC for the retrospective use of the data was provided (See Appendix 1) or Ethic Clearance Certificate No: M231010 (MED23-07-286). Informed consent has been obtained from all participants and the anonymity of personal identifiers ensured.

Participants' safety was prioritized, participants were seen in a closed office with a trained research assistant/social worker. We ensured informed and voluntary participation with clear information on potential risks and benefits, strict confidentiality was maintained to protect the identities of participants. Possible risks, benefits, costs to participants, and voluntary participation were highlighted and discussed during the informed consent process/session. In the event of emotional distress triggered by the questions asked, a qualified Social Worker was be available to talk with participants and refer them to the Psychology Unit at Chris Hani Baragwanath Academic Hospital where they would be given an appointment with a psychologist. If it was discovered that women/mothers or their child had a health problem, they would be notified and the right health care practitioner would assist with the problem and treatment be recommended.

Chapter 3 Results

This chapter starts by providing an overview of female head of household characteristics of the study sample as well as the child's nutritional status. Secondly, it presents WASH characteristics, WASH-related safety, experienced WASH-related safety, and anxiety of women living in Nomzamo Park informal settlement in Soweto. It furthermore presents whether there is an association between perceived safety, WASH facility usage, and anxiety among women. It concludes with a presentation of whether there is an association between maternal anxiety, and nutritional status in children under the age of 5 years. The results are structured in relation to the objectives

3.1. Female Head of Household Characteristics and Child Nutritional Status

Overall, 200 women with at least one child under the age of 5 years were enrolled. A survey was conducted to collect data on socio-economic and demographic characteristics, as well as age, and height. Table 3.1.3 shows that many women (91.0%) reported to have started and/or completed high school education, and (73.1 %) women reported that they were single. Furthermore, 135 women were reported to have low anxiety (67.5%) meanwhile, (32.5%) had moderate to high anxiety. The mean child HAZ score was -0.69 (SD:1.8) with the minimum HAZ score of -8.09, and the maximum HAZ score of 13.93. The total number of 31 children were stunted, a proportion of 15%. The women's mean age was 29.8 years (SD: 7.1).

3.2. WASH Characteristics

Very few women (1%) women have access to facilities piped into their yards/plot while 87% of women had access to public taps and 12% had access to tanker/carts. It took an average of 5 minutes for women to collect water and come back. The type of sanitation facilities available were either a pit latrine, bucket/open defecation, or basic sanitation (portable toilets with ventilation). Most women (54.5%) reported using a portable toilet during the day, and 28.5% women reported that they used a bucket or open defecation during the day compared to 13% of women who used a pit latrine. Furthermore, 36.5% of women reported to using a bucket or open defecation at night, which is an increase of 8% compared to the use of a bucket or open defecation during the day. The most common problem reported by 79.5% of women

regarding the usage of WASH facilities is the lack of privacy. This could be due to shared facilities, absence of doors, or doors being unlocked. 5.5% of women reported being unable to dispose of sanitary items at the toilet facilities, indicating a lack of proper disposal mechanisms.

Overall, these findings highlight the limited access to piped water and the predominant use of public taps and tanker/carts among the surveyed women. Additionally, privacy concerns and challenges related to the disposal of sanitary items emerge as significant issues associated with the usage of WASH facilities, which may impact women's health and well-being.

3.3. WASH-related safety

The majority (91%) of women reported that they did not perceive their neighborhood as safe. This indicates a widespread feeling of insecurity or discomfort among the women regarding their immediate surroundings. Similarly, 86.5% of women reported feeling that living in the informal settlements of Nomzamo Park was unsafe. This suggests that there are specific concerns related to safety within the Nomzamo Park informal settlements area. A large proportion (76.3%) of women reported feeling unsafe walking in the neighborhood at night. This indicates a heightened sense of vulnerability during nighttime hours. Additionally, 74.1% of women reported perceiving a "high level" of crime in their area. This perception of high crime rates may contribute to feelings of insecurity and fear among women. The majority (72.5%) of women reported feeling that it was not safe going to and from WASH facilities, this highlights safety concerns specifically related to accessing water and sanitation facilities.

3.3.1. Descriptive Table

		Baseline	
		N	% and Mean, SD
Female Head of Household Characteristics			
Marital status	Married	21	10.6%

	Single	144	73.1%
	Cohabitation	32	16.2%
Highest form of education	Primary	7	3.5%
	High School	182	91.0%
	Tertiary	11	5.5%
Household income	Poorest	116	72.5%
	Wealthy	44	27.5%
Female Head of Household Age			
Age (Mean, SD)	Years	200	29.8 (7.1)
Child Age and Height-Length			
Age (mean, SD)	Months	199	26.2 (17.4)
Age Group	00 – 05 months	23	11.9%
	06 – 11 months	31	16.1%
	12 – 23 months	41	21.2%
	24 – 35 months	48	24.9%
	48 – 59 months	18	9.3%
HAZ (Mean, SD)		191	-0.69 (1.8)
WASH Characteristics			
Piped Shared Facility	Public tap	174	87.0%
	Tanker/Cart	24	12.0%
	Piped into yard/plot	2	1.0%
Time for water collection (median, range)	Minutes	200	5 (1-60)
Type of sanitation (Day)	Portable Toilet	109	54.5%
	Pit Latrine	26	13%
	Bucket/Open Defecation	56	28.5%
Type of sanitation (Night)	Portable Toilets	104	52.0%
	Pit Latrine	23	11.5%
	Bucket/Open Defecation	73	36.5%
Experienced problems with usage of WASH facilities	Unclean	30	15.0%
	Not Private	159	79.5%
	Unable to dispose of sanitary items	11	5.5%

SSS: Spielberger State Anxiety Scale			
Feel calm	Not at all	17	8.5%
	Somewhat	47	23.5%
	Moderately	124	62.0%
	Very much so	12	6%
Tense	Not at all	107	53.5
	Somewhat	58	29.0%
	Moderately	34	17.0%
	Very much so	1	0.5%
Feel upset	Not at all	124	79.3%
	Somewhat	45	22.6%
	Moderately	12	6.0%
	Very much so	-	-
Relaxed	Not at all	15	7.5%
	Somewhat	45	22.5%
	Moderately	128	64.0%
	Very much so	12	6.0%
Feel content	Not at all	11	5.5%
	Somewhat	44	22.0%
	Moderately	134	67.0%
	Very much so	11	5.5%
Worried	Not at all	133	66.8%
	Somewhat	40	20.1%
	Moderately	23	11.6%
	Very much so	3	1.5%
SSS Scores	Low Anxiety	135	67.5%
	Moderate & High Anxiety	65	32.5%
Perceived Safety			
Perception of neighbourhood safety	No	182	91.0%
	Yes	18	9.0%
Level of perceived neighbourhood safety	Safe	10	5.5
	Average	17	8.5%

	Unsafe	173	86.5%
Perceived safety walking at night in neighbourhood	Safe	47	23.6%
	Unsafe	152	76.3%
Perceived level of crime in neighbourhood	High	146	74.1%
	Low	51	25.8%
Safe going to and from WASH facilities	No	130	65.0%
	Yes	70	35.0%
Level of perceived safety going to and from WASH facilities	Safe	16	8%
	Average	39	19.5%
	Unsafe	145	72.5%

3.4. The association between perceived safety, WASH facility usage, and anxiety among women

Bivariate analyses were conducted to examine the relationship between various factors: women's anxiety (outcome/dependent variable), perceived safety; WASH characteristics, including the water source, time required for water collection, type of sanitation facilities, and encountered issues with facility usage; individual factors such as marital status, household income, and education level.

3.4.1. Bivariate Analyses Table – Outcome/Dependent Variable: Anxiety

Outcome Variable : Anxiety		
	P- Value	Conf-Interval
Individual Factors:		
Marital status	0.1919	-.4044978 - .0816849
Highest form of education	0.2715	-.3826559 - 1.353638
Household income	0.7246	-.5934518 .4135246
WASH:		
Water Source	0.4999	-.5379139 - .2632927
Time for water collection (median, range)	0.4098	-.5379139 - .2632927
Interruption to water supply	0.8843	-.0406475 - .0350539
Type of sanitation (Day)	0.8086	-.157965 - .202263
Type of sanitation (Night)	0.9592	-.1558931 - .147993
How often does the toilet get cleaned	0.7711	-.6060106 - .4500171
Experienced problems with usage of WASH facilities	0.5466	-.2419554 - .3355855
Experienced problems with usage of WASH facilities	0.2634	-.1603885 - .0440847
Perceived Safety		
Perception of neighbourhood safety	0.2419	-1.447965 - .3673793
Level of perceived neighbourhood safety	0.5915	-.3241705 - .5671448
Perceived safety walking at night in neighbourhood	0.3676	-.333572 - .8971219
Perceived level of crime in neighbourhood	0.6854	-.2714072 - .4120092
Safe going to and from WASH facilities	0.7364	-.4529317 - .6397449
Level of perceived safety going to and from WASH facilities	0.9744	-.3009725 - .3109618
Statistical method: Bivariate linear regression p=$\leq$0.05* and p=$\leq$0.01**		

Table 3.4.1 indicates that there is no statistically significant association between women's anxiety levels and the time it takes for them to collect water (p-value of 0.41). In other words, the duration of time spent collecting water does not appear to influence the women's anxiety levels. The analysis found no statistically significant relationship between the type of sanitation women access at night and their anxiety levels. The recorded p-value of 0.96 indicates that there is no significant association between the type of sanitation facilities used at night and women's anxiety levels. This may suggest that the type of sanitation facility accessed does not seem to affect women's anxiety levels. Furthermore, the analysis did not identify any distinguished relationship between women's anxiety levels and their perceptions of WASH-related safety. This suggests that women's anxiety levels are not significantly

associated with their perceptions of safety related to WASH facilities and contexts. In summary, the results suggest that women's anxiety levels do not have a statistically significant association with various aspects of water collection, sanitation access, perceived WASH-related safety.

These findings provide important insights into the factors that may or may not influence women's anxiety levels in the context of WASH-related activities and experiences.

3.5. The associations between WASH-related safety, maternal anxiety, and child nutritional status

Bivariate analyses were conducted to examine the relationship between various factors: Child's nutritional status, perceived safety; WASH characteristics, including the water source, time required for water collection, type of sanitation facilities, and encountered issues with facility usage; maternal factors such as marital status, household income, and education level.

Table 3.5.1 indicates that there is a statistically significant relationship between a child's HAZ score and the type of household water access available in Nomzamo Park. This suggests that the quality or availability of water may impact the health and growth of children in the community. Contrary to the water access findings, there seems to be no statistically significant association between a child's nutritional status and the household income. This implies that household income alone may not be a determining factor in a child's nutritional status in this context. The analysis indicates a significant association between the perception of neighbourhood safety and the child's HAZ score. This suggests that a safer neighbourhood environment might positively impact child health and development. Additionally, there is a significant association between the child's HAZ score and the perceived safety of walking at night in the neighbourhood. This highlights the importance of safety concerns on the health outcomes of children in the community.

In summary, the results suggests that access to clean water, perceptions of neighbourhood safety, and possibly other environmental factors can significantly influence a child's growth and well-being.

3.5.1. Bivariate Analyses Table – Outcome/Dependent Variable: HAZ

Outcome Variable : HAZ		
	P-Value	Conf. Interval
Anxiety:		
SSS Scores	0.2230	-.0522309 - .2225419
Individual Factors:		
Marital status	0.6639	-.2952751 - .1885462
Highest form of education	0.2734	-.3745801 - 1.315948
Household income	0.8984	-.4302834 - .4898621
WASH:		
Water Source	***0.0067	.1551584 - .9529723
Time for water collection (median, range)	0.9845	-.0395447 - .0403349
Interruption to water supply	0.7842	-.0419891 - .0317392
Type of sanitation (Day)	0.8482	-.161024 - .1956964
Type of sanitation (Night)	0.5964	-.1095074 - .1900679
How often does the toilet get cleaned	0.8423	-.4625159 - .5664411
Experienced problems with usage of WASH facilities	0.7057	-.3637146 - .2466802
Experienced problems with usage of WASH facilities	0.8138	-.1125162 - .0884809
Perceived Safety:		
Perception of neighbourhood safety	***0.0010	.6040433 - 2.331242
Level of perceived neighbourhood safety	***0.0008	-1.209275 - -.3216073
Perceived safety walking at night in neighbourhood	***0.0099	-1.389032 - -.1923082
Perceived level of crime in neighbourhood	***0.0047	.149186 - .8114703
Safe going to and from WASH facilities	0.1471	-.9374235 - .141314
Level of perceived safety going to and from WASH facilities	0.7195	-.2451801 - .3545401
Statistical method: Bivariate linear regression p=≤0.05* and p=≤0.01**		

Multivariate analyses were performed between women's anxiety, perceived safety, WASH characteristics, and individual factors as well as the child's height for age. Bivariate results were integrated with *a priori* hypotheses of key associations to estimate a multi-variable regression model.

Table 3.5.2: Multivariate Models Explained

- Model 1 includes maternal anxiety as the only predictor, to test whether maternal anxiety alone is associated with child HAZ scores. Anxiety scores showed no significant association with HAZ in this model, suggesting that maternal anxiety in isolation is not a strong predictor of child nutrition in this sample.
- Model 2 adds household-level variables (water source, type of sanitation used at night, and household income) to determine whether WASH infrastructure and economic status are associated with child HAZ, controlling for household context. In this model, none of the household-level factors were significantly associated with child HAZ, although “bucket/open defecation” begins to show a trend toward significance.
- Model 3 includes community-level variables (perceived neighborhood safety, perceived level of crime, safety of accessing WASH facilities, and WASH facility usage issues) to test whether the broader community environment and safety perceptions influence child nutritional status. Significant negative associations were found between unsafe perceptions of the neighborhood and accessing WASH facilities and lower HAZ scores. This suggests that the community safety environment plays an important role in child nutrition.
- Model 4 combines individual (maternal anxiety), household (WASH, income), and community (safety) characteristics to evaluate the combined influence of all relevant factors on the child nutritional status. The model shows that child nutritional status is most strongly linked to community safety perceptions and sanitation quality, not maternal anxiety or economic status alone

Table 3.5.2 shows that there is no significant association between the child’s HAZ scores and the mother’s anxiety scores. The analysis suggests that there is no significant relationship between a child’s HAZ scores, the level of anxiety experienced by the mother does not appear to have a noticeable impact on the child’s nutritional status. Furthermore, there is no significant association between the water source, household income and the child’s HAZ score. However, there is a statistically significant association between the child’s nutritional status and the level

of perceived neighborhood safety. Specifically, children whose mothers perceive their neighborhood as safer tend to have better nutritional status, as indicated by their HAZ scores. This association is supported by the recorded p-values: 0.02 for feeling safe and 0.00 for feeling unsafe. Overall, these findings suggest that while factors like maternal anxiety, water source, and household income may not significantly influence a child's nutritional status, the perceived safety of the neighborhood does appear to play a role. Children whose mothers feel safer in their neighborhoods tend to have better nutritional status.

The results further provide additional insights into the factors influencing a child's nutritional status, particularly regarding access to Water, Sanitation, and Hygiene (WASH) facilities and community characteristics. Initially, in Model 3, there is a significant association between the safety of accessing WASH facilities and the child's nutritional status, with a recorded p-value of 0.03. This suggests that children whose mothers perceived it safer to go to and from WASH facilities tend to have better nutritional status. However, this significant correlation is not retained in model 4. Model 3 also revealed a significant association between the child's nutritional status and broader community characteristics, with a recorded p-value of 0.00. This implies that aspects of the community environment beyond individual or household factors play a role in determining a child's nutritional status. In Model 4, which incorporated individual, household, and community level characteristics together, the overall association with the child's HAZ scores recorded at a p-value of 0.07. This suggests that when considering all these factors together, the association with the child's nutritional status becomes less significant, but still somewhat notable. However, despite the overall association in Model 4 not being as strong, there was still a significant association found between the child's nutritional status and the type of sanitation used at night, particularly the bucket/open defecation type, with a recorded p-value of 0.04. This implies that the type of sanitation facilities used by the household at night is linked to the child's nutritional status.

3.5.2. Multivariate Analyses Table – Outcome/Dependent Variable: HAZ

	Model 1 (Individual only) 191	Model 2 (Household only) 152	Model 3 (Community only) 187	Model 4 (Full model) 149
Model 1: Individual Characteristics				
Maternal Anxiety (raw anxiety core)	0.08 (-0.05, 0.22)			0.11 (-0.02, 0.25)
Model 2: Household Characteristics				
Water Source (ref: Tanker/Cart)				
– Public Tap		0.67 (-0.21, 1.57)		0.65 (-0.23, 1.54)
Sanitation Type at Night (ref: Portable Toilet)				-
– Pit Latrine		-0.07 (-1.05, 0.90)		-0.07 (-0.90, 1.04)
– Bucket/Open Defecation		0.29 (-0.29, 0.89)		0.65* (0.01, 1.29)
Household Income (ref: Wealthy)				
– Poorest		0.09 (-0.53, 0.71)		0.16 (-0.47, 0.79)
Model 3: Community Characteristics				
Level of perceived Neighborhood Safety (ref: Average)				

– Safe			-1.67* (-3.17, -0.18)	-2.04* (-3.77, -0.31)
– Unsafe			-1.50** (-2.51, -0.50)	-1.54** (-2.68, -0.40)
Perceived level of crime in Neighborhood (ref: Low)			0.56 (-0.06, 1.19)	0.23 (-0.47, 0.94)
Safe going to and from WASH facilities (ref: Yes)			-0.58* (-1.12, -0.04)	-0.54 (-1.22, 0.12)
Experienced problems with usage of WASH facilities (ref: Unclean)				
– Not Private			0.56 (-0.14, 1.27)	0.40 (-0.41, 1.22)
– No Sanitary Disposal			0.67 (-0.70, 2.06)	0.41 (-1.11, 1.93)
Model Significance (p-value)	0.22	0.40	0.00**	0.07
95% Confidence Interval in parentheses Significance levels: * p 0.05 and ** p 0.01				

Table 3.5.3: Multivariate Models Explained

- Model 1 includes marital status (married, single, cohabiting) to assess whether a woman's marital status is associated with her anxiety levels. There were no statistically significant associations between marital status and maternal anxiety. Neither being single nor cohabiting significantly affected anxiety compared to being married.
- Model 2 adds household-specific variables (time to collect water, and household income) to determine whether household economic status and water access predict maternal anxiety. No significant associations were found. Time taken to collect water and income levels did not predict maternal anxiety, suggesting that these basic access and economic factors are not the key drivers of maternal anxiety.
- Model 3 includes variables related to perceived community environment (perceived neighborhood safety, perceived crime levels, safety accessing WASH facilities, and problems with WASH facilities) to assess whether perceived safety and environmental stressors are associated with maternal anxiety. None of the community-level variables showed a significant relationship with maternal anxiety. This suggests that even though women may feel unsafe in their communities or while using WASH facilities, this does not necessarily translate into higher anxiety scores.
- Model 4 combines all individual, household, and community variables to understand the combined effect of all variables on maternal anxiety. No significant predictors emerged, this suggests that none of the measured variables had a significant independent effect on maternal anxiety.

Table 3.5.3 indicates that there are no statistically significant associations between maternal anxiety and the individual, household, or community characteristics examined. This suggests that factors such as demographic characteristics, household composition, or community attributes may not have a significant impact on maternal anxiety levels, at least based on the analysis conducted. Similar to the other associations examined, there is no significant relationship found between maternal anxiety and the type of sanitation used at night. This implies that the type of

sanitation facility used does not seem to be linked to maternal anxiety levels in this context.

The table further indicates that there is no significant association between maternal anxiety and several other factors. The duration of water collection does not appear to have a significant impact on maternal anxiety levels. Maternal anxiety levels do not seem to vary significantly based on perceptions of safety in the neighbourhood.

The perceived safety of accessing WASH facilities and any experienced problems with their usage do not show a significant association with maternal anxiety.

Overall, the findings suggest that maternal anxiety levels are not strongly influenced by the factors examined in this study. This indicates that there may be other underlying factors or contexts not captured in the analysis that contribute to maternal anxiety among the study population.

3.5.3. Multivariate Analyses Table – Outcome/Dependent Variable: Anxiety

	Model 1 (Individual only) 197	Model 2 (Household only) 160	Model 3 (Community only) 197	Model 4 (Full model) 155
Model 1: Individual Characteristics				
Marital Status (ref: Married)				
– Single	-0.01 (-0.88, 0.86)			-0.07 (-1.20, 1.05)
– Cohabiting	-0.55 (-1.60, 0.49)			-0.82 (-2.12, 0.48)
Sanitation Type at Night (ref: Portable Toilet)				
– Pit Latrine	0.44 (-0.41, 1.31)			0.28 (-0.84, 1.41)
– Bucket/Open Defecation	-0.11 (-0.69, 0.45)			-0.14 (-0.90, 0.61)
Model 2: Household Characteristics				
Time for Water Collection (min)		-0.01 (-0.05, 0.02)		-0.01 (-0.05, 0.02)
Household Income (ref: Wealthy)				
– Poorest		0.19 (-0.67, 0.71)		0.10 (-0.64, 0.85)
Model 3: Community Characteristics				
Level of Perceived Neighborhood Safety (ref: Average)				

– Safe			-0.06 (-1.64, 1.52)	0.00 (-2.01, 2.03)
– Unsafe			0.22 (-0.80, 1.24)	0.29 (-0.98, 1.57)
Perceived Level of Crime in Neighborhood (ref: Low)			0.07 (-0.60, 0.75)	-0.07 (-0.93, 0.77)
Safe going to and from WASH facilities (ref: Yes)			0.11 (-0.46, 0.68)	0.13 (-0.65, 0.93)
Experienced problems with usage of WASH facilities (ref: Unclean)				
– Not Private			0.09 (-0.71, 0.19)	0.36 (-0.62, 1.34)
– No Sanitary Disposal			0.45 (-0.95, 1.86)	0.55 (-1.16, 2.28)
Model Significance (p-value)	0.39	0.84	0.98	0.94
95% Confidence Interval in parentheses Significance levels: * p 0.05 and ** p 0.01				

Chapter 4 Discussion

The purpose of this study was to characterize the type and use of WASH facilities, to assess the association between perceived safety, WASH facility usage, and anxiety among women, and assess the association between maternal anxiety, and nutritional status in children under the age of 5 years.

4.1. WASH Characteristics and Female Head of Household Characteristics

Firstly, we tried to characterize the type and use of WASH facilities available to women, a basic sanitation as defined by WHO/UNICEF JMP is a facility (flush/pour to piped sewer system) where excreta are safely disposed *in situ* or treated off-site. This definition does not seem to apply in the community of Nomzamo Park. Results show that majority of women had access to shared portable toilets with ventilation and this type of toilet facility can be described as a basic sanitation facility. The type of sanitation facilities available were either a pit latrine, bucket/open defecation, or basic sanitation (portable toilets with ventilation).

Through the Free Basic Sanitation service policy, many informal settlements in South Africa have been provided with basic sanitation facilities (68). These basic sanitation facilities include VIP latrines (portable toilets), ecological sanitation (urine diversion toilet), and waterborne sanitation (flush toilets) (69). However, access to these facilities remains challenging for many residents, and these challenges have compelled residents to adopt a range of alternative sanitation practices (70). Most women 54.5% reported using a portable toilet during the day, and 28.5% women reported that they used a bucket or open defecation during the day compared to 13% of women who used a pit latrine. Furthermore, 36.5% of women reported to using a bucket or open defecation at night, which is an increase of 8% compared to the use of a bucket or open defecation during the day. In South Africa, Uganda and Kenya, communal facilities are not used at night because of perceived safety concerns and users prefer buckets, plastic or other alternatives instead (70). The lack of adequate access to improved and safe sanitation facilities in informal settlements has been one of the main contributing factors to high incidences of violence against women (70) (71). It has compelled women and children to resort to their own means of accessing sanitation such as open defecation, or plastic bags and the use of buckets (72).

A higher percentage of women live in or come from the poorest households (72.5%) compared to those from wealthier households (27.5%) within the Nomzamo Park informal settlements. At baseline, households with an income of R2500 or below were classified as poorest and households with an income of R2500 and above were classified as wealthiest on a socio-economic scale. Data was drawn from the Socio-Economic Status and Demographics questionnaire which was developed through integrating aspects of the National Income Dynamic Survey (NIDS) (66), as well as the Living Conditions Survey (LCS) (67).

There has been a rapid growth in the proportion of households that are female headed, and the poverty rate is much higher among these households than among married couple households (73). A large number of women (73.1 %) reported that they were single. Many of the country's poor are housed in urban informal settlements where they often lack services such as education, healthcare, sanitation, portable water, and electricity (74). The high representation of women in the country's informal settlements has also meant that the government's gender equality policies have not yielded a significant transformation of the societal demographics relating to the emancipation of women from poverty and exclusion (74). It is therefore suggested that lowering the cost of access to formal housing and making housing affordable for women is very important (75). The relationship between the above and this study is because, this study's data was drawn on drawn on cross-sectional data from a larger controlled before-and- after intervention study, entitled "A software platform to improve safety and utilization of sanitation and water source facilities among women in South African informal settlements". Participating women contributed to crowd-sourced data pertaining to the safety, cleanliness, and functionality of WASH facilities in their immediate community. Participants of the amaWASHa study included one woman per household (female head of the household) with at least one child under the age of 5 years of age in the household. Results from this study have shown that most women come from the poorest households, using shared/communal WASH facilities.

4.2. WASH-related safety, and anxiety

We explored if there is an association between how safe women feel in their neighbourhood, especially in relation to the use of WASH facilities, and their anxiety. The baseline assessment of this survey took place in August 2021, South Africa was placed on lockdown alert level 1 at the time due to the COVID-19/Coronavirus pandemic. COVID-19 and the lockdown most likely contributed to the worsening of pre-existing mental health stressors, and led to increased levels of anxiety, emotional distress, and other negative emotions amongst young girls and women in poor communities (76). Individual, relational and contextual factors, such as poverty, geopolitics, age, gender, mental health and parenthood, shape an individual's ability to buffer against material and psychosocial shocks, and constrain their ability to cope (77). According to the results, 67.5% of women reported experiencing low levels of anxiety compared to the 32.5% of women who reported experiencing moderate to high levels of anxiety. The findings suggest that a majority of women experience low levels of anxiety, this could indicate a relatively stable mental health status among this group. Experiences of an overwhelming feeling of hopelessness, and the strain that the COVID-19 pandemic and lockdown placed on people's ability to maintain a hopeful outlook are common themes emerging in current research (78). It is important to further look into women's emotional resilience capabilities to maintain hope in the face of challenges.

Although this study did not collect data on the impact of COVID-19 lockdown on women's mental health, several studies have been conducted in South Africa to assess this association. A study on women's mental health during COVID-19 in South Africa found that, African women's probability of experiencing worsening mental health is less than that of other race groups. Furthermore, the study found that women who were depressed before the pandemic increased the probability of women being more depressed during the pandemic (56). A study conducted in Gauteng revealed that participants were affected by lack of space to practice social distancing, over-burdened infrastructure, lack of savings, loss of income and shortage of food, hunger and diseases, anxiety and depression and poor access to education (79). Another study in Soweto found that greater perceived risk of COVID-19 infection predicts greater depression risk, particularly among adults with histories of childhood trauma. Over 70% of individuals, however, reported that the pandemic

did not impact their mental health, a discrepancy which may lead individuals to disregard their psychological needs (53)

Qualitative research from Uganda, Kenya, and India have found that fear of sexual or physical assault and lack of privacy are driving factors in women's sanitation practices and an important source of anxiety and stress (80). The majority of women (79.5%) reported that their most experienced problem with using WASH facilities was related to privacy concerns. Results on table 3.3.1 indicate that a significant proportion of women in the community feel that the lack of privacy in these facilities is a major issue, potentially impacting their comfort and dignity while accessing sanitation services. Table 3.3.1 also shows that a smaller proportion of women, (5.5%) reported being unable to dispose of sanitary items. This highlights a specific challenge related to the management of menstrual hygiene within the community. The inability to dispose of sanitary items properly can lead to hygiene issues and discomfort for women. Literature has established that managing menstruation under conditions of limited sanitation is also in itself very stressful. Lack of adequate/improved WASH facilities, has been described as a barrier to menstrual hygiene (81).

Furthermore, Table 3.5.3 shows that there is no significant association between maternal anxiety and several other factors. The duration of water collection does not appear to have a significant impact on maternal anxiety levels. Maternal anxiety levels do not seem to vary significantly based on perceptions of safety in the neighbourhood. The perceived safety of accessing WASH facilities and any experienced problems with their usage do not show a significant association with maternal anxiety. Overall, the findings suggest that maternal anxiety levels are not strongly influenced by the factors examined in this study. This indicates that there may be other underlying factors or contexts not captured in the analysis that contribute to maternal anxiety among the study population. However, it is worth mentioning that there is a lack of research on experiences of WASH-related safety in terms of quantifying the association between experience or worry of violence when using the toilet or collecting water and anxiety among women in South Africa (80).

4.3. The association between maternal anxiety, and nutritional status in children

Finally, we explored the relationship between maternal anxiety and the nutritional status of children living in the household. According to UNICEF, in South Africa, 13% of children under 5 years are overweight while 27% are stunted (82). Children in this study reported an HAZ score of -0.69 (SD:1.8) with the minimum HAZ score of -8.09, and the maximum HAZ score of 13.93. Stunting (low height-for-age z-score below -2 SD), is one of the most widely used indicators of a child's nutritional status (83). Based on these indicators, the majority of children recruited into this study were not stunted, but a total of 31 children were stunted. There are various factors that explain what it means when a child is not stunted but still short for their age. Genetics is the most common reason for a child being shorter than average. Some children experience a delay in their growth spurt compared to others. They might catch up later in adolescence. While the child might not be stunted due to malnutrition, inadequate nutrition can still affect their growth. Interventions to reduce undernutrition and improve child growth have incorporated improved water, sanitation, and hygiene (WASH) as part of disease transmission prevention strategies. Knowledge gaps still exist, namely, when and which WASH factors are determinants for growth faltering, and when WASH interventions are most effective at improving growth (44).

Even though there is no significant association between maternal anxiety and the child's nutritional status recorded in our results, growing evidence suggests a link between maternal mental health and child undernutrition in low-income country settings. One pathway to explain the association between maternal mental health problems and child undernutrition is that depression and anxiety symptoms and impairment may negatively impact childcare and nutritional status (84). Depressed mothers may lack the energy or motivation to engage in caregiving activities like feeding, playing, or providing adequate stimulation for the child's development (85). A mother's mental health can influence the overall psychosocial environment of the household. Children living in homes with depressed or anxious mothers may experience heightened stress levels themselves, which can affect their appetite, digestion, and overall health.

Thirty percent of South Africa's children live below the food poverty line in households with a per capita income of less than R571 per month(86). These households do not have enough money to meet the nutritional needs of children. While frequent infections caused by overcrowding and poor access to water, sanitation and health care services further compromise children's nutritional status (86)A higher percentage of women who identify as heads of the poorest households (72.5%) compared to those from wealthier households (27.5%) within the Nomzamo Park informal settlements. Households with an income of R2500 or below were classified as poorest and households with an income of R2500 and above were classified as wealthiest on a socio-economic scale. Bivariate and multivariate analyses show that there is no association between household income and the nutritional status in children as well as no significant association between maternal anxiety and household income. However, these results do not preclude that a child's nutritional status is not influenced by the mother's mental health, these results also do not preclude that household income, particularly in female headed households, do not have an impact on the child's nutritional status or maternal mental health.

4.4. Strengths and Limitations

The primary focus of this study was to evaluate the impact of perceived safety related to Water, Sanitation, and Hygiene (WASH) facilities among women residing in informal settlements. Remarkably, there's a discernible gap in research concerning WASH-related safety and its repercussions on mental well-being, along with its connection to the nutritional status of children in Soweto. The strengths of this study lie in its expansive design, encompassing a large sample size, and its inclusion of comprehensive inquiries into first hand experiences of WASH-related safety, including the specific activities related to WASH where safety is a concern.

However, certain limitations need to be acknowledged. Firstly, the study's cross-sectional nature implies that it captures data at a single point in time, limiting its ability to establish causality or determine long-term effects. It's important to note that while significant correlations between variables may be observed, correlation does not imply causation. Even when two or more variables exhibit a notable correlation, the precise cause-and-effect relationship remains uncertain.

Furthermore, it's essential to recognize that the absence of a significant linear relationship between variables does not preclude the existence of a nonlinear relationship or a weak association, which may not be adequately captured by linear correlation coefficients. In such instances, alternative statistical methodologies may be necessary to delve deeper into the relationship between the variables.

Chapter 5 Recommendations and conclusion

5.1. Recommendations

- It is important to further look into women's emotional resilience capabilities to maintain hope in the face of challenges.
- Inadequate or poorly designed WASH facilities may lack sufficient privacy, leading to discomfort and anxiety, especially for women. The fear of harassment or assault contributes to heightened anxiety when using such facilities. Privacy and safety are factors that may influence the type of sanitation facility women chose to make use of.
- Further research is needed to provide additional insights into the factors influencing a child's nutritional status, particularly regarding access to Water, Sanitation, and Hygiene (WASH) facilities and community characteristics. Statistical analyses on this study reported a significant association found between the child's nutritional status and the type of sanitation used at night, particularly the bucket/open defecation type, as well as the type of water access available. This implies that the type of WASH facilities used by the household is linked to the child's nutritional status.

5.2. Conclusion

There is a recognized link between water, sanitation, and hygiene (WASH) conditions and various health outcomes, including maternal and child health. In informal settlements where access to clean water, proper sanitation, and adequate hygiene facilities may be limited, there can be higher instances of WASH-related issues. Safety, or the lack thereof, in these contexts can worsen these problems and contribute to maternal anxiety which in turn, can impact caregiving practices and potentially influence child nutritional status. Poor WASH infrastructure and services can lead to increased vulnerability to violence, particularly in informal settlements where living conditions are often inadequate. Maternal anxiety, which can be influenced by various socio-economic factors including living conditions and access to basic services like clean water and sanitation, can impact maternal and child health outcomes. Maternal stress and anxiety have been linked to adverse birth outcomes and child development. Child nutritional status is also closely linked to

access to clean water, proper sanitation, and hygiene practices. Inadequate WASH conditions can contribute to malnutrition and poor health outcomes among children.

Examining the intersection of these factors in Soweto or similar informal settlements, is an important area of research in public health and development. Understanding the complex interplay between WASH-related safety, maternal anxiety, and child nutritional status is crucial for designing effective interventions to improve health outcomes in these communities.

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Appendix 1



R14/49 Dr R Said-Mohamed, et al

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL) CLEARANCE CERTIFICATE NO. M200372

NAME: Dr R Said-Mohamed, et al
(Principal Investigator)

DEPARTMENT: School of Clinical Medicine
Department of Paediatrics and Child Health
Developmental Pathways for Health Research Unit
Chris Hani Baragwanath Academic Hospital

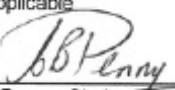
PROJECT TITLE: A software platform to improve safety and utilization of sanitation and water source facilities among women in South African informal settlements

DATE CONSIDERED: 2020/03/27

DECISION: Approved unconditionally

CONDITIONS:

SUPERVISOR: Not applicable

APPROVED BY: 
Dr CB Penny, Chairperson, HREC (Medical)

DATE OF APPROVAL: 2020/08/07

This clearance certificate is valid for 5 years from the date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the 3rd Floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to submit details to the Committee. I agree to submit a yearly progress report. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **March** and will therefore reports and re-certification will be due early in the month of **March** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature

Date

UNIVERSITY OF THE
WITWATERSRAND
JOHANNESBURG



R14/49 Miss Bongiwe Innocentia Nkambule

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M231010 MED23-07-286

NAME: Miss Bongiwe Innocentia Nkambule
(Principal Investigator)
DEPARTMENT: Paediatrics and Child Health
SAMRC/Wits Developmental Pathways for Health
Research Unit

DEGREE: Master of Science in Medicine

PROJECT TITLE: *Evaluating the associations between (Water and Sanitation Hygiene) WASH-related violence, maternal anxiety, and child nutritional status in informal settlements in Soweto*

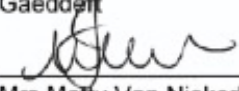
DATE CONSIDERED: 27/10/2023

DECISION: Approved unconditionally

CONDITIONS:

NOTE: If contact information regarding student study participants is required, please contact the Registrar's office - Nicoleen.Potgieter@wits.ac.za

SUPERVISOR: Dr D. Momberg, Prof A. van Heerden and Dr L. Voth-Gaeddert

APPROVED BY: 
Mrs Mafy Van Niekerk, Co-Chairperson, HREC (Medical)

DATE OF APPROVAL: 15/02/2024 **EXPIRY DATE:** 15/02/2029
This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report.** The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in **October** and will therefore be due in the month of **October** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature

Date

Appendix 2



WASH (LF)

University of the Witwatersrand, Johannesburg
Developmental Pathways for Health Research Unit
Department of Paediatrics and Child Health

AAS ICT WASH Study

WASH (LF)

AASID: (Female Head)	AAS						
AASID: (Child 1)	AAS						
AASID: (Child 2)	AAS						

Timepoint:			Month
Visit Location:	Home	DPHRU	Other:
If other, specify:			

Any other enrolment or ID:	No		Yes		Specify,
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Researcher Name:					Researcher Signature:					
Researcher Code:			Date:		D	D	M	M	Y	Y

Comments:

SECTION A: Water Supply (Quantity and Quality), Storage, Treatment and Disposal

1. What are the most common (within past 2 weeks) sources of water you have access to and what do you use the water for?

Multiple responses possible, please report all appropriate answer(s)

Coding: 1 = Yes 0 = No

	Drinking	Domestic	Cooking		Drinking	Domestic	Cooking
Bottled Water				Public Tap			
Piped into dwelling				Tanker/Cart with small tank			
Piped into yard/plot				Unprotected dug well			
Protected dug well				Surface water			
Rainwater				Unprotected spring			
Protected spring				Borehole			
Other							
Specify:							

2. How long does it take to collect water, get there and come back?

If water is on the premises, skip to Question 7. If water is collected outside the house complete Questions 3, 4, 5, and 6.

Water on Premises		Number of Minutes	
3. If water is collected outside the house, who usually goes to collect water for the household?			
(0) Adult Man		(1) Adult Woman	
(2) Male Child (under 15 years)		(3) Female Child (under 15 years)	

4. If water is collected outside the house, what do you use to transport water?							
(0) Bucket		(1) Pot		(2) Bottle		(3) Tub/Basin	
(4) Water Can		(5) Other, Specify					
5. If water is collected outside the house, what do you use to store water?							
(0) Bucket		(1) Pot		(2) Bottle		(3) Tub/Basin	
(4) Water Can		(5) Other, Specify					
6. If water is collected outside the house, how do you take water out of where it stored?							
(0) Cup		(1) Ladle/Jug		(2) Bowl			
(3) Tap		(4) Pour		(5) Other, specify			
7. How often do you have interruptions to your water supply? Please tick only one response							
(0) Daily				(3) Rarely/Never			
(1) Once a Week				(99) Don't know			
(2) Once a Month							
8. Do you have enough water for all your needs? Please tick only one response							
(1) Yes				(0) No			
9. What methods do you use to treat your water? Multiple responses possible, please tick appropriate answer(s)							
(0) None		(1) Add Bleach/Chlorine		(2) Boiling			

(3) Strain it through a cloth		(4) Use a water filter		(5) Solar Disinfection	
(6) Let it Stand/Settle		(7) Other, specify:			
10. Where do you or the other members of your household throw away your household's used cooking, cleaning and bathing water? (Tick ONE disposal point for each type of water used)					
CODE 01= Roadside 02= Bush/ field 03= Channel/ gulley/ ditch 04= Toilet 05= Garden 06= Manhole/ sewer	Cooking water CODE	Cleaning water CODE	Bathing water CODE		
11. If you use a bucket toilet in your home, where do you dispose of the contents? (Pick ONE option) 01= Roadside 02= Bush/ field 03= Channel/ gulley/ ditch 04= Toilet 05= Garden 06= Manhole/ sewer				CODE	

SECTION B: Sanitation

12. What type of toilet facility is used by you and members of your household...	during the day?	at night?
01= Flush toilet connected to public sewer system 02= Flush toilet connected to a septic tank or conservancy tank 03= Pour flush toilet connected to a septic tank 04= Chemical toilet 05= Pit latrine with ventilation pipe (VIP) 06= Pit latrine without ventilation pipe 07= Bucket toilet (collected by municipality) 08= Bucket toilet (emptied by household) 09= Ecological Sanitation Systems (EcoSan), e.g. Urine Diversion (UD) toilets 10= Open defecation (e.g. no facilities, in the field, bush) → Go to Q 11= Other (specify) → Go to Q	CODE	CODE
13. Is the toilet facility shared with other households? 01= Yes 02= No	CODE	
14. Is the toilet facility in your dwelling, in the yard or outside the yard? 01= In dwelling 02= In yard 03= Outside yard	CODE	

15. Who cleans and maintains the toilet you use? 0= Municipal appointed external contractor 1= Residents appointed and paid by the municipality 2= Residents who use the toilet and organise themselves to clean their toilet 3= Other 4= The toilet does not get cleaned or maintained 5= N/A				CODE			
16. How often does the toilet you use get cleaned? 0= Every day 1= More than 3 times per week 2= Between 1 and 3 times per week 3= Never 4= N/A				CODE			
17. If you use a bucket toilet in your home, where do you dispose of the contents? 01= Roadside 02= Bush/ field 03= Channel/ gulley/ ditch 04= Toilet 05= Garden 06= Manhole/ sewer				CODE			
18. How often do you have interruptions to your sanitation supply? Please tick only one response							
(0) Daily		(1) Never		(2) Once a Week		(3) Once a Month	
19. During the past 6 months, has your household experienced any of the following problems with regards to the toilet facility usually used by this household?							

(Read all the options, tick all that apply) 01= No water to flush the toilet 02= Toilet blocked up 03= Toilet pit or chamber full 04= Toilets not well maintained and broken 05= Poor lighting 06= Toilets not enclosed well/ poor structure 07= Broken pipes or blockages in the municipal system (eg sewerage flowing in street) 08= Problem reported but not repaired within 5 days 09= Toilet system overflowing in yard 10= Toilet system not working properly causing odours and insects 11= No tap or water point to wash hands after using the toilet 12= Sewer problems being repaired that the municipality informed you about	Yes/ No/ N/A Yes/ No/ N/A Yes/ No/ N/A Yes/ No/ N/A Yes/ No/ N/A Yes/ No/ N/A Yes/ No/ N/A Yes/ No/ N/A Yes/ No/ N/A Yes/ No/ N/A Yes/ No/ N/A
20. During the past 6 months, have you experienced any of the following problems while using the toilet facility usually used by this household? (Read all the options, tick all that apply) 01= Toilet unsafe to use due to risk of assault 02= Toilet unsafe to use, due to health risks 03= Too many people, long waiting times 04= Toilet not cleaned (if shared public toilet) 05= Toilet does not provide privacy 06= Unable to dispose of sanitary items	Yes/ No/ N/A Yes/ No/ N/A Yes/ No/ N/A Yes/ No/ N/A Yes/ No/ N/A Yes/ No/ N/A

SECTION C: Hygiene					
Waste Disposal					
21. How is waste stored prior to disposal? Please tick only one response					
(0) Plastic Bags		(1) 'Black' bins		(2) Bucket	
(3) Other, specify:					
22. Where is waste stored prior to disposal? Please tick only one response					
(0) Inside the house		(1) Outside the house		(2) Off the property	
(3) Other, specify:					
23. How is waste disposed of? Please tick only one response					
(0) Around or outside the house		(1) Bush/Open plot		(2) Waste pit	
(3) Municipal removal		(4) Burning		(5) Dumping	
(6) Other, specify:					
24. How often is waste disposed of? Multiple responses possible, please tick appropriate answer(s)					
(0) Weekly		(1) Fortnightly		(2) Monthly	
Personal Hygiene: Household					

25. How often do you clean the house? Please tick only one response					
(0) Everyday		(1) 3-4 times per week		(2) 1-2 times per week	
(3) Other, specify:					
26. Do you have any animals on the property? Multiple responses possible, please tick appropriate answer(s) If NO Skip to Question 20					
(1) Yes		(0) No			
A: Domestic:					
(0) Cats		(1) Dogs		(2) Other, specify:	
B: Livestock:					
(0) Chickens		(1) Goats		(4) Other, specify:	
(2) Sheep		(3) Cattle			
Personal Hygiene: Handwashing and Ablutions					
27. When do you wash your hands? Multiple responses possible, please tick appropriate answer(s)					
(0) Before and after eating		(1) When hands are dirty		(2) After using toilet	
(3) Before preparing food					
(6) Never/Rarely		(7) Other, specify			
28. What do you wash your hands with?					

(0) Only water		(1) Soap and Water		(2) Water and ash	
(3) Other, specify:					
29. Where do you wash your hands? Please tick only one response for you and one response for your baby					
(0) Basin at toilet		(1) Communal standpipe			
(2) At home		(3) Do not wash hands			
(4) Other		Specify:			

Appendix 3



PSV

University of the Witwatersrand, Johannesburg
Developmental Pathways for Health Research Unit
Department of Paediatrics and Child Health

AAS ICT WASH Study PERCEIVED SAFETY AND EXPERIENCED VIOLENCE QUESTIONNAIRE (PSV)

AASID: (Female Head)	AAS						
AASID: (Child 1)	AAS						
AASID: (Child 2)	AAS						

Timepoint:			Month
Visit Location:	Home	DPHRU	Other:
If other, specify:			

Any other enrolment or ID:	No		Yes		Specify,
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Researcher Name:					Researcher Signature:					
Researcher Code:			Date:		D	D	M	M	Y	Y

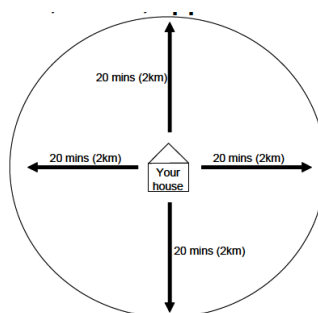
Comments:

PERCEIVED SFETY AND EXPERIENCED VIOLENCE QUESTIONNAIRE

Introduction

We heard about the violence and crimes in the community and the neighbourhood when using outdoor public water and toilet facilities from the families we discussed with earlier this year. We asked them about violence and crimes when using public water and toilet facilities because we thought it was important for understanding well-being in the community. We would now like to find out more about your personal experience. We hope that the study will help to design a program, which aim to improve the safety when using outdoor public water and toilet facilities and to improve the health and wellbeing of those living in informal settlements.

The following questions refer to the **neighbourhood** where you live which we consider to be the **area where you could potentially walk to in about 20 minutes**



from your house, that is, approximately 2km in any direction from your house.

If you live in more than one house because for example you stay with your mother/father/partner, as they do not live in the same house, please answer the questions based on the neighbourhood where you spend **most** of your time. There are no right or wrong answers to the questions we are asking you as we are only interested in your **perceptions** of the neighbourhood where you live.

Information about the participant

1. How long have you been living in this neighbourhood?

Less than 6 month; between 6 months and a year, between 1 year and 3 years, more than 3 year

Perceived safety

Perceived neighbourhood safety

2. Do you think that the area you live in is safe in general? (Yes/No; If NO explain)

3. How safe do you feel living in your neighbourhood? (Very unsafe / Unsafe / Average / Safe / Very Safe)

4. How safe do you feel walking in this area at night? (Very safe / Rather safe / Rather unsafe / Very unsafe)

5. In your opinion, how much crime is there in your neighbourhood? (A lot/Some/Average/Not much/None)

6. In your opinion, what is the most common type of crime in your neighbourhood? (Murder / Rape / Physical abuse-beating / Hijacking/car theft / Break-in (car and house) / Mugging / Vandalism / Other, please specify)

7. Are any of the following things go on in your neighbourhood?

- Persons using drugs (No/Yes/Don't Know)
- Persons destroying things (vandalism) (No/Yes/Don't Know)
- Persons getting into fights (No/Yes/Don't Know)
- Persons stealing things (No/Yes/Don't Know)
- Persons threatening or bullying (No/Yes/Don't Know)

8. What is the risk of being in this neighborhood:

- Personally threatened, robbed/mugged (very high, high, low, or very low)
- Assaulted or threatened with aggression (very high, high, low, or very low)
- Abducted (kidnapped) (very high, high, low, or very low)
- Hit by a stray bullet (very high, high, low, or very low)
- Seriously injured or killed (very high, high, low, or very low)
- A victim of police violence. Respondents rated (very high, high, low, or very low)

Perceived WASH-related safety

9. In general, do you think that it is safe to go to and from the toilet or the water point in your neighbourhood? (Yes/No; If NO explain)
10. How safe do you feel going to and from the toilet or the water point in your neighbourhood? (Very unsafe / Unsafe / Average / Safe / Very Safe)
11. In your opinion, how much crime is there going to and from the toilet or to the water point in your neighbourhood? (A lot / Some / Average / Not much / None)

Experienced violence

Experienced neighbourhood violence

12. During the last 3 months, how often did the following happen to you (not on TV or in movies) in your neighbourhood?
 - I have heard gun shots (Never, Once or twice, More than Twice)
 - I have seen somebody arrested (Never, Once or twice, A few times, Many times)
 - I have seen drug deals (Never, Once or twice, A few times, Many times)
 - I have seen someone being beaten up (Never, Once or twice, A few times, Many times)
 - My house has been broken into (Never, Once or twice, A few times, Many times)
 - I have seen somebody get stabbed (Never, Once or twice, A few times, Many times)
 - I have seen somebody get shot (Never, Once or twice, A few times, Many times)
 - I have seen a gun in my home (Never, Once or twice, A few times, Many times)
 - I have seen gangs in my neighbourhood (Never, Once or twice, A few times, Many times)
 - I have seen somebody pull a gun on another person (Never, Once or twice, A few times, Many times)
 - I have seen someone in my home get shot or stabbed (Never, Once or twice, A few times, Many times)

Experienced WASH-related violence

13. During the last 3 months, have you been in real danger going to or from the toilet or the water point in your neighbourhood? (Yes/No)
14. During the last 3 months, have you been a victim of a violent crime going to or from the toilet or the water point (like armed robbery, assault, rape etc)? (Yes/No)
15. *If YES to question 11 and/or 12.*

Going to or from the toilet or the water point in your neighbourhood, how often have you been:

- Hit (Never; Once or twice; A few times; Many times)
 - Kicked (Never; Once or twice; A few times; Many times)
 - Pushed or shoved (Never; Once or twice; A few times; Many times)
 - Badly beaten up (Never; Once or twice; A few times; Many times)
 - Threatened with a knife or sharp weapon (Never; Once or twice; A few times; Many times)
 - Attacked with a knife or sharp weapon (Never; Once or twice; A few times; Many times)
 - Threatened with a gun (Never; Once or twice; A few times; Many times)
 - Verbally or emotionally abused, that is, being called names or having things said to you that make you feel bad about yourself or afraid (Never; Once or twice; A few times; Many times)
 - Shot at (Never; Once or twice; A few times; Many times)
 - Sexually harassed (Never; Once or twice; A few times; Many times)
 - Sexually assaulted (attacked) (Never; Once or twice; A few times; Many times)
 - Robbed (Never; Once or twice; A few times; Many times)
16. During the last 3 months, did you witness a violent crime going to or from the toilet or the water point (e.g. murder, robbery, assault, rape)? (Yes/No)

Response to violence

17. Whom do you contact first when you suspect that you may become victim of crime:
- Nobody
 - Relative/Friend

- Private security companies
 - Community/organisation
 - Traditional authority
 - SAPS
 - Metro police
 - Community policing forum
 - Other
18. What measures do you take to protect yourself against crime:
- Physical measure of home
 - Physical protection measures of vehicles
 - Carry weapon
 - Private security
 - Self-help groups
 - Other
19. Have you ever carried a weapon for protection going to or from the toilet or the water point in your neighbourhood? (Yes/No)
- If YES, what type? Gun; Knife / blade; Stick / knobkerrie; Other, please describe
20. Do you know of a friend who has carried a weapon going to or from the toilet or the water point in your neighbourhood? (Yes/No)
- If YES, what type? Gun; Knife / blade; Stick / knobkerrie; Other, please describe

Appendix 4



SSS

University of the Witwatersrand, Johannesburg
Developmental Pathways for Health Research Unit
Department of Paediatrics and Child Health

AAS ICT WASH Study

Social Support Stress and Depression (SSS)

AASID: (Female Head)	AAS						
AASID: (Child 1)	AAS						
AASID: (Child 2)	AAS						

Timepoint:			Month
Visit Location:	Home	DPHRU	Other:
If other, specify:			

Any other enrolment or ID:	No		Yes		Specify,
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Researcher Name:					Researcher Signature:					
Researcher Code:			Date:		D	D	M	M	Y	Y

Comments:

Section A: Social Support

In order for us to be able to understand your particular circumstances better, we would like to know how much help and support you feel you get from your family and friends.			
1. If you had a really big problem and needed help with money, the children, accommodation and so on, are there people who could help you?	Nobody	Maybe/Unsure	A number of People
2. Can you talk to your parents, other family members or friends about any problems you may have?	Nobody	Maybe/Unsure	A number of People
3. Can you talk to your husband or partner about any problems you might have?	Never	Sometimes	Always
4. Some people think the sisters at the clinic are always helpful, others think only sometimes and some say they are seldom helpful. How do you feel?	Always Helpful	Sometitmes Helpful	Seldom Helpful
5. Do you feel that the father of your child or your partner makes things harder for you because of the way he acts?	Never	Sometimes	Always
6. Do you belong to a church group or any other organisation?	Yes		No
7. If YES, how often do you go to meetings?	Once a Week	Once a Month	Irregularly
8. Do you have a friend who is also going to have a baby or has just had a baby?	Yes		No
9. If YES, how often do you see her?	Once a Week	Once a Month	Irregularly

Section B: Revised Life Orientation Test

Please answer the following questions about yourself by indicating the extent of your agreement using the following scale:

SA	Strongly Agree	A	Agree	N	Neutral	D	Disagree	SD	Strongly Disagree
Be as honest as you can throughout, and try not to let your responses to one question influence your response to other questions. There are no right or wrong answers.									
1. In uncertain times, I usually expect the best.							SA	A	N
2. It's easy for me to relax.							SA	A	N
3. If something can go wrong, it will.							SA	A	N
4. I'm always optimistic about my future.							SA	A	N
5. I enjoy my friends a lot.							SA	A	N
6. It's important for me to keep busy.							SA	A	N
7. I hardly ever expect things to go my way.							SA	A	N
8. I don't get upset too easily.							SA	A	N
9. I rarely count on good things happening to me.							SA	A	N
10. Overall, I expect more good things to happen to me than bad.							SA	A	N

Section C: Spielberger State Anxiety Scale

A number of statements which people have used to describe themselves are given below. I will read you each statement and I would like for you to indicate how you feel <i>right now</i> , that is, <i>at this moment</i> . There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.									
SA	Strongly Agree	A	Agree	N	Neutral	D	Disagree	SD	Strongly Disagree
Be as honest as you can throughout, and try not to let your responses to one question influence your response to other questions. There are no right or wrong answers.									
1. I feel calm							SA	A	N
2. I am tense							SA	A	N
3. I feel upset							SA	A	N
4. I am relaxed							SA	A	N
5. I feel content							SA	A	N

6. I am worried	SA	A	N	D	SD
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Section D: Stress

Sometimes one's life and that of one's close family goes through periods of being very stressful. I'd like to ask you some questions about any stresses you might have experienced in the last few months.				
1. During the last 6 months have you or a member of your close family been in real danger of being killed, in one of the following ways?	1	2	3	4
1. By criminals				
2. By police, army or other 'officials'				
3. During political activities				
4. This has not happened at all				
2. During the last 6 months did you witness a violent crime (e.g. murder, robbery, assault, rape)?	Yes	No		
3. During the last 6 months have you found that you are in so much debt that you don't know how you will repay the money?	Yes	No		
4. During the last 6 months have you or your close family ever had too little money for basics, such as food, rent, and clothes?	Yes	No		
5. Have you or one of your close family not been able to find a job for more than 6 months?	Yes	No		
6. During the last 6 months have you or anyone in your close family been seriously ill?	Yes	No		
7. During the last 6 months did any member of your close family die?	Yes	No		
8. Is there anyone in your close family with a serious disability (e.g. epilepsy, mental retardation, deafness, blindness, mental illness)?	Yes	No		

9. Is there anyone in your close family who has a problem with drugs or alcohol?	Yes	No
10. During the last 6 months have you had a break-up with your husband or partner?	Yes	No
11. During the last 6 months has your husband or partner hit or beaten you?	Yes	No
12. During the last 6 months have you had any serious fight or alienation from members of your family or your close neighbours?	Yes	No
13. During the last 6 months have you or any member of your close family been arrested, had to go to court or consulted a lawyer on a non-routine matter?	Yes	No
14. During the last 6 months have you given help (money, accommodation etc.) to close family or friends in need?	Yes	No
15. During the last 6 months have you been separated unwillingly from any of your children (excluding holidays)?	Yes	No
16. During the last 6 months have you experienced any problems with your other children (such as schools closing, failure at school, problem behaviour, drugs, etc.)?	Yes	No
If YES, specify problem.		

Section E: Edinburgh Depression Scale

Please mark the answer which comes closest to how you have felt in the past 7 days, not just how you feel today.				
1. I have been able to laugh and see the funny side of things.	1	2	3	4

1. As much as I always could				
2. Not quite so much now				
3. Definitely not so much now				
4. Not at all				
2. I have looked forward with enjoyment to things.	1	2	3	4
1. As much as I ever did				
2. Rather less than I used to				
3. Definitely less than I used to				
4. Hardly at all				
3. I have blamed myself unnecessarily when things went wrong.	1	2	3	4
1. Yes, most of the time				
2. Yes, some of the time				
3. Not very often				
4. No, never				
4. I have been anxious or worried for no good reason.	1	2	3	4
1. No, not at all				
2. Hardly ever				
3. Yes, sometimes				
4. Yes, very often				
5. I have felt scared or panicky for not very good reason.	1	2	3	4
1. Yes, quite a lot				
2. Yes, sometimes				
3. No, not much				
4. No, not at all				
6. Things have been getting on top of me.	1	2	3	4
1. Yes, most of the time I haven't been able to cope at all				
2. Yes, sometimes I haven't been coping as well as usual				
3. No, most of the time I have coped quite well				

4. No, I have been coping as well as ever				
7. I have been so unhappy that I have had difficulty sleeping.	1	2	3	4
1. Yes, most of the time				
2. Yes, sometimes				
3. Not very often				
4. No, not at all				
8. I have felt sad or miserable.	1	2	3	4
1. Yes, most of the time				
2. Yes, sometimes				
3. Not very often				
4. No, not at all				
9. I have been so unhappy that I have been crying.	1	2	3	4
1. Yes, most of the time				
2. Yes, quite often				
3. Only occasionally				
4. No, never				
10. The thought of harming myself has occurred to me.	1	2	3	4
1. Yes, quite often				
2. Sometimes				
3. Hardly ever				
4. Never				

Appendix 5



SES

University of the Witwatersrand, Johannesburg
Developmental Pathways for Health Research Unit
Department of Paediatrics and Child Health

AAS ICT WASH Study Socioeconomic Status (SES)

AASID: (Female Head)	AAS						
AASID: (Child 1)	AAS						
AASID: (Child 2)	AAS						

Timepoint:			Month
Visit Location:	Home	DPHRU	Other:
If other, specify:			

Any other enrolment or ID:	No		Yes		Specify,
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Researcher Name:					Researcher Signature:					
Researcher Code:			Date:		D	D	M	M	Y	Y

Comments:

SECTION I: GENERAL INFORMATION

1. How many people have been living in your home over the past 3 months?

NUMBER

2. Can you please list the other people who have stayed in your household and say for each adults if they currently have a job or not?

(On average at least four nights a week over the last 3 months. Do not forget to include babies, the bedridden and elderly people, also include your partner but not yourself)

Children (≤to 18 years of age)

Adults (>18 years of age)

Age	Sex	Highest level of education	Relationship to yourself	Age	Sex	Highest education level	Relationship to yourself	Job
	M/F	CODE EDUCATION	CODE RELATIONSHIP		M/F	CODE EDUCATION	CODE RELATIONSHIP	CODE
	M/F	CODE EDUCATION	CODE RELATIONSHIP		M/F	CODE EDUCATION	CODE RELATIONSHIP	CODE
	M/F	CODE EDUCATION	CODE RELATIONSHIP		M/F	CODE EDUCATION	CODE RELATIONSHIP	CODE
	M/F	CODE EDUCATION	CODE RELATIONSHIP		M/F	CODE EDUCATION	CODE RELATIONSHIP	CODE
	M/F	CODE EDUCATION	CODE RELATIONSHIP		M/F	CODE EDUCATION	CODE RELATIONSHIP	CODE

CODES EDUCATION	0= No formal schooling 1= Grade R to Grade 3 2= Grade 4 to Grade 7 3= Grade 8 to Grade 11 4= Grade 12 5= Post grade 12 diploma or certificate 6= Undergraduate degree 7= Postgraduate degree
CODES RELATIONSHIP	0= Parent 1= Grandparent 2= Your own child 3= Sibling 4= Other relative (including other children, in laws, etc) 5= Spouse 6= Partner 7= Friend 8= Housemate/flatmate/roommate 9= Other: Specify
CODES JOB (for only adults)	0= No job 1= Job 99= Don't know

SECTION II: MARITAL STATUS

3. What is your current marital status? (Legal Status)

CODE

CODES

0= Married with certificate (by home affairs)
1= Married traditionally
2= Widowed
3= Divorced or Separated
4= Single
5= Cohabitation

SECTION III: OCCUPATION

4. Have you ever had a job?

*By job we mean any work done to earn money or to gain skills.
This includes casual/informal & volunteer work*

YES/NO

10. When did you start your current job? (Month & Year)		MM/YY													
11. Who is your employer		CODE													
CODES	0= Self 1= Family 2= Government 3= Non-governmental/community based organisation 4= Private company 5= Other: Specify														
12. What is your total salary/ pay at your main job? Before tax and other deductions, and including overtime pay. If "NONE", "REFUSE" or "DON'T KNOW" write 999 999 999 and go to Q14.		AMOUNT IN Rands													
13. (Ask only if an amount is given in Q12) Was this payed...?		CODE													
CODES	0= Daily 1= Weekly 2= Monthly														
14. (Ask only if "NONE", "REFUSE" or "DON'T KNOW" for Q12) What is your total salary/ pay at your main job? Before tax and other deductions, and including overtime pay.		CODE													
CODES	<table border="1"> <thead> <tr> <th></th> <th>Weekly</th> <th>Monthly</th> <th>Annually</th> </tr> </thead> <tbody> <tr> <td>01</td> <td>NONE</td> <td>NONE</td> <td>NONE</td> </tr> <tr> <td>02</td> <td>R1 – R46</td> <td>R1 – R200</td> <td>R1 – R2400</td> </tr> </tbody> </table>				Weekly	Monthly	Annually	01	NONE	NONE	NONE	02	R1 – R46	R1 – R200	R1 – R2400
	Weekly	Monthly	Annually												
01	NONE	NONE	NONE												
02	R1 – R46	R1 – R200	R1 – R2400												

	03	R47 – R115	R201 – R500	R2401 – R6000	
	04	R116 – R231	R501 – R1000	R6001 – R12000	
	05	R232 – R346	R1001 – R1500	R12001 – R18000	
	06	R347 – R577	R1501 – R2500	R18001 – R30000	
	07	R578 – R808	R2501 – R3500	R30001 – R42000	
	08	R809 – R1039	R3501 – R4500	R42001 – R54000	
	09	R1040 – R1386	R4501 – R6000	R54001 – R72000	
	10	R1387 – R1848	R6001 – R8000	R72001 – R96000	
	11	R1849 – R2540	R8001 – R11000	R96001 – R132000	
	12	R2541 – R3695	R11001 – R16000	R132001 – R192000	
	13	R3696 – R 6928	R16001 – R30000	R192001 – R360000	
	14	R6929 OR MORE	R30001 OR MORE	R360001 OR MORE	
	15	DON'T KNOW	DON'T KNOW	DON'T KNOW	
	16	REFUSE	REFUSE	REFUSE	
	15. If you have stopped working in the past 3 months, why did you stop?				CODE
CODES	0= Resigned 1= Fired 2= Retrenched 3= Health reasons 4= Maternity leave 5=No transport 6=Others				

16. If you currently don't have a job, what is your source(s) of income?		CODE
CODES	0= Inheritance 1= Pension 2= Support from family or friend (grandparents, parent, sibling, friend, etc.) 3= Community support (other than family: anonymous donation, church...) 4= Partner 5= Grant (child support, disability) 6= Profit 7= Own loan 8= Other: Specify	
17. In the last four weeks were you looking for and kind of job or trying to start any kind of business?		YES/NO
18. Would you have liked to work during the last week?		YES/NO

SECTION IV: EDUCATION		
19. What is your highest level of education?		CODE
CODES	0= No formal schooling 1= Grade R to Grade 3 2= Grade 4 to Grade 7 3= Grade 8 to Grade 11 4= Grade 12 5= Post grade 12 diploma or certificate	

	6= Undergraduate degree 7= Postgraduate degree
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SECTION V: HOUSEHOLD INCOME, ASSETS AND EXPENDITURE

A household is considered as one or more people habitually living in the same dwelling, sharing a meal and having a joint budget.

20. What were the sources of income for this household in the last month? 01= Salaries/ wages/ commissions 02= Income from a business 03= Remittances (money/ goods received from people living elsewhere) 04= Pension, including Old Age Grant 05= Child Support Grant, other government grants 06= Sales of farming products or services 07= Other income sources, e.g. rental income, interest 08= No income	YES/NO YES/NO YES/NO YES/NO YES/NO YES/NO YES/NO YES/NO
21. What was the total household income from all sources in the last month? If "NONE", "REFUSE" or "DON'T KNOW" write 999 999 999 and go to Q22.	AMOUNT IN RANDS
22. (Ask only if "NONE", "REFUSE" or "DON'T KNOW" for Q21) What was the total household income from all sources in the last month?	CODE
CODES	

		Monthly	
	01	NONE	
	02	R1 – R200	
	03	R201 – R500	
	04	R501 – R1000	
	05	R1001 – R1500	
	06	R1501 – R2500	
	07	R2501 – R3500	
	08	R3501 – R4500	
	09	R4501 – R6000	
	10	R6001 – R8000	
	11	R8001 – R11000	
	12	R11001 – R16000	
	13	R16001 – R30000	
	14	R30001 OR MORE	
	15	DON'T KNOW	
16	REFUSE		
23. What was the total household expenditure in the last month? Include money spent on food, clothing, transport, rent and rates, alcohol and tobacco, school fees, medical spending, entertainment and any other expenses. If “NONE”, “REFUSE” or “DON'T KNOW” write 999 999 999 and go to Q24.			AMOUNT IN RANDS

24. (Ask only if “NONE”, “REFUSE” or “DON’T KNOW” for Q23) What was the total household expenditure in the last month?		CODE																																			
CODES	<table border="1"> <tr> <td></td> <td>Monthly</td> </tr> <tr> <td>01</td> <td>R0</td> </tr> <tr> <td>02</td> <td>R1 – R200</td> </tr> <tr> <td>03</td> <td>R201 – R500</td> </tr> <tr> <td>04</td> <td>R501 – R1000</td> </tr> <tr> <td>05</td> <td>R1001 – R1500</td> </tr> <tr> <td>06</td> <td>R1501 – R2500</td> </tr> <tr> <td>07</td> <td>R2501 – R3500</td> </tr> <tr> <td>08</td> <td>R3501 – R4500</td> </tr> <tr> <td>09</td> <td>R4501 – R6000</td> </tr> <tr> <td>10</td> <td>R6001 – R8000</td> </tr> <tr> <td>11</td> <td>R8001 – R11000</td> </tr> <tr> <td>12</td> <td>R11001 – R16000</td> </tr> <tr> <td>13</td> <td>R16001 – R30000</td> </tr> <tr> <td>14</td> <td>R30001 OR MORE</td> </tr> <tr> <td>15</td> <td>DON'T KNOW</td> </tr> <tr> <td>16</td> <td>REFUSE</td> </tr> </table>				Monthly	01	R0	02	R1 – R200	03	R201 – R500	04	R501 – R1000	05	R1001 – R1500	06	R1501 – R2500	07	R2501 – R3500	08	R3501 – R4500	09	R4501 – R6000	10	R6001 – R8000	11	R8001 – R11000	12	R11001 – R16000	13	R16001 – R30000	14	R30001 OR MORE	15	DON'T KNOW	16	REFUSE
		Monthly																																			
	01	R0																																			
	02	R1 – R200																																			
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	11	R8001 – R11000																																			
	12	R11001 – R16000																																			
	13	R16001 – R30000																																			
	14	R30001 OR MORE																																			
	15	DON'T KNOW																																			
16	REFUSE																																				
25. Who has usually paid for the following expenses for you		Food	CODE																																		
		Transport	CODE																																		
		Housing & utilities	CODE																																		
		Education	CODE																																		

during the past 3 months <i>(Please answer all questions)</i>	Clothing	CODE
	Cell phone airtime or contract	CODE
CODES	0= I pay for this with my own funds (Myself) 1= Family members pay for this 2= Partner pays for this 3= Someone else pays for this: Specify	
26. Do you have any debts?	Money owed to banks or financial institutions (legal and documented loans)	YES/NO
	Money owed to money lenders (loan sharks, community money-lenders)	YES/NO
	Money owed to family or friends	YES/NO
	Money owed to shops/private companies/ municipality/unpaid bills/accounts/store accounts (e.g. Jet or Edgars)	YES/NO

SECTION VI: HOUSING AND HOUSEHOLD CHARACTERISTICS

A household is considered as one or more people habitually living in the same dwelling, sharing a meal and having a joint budget.

27. What is your home ownership situation?		CODE
CODES	0= Owner 1= Renting 2= Squatting 3= Not renting, not owner, but family property 90= Refused to respond	
<i>If the response is Owner, go to question 18</i> <i>Otherwise, go to question 19</i>		
28. Where did you find funding for your house?		CODE
CODES	0= Inheritance 1= Mortgage from bank 2= Own funding 3= Government 4= Other (Specify)	
29. What is the total number of rooms for currently used for sleeping in your home? <i>Include outside bedrooms if they are used by household members, and exclude if rented out, kitchen and bathroom.</i>		NUMBER
	Electricity	YES/NO

30. Which of the following do you have in your current home? <i>Place where you spent most nights in the past 3 months</i> <i>It does not matter who owns/pays for these things. (answer all questions)</i>	Bicycle	YES/NO
	Motorcycle/Bike	YES/NO
	Motor vehicle/Car	YES/NO
	Fridge	YES/NO
	Microwave oven	YES/NO
	Washing machine	YES/NO
	Landline telephone	YES/NO
	Camera	YES/NO
	Cell phone	YES/NO
	Television	YES/NO
	Video machine/DVD player	YES/NO
	MNet/DSTV/Satellite	YES/NO
	Agricultural land	YES/NO
	Farm animals	YES/NO
	Computer/laptop	YES/NO
Internet access	YES/NO	
31. How would you describe the home you are living in?		CODE
CODES	0= Shack/Zozo 1= Flat/Cottage 2= House 3= Room/Garage 4= Residence (attached to education or employment) 5= Hostel 6= RDP/Government Housing 7= Other: Specify	
32. What are the main walls in your current home made of?		CODE

CODES	0= No walls 1= Mud 2= Plaster finished 3= Corrugated Zinc 4= Prefab 5= Bare brick or cement block 6= Cement 7= Other: specify	
33. What is the main floor material in your current home?		CODE
CODES	0= Ceramic tiles 1= Cement 2= Carpet 3= Earth/sand/mud 4= Wood planks 5= Parquet or finished wood 6= Vinyl/linoleum 7= Other: Specify	
34. Which of the following types of energy do you use the most for cooking in your current home?		CODE
CODES	0= Electricity 1= Egoli gas 2= Grass/ Shrubs 3= Kerosene 4= Charcoal 5= Liquid Propane 6= Wood 7= Animal Dung 8= Paraffin 9= Solar Panel 10= Generator	

	11= No Cooking facilities 12= Other: Specify
35. Which of the following types of material does the roof of your current house have the most?	CODE
CODES 0= Poured concrete 1=Metal 2=Wood 3=Thatch 4= Other: Specify	

SECTION VII: HOUSEHOLD FOOD SECURITY: MAHFP, HFIAS, CSI, DDS

A household is considered as one or more people habitually living in the same dwelling, sharing a meal and having a joint budget.

36. In the past month, 1= did you worry that your household would not have enough food? 2= were you or any household member not able to eat the kinds of food your preferred, because of a lack of resources? 3= did you or any household member have to eat a limited variety of foods, because of a lack of resources? 4= did you or any member of the household have to eat some foods that you really did not want to eat, because of a lack of resources to obtain other food?	CODE CODE CODE CODE CODE
--	---

5= did you or any household member have to eat a smaller meal than you felt you needed, because there was not enough food? 6= did you or any household member have to eat fewer meals in a day because there was not enough food? 7= was there ever no food to eat of any kind in your household because of lack of resources to get food? 8= did you or any household member go to sleep hungry because there was not enough food? 9= did you or any household member go a whole day and night without eating anything because there was not enough food?	CODE CODE CODE CODE
CODES	0= No/ never 1= Rarely (once or twice in the past month) 2= Sometimes (three to ten times in the past month) 3= Often (more than ten times in the past month) 4= Other: Specify

37. In the past 24 hours, did you or any household member eat any of the following foods? 01= Maize, rice, sorghum, millet, bread and other cereals 02= Potatoes, sweet potatoes, cassava 03= Beans, peas, nuts, seeds 04= Spinach and other wild green leaves 05= Other vegetables e.g. carrots, relish, tomatoes, cabbage, beetroots etc	YES/NO YES/NO YES/NO YES/NO YES/NO
---	---

06= Fruit	YES/NO
07= Eggs	YES/NO
08= Milk, yoghurt and other dairy products	YES/NO
09= Sugar and other sugar products (e.g. sweets)	YES/NO
10= Oils, fats and butter	YES/NO
11= Meat, e.g. chicken, beef, pork, mutton/ lamb, goat	YES/NO
12= Fish	YES/NO

38. In the past month, how often have you had to	
1= rely on less preferred and less expensive foods?	CODE
2= borrow food, or borrow money to buy food?	CODE
3= purchase food on credit?	CODE
4= rely on help from a relative or friend outside the household?	CODE
5= limit portion sizes at meal times?	CODE
6= ration the little money you have to household members to buy street food?	CODE
7= limit your own, or another adult household member's, consumption to ensure a child gets enough?	CODE

8= reduce number of meals eaten in a day?		CODE
9= skip whole days without eating?		CODE
10= send household members to eat elsewhere		CODE
11= send household members to beg for food		CODE
CODES	0= Never 1= Less than once a week 2= 1-2 times per week 3= 3-6 times per week 4= Everyday	

Appendix 6



Anthro

University of the Witwatersrand, Johannesburg
Developmental Pathways for Health Research Unit
Department of Paediatrics and Child Health

AAS ICT WASH

Anthropometry (Anthro)

AASID: (Female Head)	AAS						
AASID: (Child 1)	AAS						
AASID: (Child 2)	AAS						

Timepoint:			Month
Visit Location:	Home	DPHRU	Other:
If other, specify:			

Any other enrolment or ID:	No		Yes		Specify,
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Researcher Name:					Researcher Signature:					
Researcher Code:			Date:		D	D	M	M	Y	Y

Female Height 1: (Once)				.		Cm
Female Height 2: (Once)				.		cm

Female Weight 1:				.		Kg
Female Weight 2:				.		kg

Child (1) Weight 1:			•				Kg
Child (1) Weight 2:			•				Kg

Child (1) Length/Height 1:				•		Cm
Child (1) Length/Height 2:				•		Cm
Child (1) Length/Height 3:				•		Cm

Child (2) Weight 1:			•				Kg
Child (2) Weight 2:			•				Kg

Child (2) Length/Height 1:				•		Cm
Child (2) Length/Height 2:				•		Cm
Child (2) Length/Height 3:				•		Cm

Comments:

Appendix 7



MIA (LF)

University of the Witwatersrand, Johannesburg
Developmental Pathways for Health Research Unit
Department of Paediatrics and Child Health

AAS ICT WASH Study Morbidity and Illness Assessment (MIA - LF)

AASID: (Female Head)	AAS					
AASID: (Child 1)	AAS					
AASID: (Child 2)	AAS					

Timepoint:			Month
Visit Location:	Home	DPHRU	Other:
If other, specify:			

Any other enrolment or ID:	No		Yes		Specify,
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Researcher Name:				Researcher Signature:						
Researcher Code:			Date:		D	D	M	M	Y	Y

Comments:

1. In the last two weeks, have you or any of the children in your household had

	You Yes (1) No (0)	Child 1 Yes (1) No (0)	Child 2 Yes (1) No (0)	How many days did you have this condition?	Where did you get the treatment?
Fever					
Poor appetite					
Coughing/Wheezing/Hoarseness					
Sneeze/runny/stuffy nose					
Diarrhoea: Three or more loose or liquid stools per day. If yes, was the diarrhoea;					
Acute watery diarrhoea (lasts several hours or days)					
Acute bloody diarrhoea (dysentery)					
Persistent diarrhoea (lasts 14 days or longer)					
Vomiting					
Gut/Stomach Sensitivity					
Rash					
Eye problems (red/ itching eyes)					
Other (specify)					

Coding:

0: No treatment

6: Private Hospital

1: Self treatment	7: Chemist/ Pharmacist
2: Private Doctor (General Practitioner)	8: Faith Healer
3: Government Clinic	9: Sangoma/ Traditional Healer
4: Private Clinic	10: Other (specify)
5: Government Hospital	

2. In the last two weeks, have you or any of the children in your household been diagnosed with the following by a doctor:

	You Yes (1) No (0)	Child 1 Yes (1) No (0)	Child2 Yes (1) No (0)	How many days did you have this condition?	Where did you get the treatment?
Pneumonia					
Bronchilitis					
Bronchitis					
Gastroenteritis					
Asthma					
Allergy					
Rhinitis					
Other (specify)					

3. In the last 2 weeks, have you been admitted to a hospital or clinic?

Yes (1)		No (0)	
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If YES, please specify...

Date of admission	How many days did you stay?	What was the diagnosis when you were admitted?
DD / MM / YY		
DD / MM / YY		
DD / MM / YY		
DD / MM / YY		

4. In the last 2 weeks, from whom did you receive medical care? (several responses possible)

0: No treatment		6: Private Hospital	
1: Self treatment		7: Chemist/ Pharmacist	
2: Private Doctor (General Practitioner)		8: Faith Healer	
3: Government Clinic		9: Sangoma/ Traditional Healer	
4: Private Clinic		10: Other (specify)	
5: Government Hospital			

5. How long does it take you to get to where you receive medical care?

Hours		Minutes	
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6. On average how long do you spend there?

Hours		Minutes	
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7. On average how many times have you used this service in the past month?

Number of Visits	
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8. Do you have a medical aid?

Yes (1)		No (0)	
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9. Do the children in the household have medical aid?

Yes (1)		No (0)	
------------	--	-----------	--

10. How would you describe your last bowel movement?

0. Type 1	
1. Type 2	
2. Type 3	
3. Type 4	
4. Type 5	
5. Type 6	
6. Type 7	

Bristol stool chart

Type 1		Separate hard lumps, like nuts (hard to pass)
Type 2		Sausage-shaped but lumpy
Type 3		Like a sausage but with cracks on its surface
Type 4		Like a sausage or snake, smooth and soft
Type 5		Soft blobs with clear-cut edges (passed easily)
Type 6		Fluffy pieces with ragged edges, a mushy stool
Type 7		Watery, no solid pieces, Entirely liquid

11. In the last 2 weeks, when you went to (location of sensitisation) to seek medical care, do they tell you about (topics of sensitisation)?

Location(s) of sensitisation since last visit		Topic of sensitisation	Yes (1)	No (0)
0. Clinic		Diseases prevention		
1. Hospital				
2. Community/Church Group				
3. Family/Friends				
4. Other, Specify:				
0. Clinic		Hygiene and Sanitation		
1. Hospital				
2. Community/Church Group				
3. Family/Friends				
4. Other, Specify:				
0. Clinic		Nutrition		
1. Hospital				
2. Community/Church Group				
3. Family/Friends				
4. Other, Specify:				
0. Clinic		Other, specify: _____		
1. Hospital				
2. Community/Church Group				
3. Family/Friends				
4. Other, Specify:				

14. Does anyone in the household suffer from any of the following conditons?

	Adult		Children			Adult		Children	
1. Hypertension	YES (1)	NO (0)	YES (1)	NO (0)	6. Diahorrea	YES (1)	NO (0)	YES (1)	NO (0)
2. Diabetes	YES (1)	NO (0)	YES (1)	NO (0)	7. LRTI	YES (1)	NO (0)	YES (1)	NO (0)
3. Anemia	YES (1)	NO (0)	YES (1)	NO (0)	8. Other	YES (1)	NO (0)	YES (1)	NO (0)
4. TB	YES (1)	NO (0)	YES (1)	NO (0)		YES (1)	NO (0)	YES (1)	NO (0)
5. HIV	YES (1)	NO (0)	YES (1)	NO (0)		YES (1)	NO (0)	YES (1)	NO (0)
If Other, Specify:									

Appendix 8



A software platform to improve safety and utilization of sanitation and water source facilities among women in South African informal settlements

INFORMATION SHEET AND CONSENT

Hello, my name is Dr Rihlat Said Mohamed, and I am a Researcher for the Department of Paediatrics at the University of the Witwatersrand. Together with other colleagues from the University, we would now like to invite you to participate in this research study.

What is this research study?

This research study is designed to investigate on the safety of women around communal water and sanitation facilities in your neighbourhood and their maintenance. We would like to understand how safe you feel around communal water and sanitation facilities areas and whether they are regularly serviced and maintained. We would also like to find out with you how we could improve your safety and the maintenance of the water and sanitation facilities in your neighbourhood. Finally, we are going to develop and test with you an application for cell phones that we think could provide you, your family and your community with information to unsure your safety around communal water and sanitation facilities in your neighbourhood and their maintenance.

Before you decide to participate, we would like you to understand why the research is being done and what it would involve for you and your children.

What is involved in this research study?

There are two different programmes that we will be implemented in two different neighbourhoods. Both involve monthly contact with our team from which you will receive information and material, but the material and the way this material will be delivered will be different in the two neighbourhoods:

In the neighbourhood A – Programme A

We will interview women living in the neighbourhood to understand issues they have concerning safety and maintenance of communal water and sanitation facilities and to collect information needed for us to develop the application for cell phone. We will randomly select women in the neighbourhood to whom we will provide with the application to test and deliver information through messages on their cell phone for a certain period. The cell phone application will be developed and specifically designed to help you find safer, cleaner and functioning water and sanitation facilities in your neighbourhood.

In the neighbourhood B – Programme B

We will randomly select women in the neighbourhood to whom we will deliver information through messages for the same period as women in the neighbourhood A.

Besides the programme material we will be providing you with, every participants regardless of their neighbourhood will also have interviews, group discussions and measurements done.

How will it be decided whether your neighbourhood will be assigned programme A or B?

This will be completely random and all participants from the neighbourhood in which you live will beneficiate with the same program as you. You will not be able to decide which program you want to be involved in and will stay in the same program for the full study period.

Where and when will the interviews take place?

If you agree to take part in the study, we would like to do the following with you.

The study will be conducted at our offices at Chris Hani Baragwanath Academic Hospital (MRC/Wits Developmental Pathways for Health Research Unit).

If you live in the neighbourhood A

We will meet with you 10 times over the next 18 months to collect data from you and your children under 5 years of age. We would also like to give you a call between each visit to schedule our next appointment.

- *Visit 1 to visit 4: information about your neighbourhood and development of the application*

We may invite you to discuss with you and with other members of your community about the public water and sanitation facilities that you have in your neighbourhood, and the cell phone application that we will be developing.

Visit 5 to visit 8: survey

- We will download in your cell phone the application, which we will be specific to your neighbourhood. We will train you on how to use the application using your cell phone. At each visit, we will provide you with data bundle so that you can use the application. We will ask you to use the cell phone application every time you would like to use the water and sanitation facilities in your neighbourhood. As part of the application, you will receive messages, which will give you information around safe use of communal toilet and water facilities.
 - We will measure you and your children height and weight
 - We will ask you a series of questions related to yourself
- *Visit 9: your feedback*

We will discuss with you and with other members of your community about the usage of the application and if it improved your safety, maintenance and cleanliness of your water and sanitation facilities.

- *Visit 10: stakeholders and community meeting*

At the end of the study, we will invite you to present to you the results of the study and discuss with you, other members of your community, water and sanitation service providers and telecommunication service providers.

If you live in the neighbourhood B

We will meet with you 5 times over the next 18 months to collect data from you and your children under 5 years of age. We would also like to give you a call between each visit to schedule our next appointment.

- *Visit 1 to visit 4: survey*
 - o We will send you information through text messages in your cell phone
 - o We will measure you and your children height and weight
 - o We will ask you a series of questions related to yourself
- *Visit 5: stakeholders and community meeting*

At the end of the study, we will invite you to present to you the results of the study and discuss with you, other members of your community, water and sanitation service providers and telecommunication service providers.

Procedures involving the Mother/Caregiver

Focus group discussions (for participants living in Neighbourhood A)

We may invite you to discuss with other women of your neighbourhood (8 to 10) participating in this study about the water and sanitation where you live: where they are located, the different issues you experience, the solutions that you think can improve your safety, the maintenance and cleanliness of your water and sanitation facilities. We will also ask you for your opinion regarding the cell phone application that we will be developing to help you find safer, cleaner and functioning water and sanitation facilities in your neighbourhood. We expect the focus groups to take maximum 1.5 hours of your time.

Measurements (for participants living in Neighbourhood A and B)

- Your height will be measured once during the *Survey*.
- Your weight will be measured at every visit during the *Survey*.

Measurements of yourself and your children will take about 30 minutes.

Interviewer-completed questionnaires (for participants living in Neighbourhood A and B)

At each visit at our offices, we will fill in some questionnaires with your help about your education, household circumstances and employment, events that have recently happened in your life, and safety and violence in your neighbourhood. We will ask

you some questions about you and your children's health. If you are uncomfortable answering any of the questions you need not to answer them. Each questionnaire will take approximately 15-20 minutes to complete and each visit will take 2 hours maximum.

Stakeholders meeting (for participants living in Neighbourhood A and B)

We will invite you to a meeting with other members of your community, the water and sanitation service providers of your neighbourhood and telecommunication service providers. In this meeting, we will present the results of this study. We will ask each of you to give us your opinion about it and to advise in any issues that you may highlight to us. We expect this meeting to take maximum 2 hours of your time

Please note that the group discussions and the stakeholders meeting will be audio recorded to help me capture your insights in your own words. Therefore, your information and feelings shared will not be anonymous to the group to the women (we will only use first names and not surnames); however the tapes will only be heard by the researchers and me for the purposes of this study, and will be kept in the strictest confidence. We may call you again after the group discussions and the stakeholders meeting to follow up on any of the questions.

Procedures involving the Children under 5 years of age

Measurements

- At every visit from the visit 2 we would like to measure weight, length/height of all the children living in your household and who are under 5 years of age

Possible risks

There are chances that some of the questions we ask in the interviews, group discussions or the use of the cell phone application might trigger some emotional setbacks. If this occurs, one of our staff, trained in counselling, will be available to talk with you and refer you to the Psychology Unit at Chris Hani Baragwanath Academic Hospital where you will be given an appointment with a psychologist. If you would like to and request it, we will also indicate services that you can contact if your safety has been threatened during this study.

What to do if you or your child has problems: If it is discovered that you or your child have a health problem you will be notified and the right health care practitioner to help you with the problem and treatment will be recommended.

Possible benefits

If we find any problems during the visits, we will refer you to the appropriate medical professionals further management and referral.

Costs to you

Participating in the research will involve no cost to you. When visiting our offices, you will be given refreshments once your interviews, discussions and measurements have been completed. You will also be given R150 for transport costs per visit.

Voluntary participation in research

You have the right to agree or refuse to participate in this research. If you decide to participate and later change your mind, you are free to stop at any time, or to opt out of any part of the study. Your refusal to participate will not result in any penalty or loss of benefits to which you are otherwise entitled.

Records of your participation in this research

You have the right to privacy. The principal investigator will keep information about your participation in locked files. We will give each person a unique identifying number. This means that all documents and data collected from you will be coded. Coded means that your personal information has been stripped of any direct or indirect identifiers, which are replaced by a numerical code. A list that links the coded information with your identity will be kept secure by the principal investigators, to allow for your re-identification in certain circumstances.

The audio recordings from the group discussions and the stakeholder meeting will be stored on the researcher's computer (password protected) and destroyed after two-six years following the completion of the project and depending on the publication of

results. Direct quotes from you may be used in a published paper; however, your name and other identifying information will be kept anonymous

- Ethical approval: This study protocol has been submitted to the University of the Witwatersrand's, Human Research Ethics Committee (HREC), and that committee has granted written approval. Ethics Clearance number:
- Publication of the results of the research: The results of this research may appear in scientific publications without identifying you in any way.

Your questions

The investigator listed on the first page of this form is available to answer your questions about this research. You may contact the investigator at any time on the following number (011) 933-2120. If you require any further information or have any questions/complaints about the study please contact the Human Research Ethics Committee of the University of the Witwatersrand on (011) 717-1234 or rhulani.mkansi@wits.ac.za

YOU WILL HAVE A COPY OF THIS INFORMATION SHEET TO KEEP

If you are happy to take part in the study, please read and sign the attached consent form and contact us to confirm your participation.

Your signature on the consent form certifies the following:

- You have read the information provided in this consent form
- You have received answers to all of your questions.
- You have freely decided to participate in this research.
- You understand that you are not giving up any of your legal rights.

**A software platform
to improve safety and utilization of sanitation and water source facilities
among women in South African informal settlements**

CONSENT SHEET

I agree to myself and my children under five years of age being participants in the study. The goals and methods of the study are clear to me.

I understand that the study will involve interviews and measurements. All the details and purposes of this study have been explained to me. I understand that I have the right to refuse to participate in the study.

I agree to participation in the study on the condition that:

1. I can withdraw voluntarily from the study at any time and that no adverse consequences will follow withdrawal from the study.
2. I have the right not to answer any or all questions posed in the interviews and not to participate in any or all of the procedures / assessments.
3. The University of the Witwatersrand's Human Research Ethics committee has approved the study protocol and procedures.
4. All results will be treated with the strictest confidentiality.
5. Only group results, and not my individual results, will be published in scientific journals and in the media.

6. The study scientific team are committed to treating participants with respect and privacy through interviews conducted in private and follow-up counselling available on request.

7. I will receive a referral note to a health service if any result is out of the normal range or a problem is detected during the course of the study.

8. The application for cell phones that will be developed will be the sole intellectual property of the principal investigator and co-investigators of this study.

MOTHER OF CHILDREN/CAREGIVER

Printed Name	Signature / Mark or Thumbprint	Date and Time
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RESEARCH ASSISTANT

Printed Name	Signature	Date and Time
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