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Socioeconomic Status, Water, Sanitation, Hygiene, and Economic Cost of Childhood Diarrheal Diseases in Uganda

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College of Health Sciences

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Sarah Birungi Nahalamba

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Walden University
2019

Abstract

Socioeconomic Status, Water, Sanitation, Hygiene, and Economic Cost of Childhood Diarrheal Diseases in Uganda

by

Sarah Birungi Nahalamba

MA, Nkumba University, 2008

BS Makerere University, 2000

Post Graduate Diploma, Uganda Management Institute, 2008

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Health Services

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August 2019

Abstract

Worldwide, diarrhea is the second leading cause of death in children aged under 5, yet it is both preventable and treatable. Several studies have established the effects of exposure to inadequate water, sanitation, and hygiene (WASH) on diarrhea prevalence, but little was known on how the interactions of socioeconomic status and WASH influence the economic cost of treatment of diarrhea. This retrospective cross-sectional survey study was focused on assessing the correlation between socioeconomic status, WASH, and household cost of treatment of diarrhea among children aged under 5 in Uganda using the multiple exposure-multiple effect model. Secondary data from the 2015/16 Uganda National Panel Survey were used. At bivariate level of analysis, 5 of 6 independent variables (education level of mother, household expenditure, residence type, source of drinking water, and type of toilet facility) had statistically significant associations with household cost of treatment of diarrhea (p value < .05). The multivariate-hierarchical multiple linear regression indicated that only 3 of the 6 variables significantly predicated household cost of treatment of diarrhea. These were highest education level of mother (p = 0.001), source of drinking water (p = 0.022), and type of toilet facility (p = 0.012). At p value < .05, about 67% of the variation in the cost of treatment was explained by the independent variables. Households with a higher socioeconomic status incurred higher costs of treatment, although those with a lower status experienced the highest prevalence rates. Therefore, policy makers and practitioners could use these findings to employ multiple interventions to address the disease burden and cause behavior change.

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Dedication

To Allah--The Almighty God most Gracious and most Merciful. You selected me among many, and you have made it possible for me to join the world's most educated class. You've made it possible for me to persist and persevere amidst the challenges of finances, time, family, and work responsibilities. I dedicate to you this achievement and all the proceeds that will come with it. I cannot thank you more for the love and favor that you bestowed upon me. Thank you, Allah.

To my loving and patient family. My dear husband, Mohamed Birungi, you have always been there for me all through this journey. Since the time I married you, you have been very consistent in supporting me in my carrier path, despite our ups and downs. I had one degree, but here I am with the third and highest degree. You were under tension when I was--be it meeting my school financial obligations or be it meeting my course requirements. You shouldered the burden of taking care of our three children and other children under our care to allow me concentrate on my education. I traveled a lot for both education and work-related assignments, and you always stayed home and took care of the family. I appreciate it and don't take this for granted. For all those reasons, I dedicate this achievement to you and assure you that the sky will now be the limit in catching up with the lost time. My three children, Hashim Medd Kalungi, Ibrahim Jjingo, and Asiya Namugga Birungi, you were little when I started this uphill journey; you needed me, you missed me, but you remained calm, patient, and very understanding. This achievement and its fruits are for all of us now to enjoy to the fullest. I am sure I have and will

continue to inspire you to reach your fullest potential in life. I love you my cuties, may Allah bless you for me. My twin sister, Ms. Hawa Namudira, you were both an auntie and mother to my children when I traveled for study and for work. This achievement is dedicated to you too. May we both live long to enjoy its fruits. Allah bless you for me.

To Dr. Wilberforce Kisamba Mugerwa--my Gift from God. You did not know me, nor did I know you well, but you gave me an opportunity to work at the National Planning Authority where you headed as the authority chairperson. As if that was not enough, you told me I was "bright and logical and should study a Ph.D." I thought you were joking. At first, I didn't take you seriously because I had promised myself not to study again. You persisted, you publicly called me your consultant, yet the institution had many bright and experienced staff--I didn't understand this until later. I decided to enroll for an online Ph.D. program so that I could keep in touch with my family and at the same time continue with my employment. When I gave you the news, you were very happy and encouraged me to start. As if that was not enough again, you passed a board resolution to support me financially. So, what else can I say and what else can I give you, but only to thank you and dedicate this achievement to you. May the Almighty God-Allah bless you for me and give you a long life.

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I would like to thank the officials from the Uganda Bureau of Statistics for not only easily giving me permission to access and use the data, but for going an extra mile to help me understand the data, making data analysis easier for me. They kept their doors open to me at any time, and I cannot take that for granted.

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I wish to sincerely acknowledge the contribution of my fellow Walden Doctorial students for the expansion of my knowledge especially during course discussions, group work, and sharing experiences during residencies. We all came with the aim of attaining

our Ph.Ds., but also walked away with a mission to contribute to positive social change to the world.

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Chapter 1: Introduction to the Study

The burden of diarrheal diseases from exposure to inadequate water, sanitation, and hygiene (WASH) has remained high, especially in low- and middle-income countries such as Uganda. Several studies have established the effect of inadequate WASH on diarrhea prevalence among children under 5 years old. However, little was known on how socioeconomic status (education level, household expenditure [proxy for income], and residence type) and WASH (source of drinking water, type of toilet facility, presence of hand washing facility) influence the household cost of treatment of diarrheal diseases among children under age 5. In Uganda, specifically, no current evidence had been found on this topic.

Worldwide, diarrhea disease is the second leading cause of death in children under the age of 5, yet it is both preventable and treatable (World Health Organization [WHO], 2017f). In Uganda, diarrheal diseases were ranked Number 9 of the top 25 causes of years of life lost in Uganda (Ministry of Health [MOH], 2015). In 2016, acute diarrhea was ranked Number 6 of the top 10 leading causes of under-5 in-patient mortality in the country (MOH, 2017).

In this study, therefore, I focused on assessing the correlation between socioeconomic status, WASH, and household cost of treatment of diarrheal diseases among children under 5 years old in Uganda. In Uganda, this age group is the most affected by this disease burden, yet it constitutes 17.7% of Uganda's population, an equivalent of 6,089,600 million children (Uganda Bureau of Statistics [UBOS, 2016c).

A review of global and country level scholarly literature and reports has revealed that much has been studied and documented on the burden of diarrheal diseases associated with inadequate WASH, especially among children under age 5. However, little was documented on the influence of socioeconomic status, WASH, and their interactive effects on household cost of treatment of diarrheal diseases among children under age 5. In Uganda, specifically, no current scholarly evidence has been found on this topic, revealing a knowledge gap that needed to be filled.

In this study, I have revealed current country specific evidence on the influence of socioeconomic status, WASH, and their interactive effects on household cost of treatment of diarrheal diseases among children under age 5. This addresses a scholarly knowledge gap both in the country and globally. This information could be used to inform and convince policy makers and practitioners on the need for a multiple intervention approach to reducing the burden of diarrheal diseases in the country. The findings could also be used to design more appropriate healthcare financing models and interventions that focus on health from a systems approach. At the household level, the evidence could be used to inform parents and care takers and enable them to appreciate the need for improving both WASH practices and socioeconomic status. With increased knowledge, appreciation, and positive practices, the country could reduce the burden of diarrheal diseases and consequently save resources that could be put on more pressing national problems/needs.

In this chapter, I present the background to the study to summarize what is known about the problem and the knowledge gaps that the current study addresses. I also present

the problem statement, which justifies the gap and the need to address it. I further present the purpose of the study, the research questions and hypotheses, the theoretical foundation of the study, and the nature of study. I also present the definitions of study variables and key concepts; I highlight the study assumptions, scope and delimitations, limitations, and significance of the study. This section ends with a summary of the main points.

Background of the Study

Mishra, Dhimal, Parash, and Adhikari (2017), in their global study on sanitation for all revealed that sanitation remains a global challenge. The study findings indicated that about 2.4 billion people are not able to access adequate sanitation (Mishra et al., 2017). In addition, 950 million people, mainly in low- and middle-income countries, do not have access to any sanitation facility (Mishra et al., 2017). Mishra et al. (2017) revealed that for a period of 25 years, sanitation coverage only increased from 54% in 1990 to 68% in 2015. The situation was even worse in less developed countries like Uganda, where the coverage increased from 20% to only 38% in the same period (Mishra et al., 2017). The study was qualitative, focusing on theoretical perspectives. Mishra et al. recommended more studies that could quantify health and economic effects to guide policies for realizing the goal of sanitation. In this study, I addressed this knowledge gap by employing quantitative methods to establish the household cost of treatment of diarrheal diseases associated with WASH and socioeconomic factors among children under the age of 5.

Pruss-Ustun et al. (2014) carried out a retrospective study on the burden of disease from inadequate WASH in 145 low-and middle-income countries. They revealed that about 842,000 diarrhea deaths in 2012 were caused by risk factors associated with poor WASH conditions, accounting for 58% of total diarrheal diseases (Pruss-Ustun et al., 2014). The findings indicated that access to an improved sanitation facility and hand washing with soap would result in a 28% and 23% effect size reduction in diarrhea morbidity respectively (Pruss-Ustun et al., 2014). In addition, Pruss-Ustun et al. revealed that improved WASH significantly reduces undernutrition, a major cause of mortality among children under 5 years old. According to Pruss-Usten et al., in 2011, about 768 million people did not have access to improved water sources, 2.5 billion lacked access to an improved sanitation facility, and about 80% of the population worldwide was affected by inadequate hand hygiene practices. Pruss-Ustun et al. established that the burden of diarrhea disease has been attributed to the three risk factors of inadequate WASH and how much diarrheal disease could be prevented through improved conditions. However, they did not establish the influence of socioeconomic factors on diarrhea prevalence and cost of treatment. In this present study, I attempted to address this knowledge gap by employing the multiple exposure multiple effect (MEME) model.

A water and sanitation focused quasi-experimental (nonrandomized) study involving 176 children under 2 years old in an urban slum in India recorded a total of 3,932 episodes of illness in 2 years (Sarker, Sivarathinaswamy, Sindhu, & Ajjampur, 2013). This translated into 12.5 illnesses per child or 3 months of illness in a year (Sarker

et al., 2013). The researchers further revealed that respiratory and diarrheal diseases where the major causes of morbidity and mortality among the study children, resulting in 87% of all childhood morbidities (Sarker et al., 2013). About 70.9% of the morbidities where recorded to have resulted in healthcare visits either in a clinic or in a hospital outpatient unit (Sarker et al., 2013). While Sarker et al. (2013) established that diarrheal illnesses were among the top causes of child morbidity and mortality and demonstrated the impact of frequent episodes of illness on children's health and development, they did not establish the influence of socioeconomic factors on disease burden and did not establish the household cost of treatment of a diarrhea episode. Sarker et al. also focused on only children under 2 years old in an urban slum area, leaving out children between 2 and 5 years and other children in nonurban slum areas who are also at high risk. In this study, I addressed this knowledge gap by including the influence of socioeconomic factors and covering all children under 5 years of age in a nationally representative sample.

A case study on sanitation and hygiene practices in Uganda in three host villages of the Community Led Total Sanitation (CLTS) program confirmed the magnitude of the problem (Abalo, 2016). Abalo (2016) revealed that Uganda lacks basic sanitation facilities and practices, leading to infections that translate into the high cost of healthcare. Abalo further revealed that Uganda's stagnation in improving water and sanitation conditions is strongly attributed to limited political prioritization of the sector and limited translation of policy into practice. Using the positive deviance approach as a conceptual

framework, Abalo revealed that communities implementing the CLTS program were able to realize significant household sanitation improvements. The findings indicated that the high costs of treating sanitation diseases among households as well as other social factors were important in motivating households to practice better sanitation (Abalo, 2016). Abalo recommended further study of such factors and targeting them for future interventions to improve sanitation in similar households. The study was qualitative, covered a small sample, and did not focus on establishing the effect of socioeconomic factors on WASH practices. In this study, I addressed this knowledge gap and provided a nationally representative picture of the problem to better inform the politicians to improve their policy and financial decisions on sanitation and hygiene in the country. I also employed a different theoretical perspective--the MEME model.

Muhoozi, Atukunda, Mwadime, Iversen, & Westerberg (2016), conducted a study on nutritional and developmental status among 6- to 8-month-old children in South Western Uganda and revealed that there are multiple predictors of undernutrition. Using a cross-sectional study method with a sample of 512 households, the results of the regression analysis indicated that gender, sanitation, child dietary diversity, and poverty were predictors of undernutrition (Muhoozi et al., 2016). Muhoozi et al. expressed a challenge in fitting good models to explain the outcomes due to a complex network of variables affecting the outcomes. They recommended multiple intervention programs addressing dietary diversity, food hygiene, infant feeding, and care practices to improve infant and child growth and development (Muhoozi et al., 2016). The MEME model that

guided this current study helps fill a knowledge gap of a theoretical framework by helping future researchers explain how the complex network of variables affect child health outcomes.

Hirai, Roess, and Graham (2016), in their study on exploring geographic distributions of high-risk WASH practices and their association with child diarrhea in Uganda, revealed a 2-week prevalence of child diarrhea. Hirai et al. carried out a hot spot analysis of a sample of 7,019 children from the Uganda Demographic and Health Survey 2011 to establish how high-risk WASH practices and child diarrhea are geographically clustered. At the individual level, none of the high-risk WASH practices were significantly associated with child diarrhea (Hirai et al., 2016). Being in the highest WASH quintile was, however, significantly associated with a 24.9% lower prevalence of child diarrhea compared to being in the lowest quintile (Hirai et al., 2016). Hirai et al. recommended that future researchers explore the potential WASH-induced burden of disease. They did not establish the socioeconomic factors associated with WASH-induced burden, which I intended to address using the MEME model.

A review of related literature revealed that globally, much was known about the burden of diarrheal diseases associated with inadequate WASH. What remained to be established specifically in Uganda was the influence of socioeconomic factors, WASH, and their interactions on household cost of treatment of diarrheal diseases. In this present study, therefore, I focused on filling this knowledge gap using the MEME model.

Problem Statement

Diarrhea disease, although preventable and treatable, is the second leading cause of death in children under the age of 5 globally (WHO, 2017). There are nearly 1.7 billion cases of childhood diarrhea every year, resulting into about 525,000 deaths (WHO, 2017). In Uganda, it was ranked Number 9 of the top 25 causes of years of life lost (MOH, 2015). In 2016, diarrhea contributed to 69% of childhood illnesses in Uganda (UBOS, 2016a). In the same year, acute diarrhea accounted for 204 cases of under-5 in-patient mortality, being ranked Number 6 of the top 10 leading causes of under-5 in-patient deaths in the country (MOH, 2017).

There is sufficient evidence globally indicating that the high prevalence of diarrheal diseases among children under the age of 5 mainly results from exposure to inadequate WASH. However, little is known about how socioeconomic status (education level, household expenditure, and residence type), WASH (source of drinking water, type of toilet facility, presence of hand washing with soap and water), and their interactions influence the household cost of treatment of diarrheal diseases among children under the age of 5. In Uganda, specifically, no current scholarly evidence had been found on this topic, revealing a knowledge gap that needed to be investigated.

In low- and middle-income countries, children under 3 years old experience on average three episodes of diarrhea every year (WHO, 2017). Each of these deprives the child of optimal nutrition necessary for growth and increases the risk of infections (WHO, 2017). Because the bulk of the world's 950 million people lacking access to any

sanitation facility are found in low and middle income countries such as Uganda (Mishra et al.,2017), the burden of diarrheal diseases is a growing concern. In Uganda, specifically, only 19% of the households have access to an improved toilet facility (An improved toilet facility in the Ugandan context includes a flush toilet, ventilated improved pit [VIP]latrine, covered pit latrine, private with a slab, and an Ecosan [UBOS, 2014].), about 8.3% practice open defecation, and 44% have a hand washing facility with soap and water (UBOs, 2016a). Although 78% of households have access to an improved source of drinking water, only 52% use an appropriate water treatment method (UBOS, 2016a).

While it has been established that a significant proportion of diarrheal diseases can be prevented through adequate WASH, it was also important to find out how socioeconomic factors could further influence this relationship and associated economic costs of diarrhea treatment. Therefore, the knowledge gap presented needed further investigation, specifically for the case of Uganda. This gap could be the missing link to provide information to policy makers, politicians, practitioners, households, and development partners to appreciate the magnitude of the problem not only as a public health concern but also as a socioeconomic issue. This could lead to a system-wide multiple intervention approach to improving children's health in the country.

Purpose of the Study

The purpose of this retrospective cross-sectional survey study was to assess the correlation between socioeconomic status, WASH, and household cost of treatment of

diarrheal diseases among children under the age of 5 in Uganda using MEME model. I focused on children under 5 years old across the country, which is the demographic group were the burden of diarrheal diseases due to socioeconomic status and inadequate sanitation and hygiene was highest. The independent variables of the study were (a) socioeconomic status (education level of mother, household expenditure, and residence type) and (b) WASH (source of drinking water, type of toilet facility, presence of hand washing facility). The dependent variable of the study was household cost of treatment of diarrhea. The control variable of the study was place of treatment.

Research Questions and Hypotheses

The study had two research questions:

Research Question 1: What is the relationship between socioeconomic status (education level of parents, household expenditure, and type of residence) and household cost of treatment of diarrhea disease among children under the age of 5 in Uganda, controlling for place of treatment?

$H_0$1: There is no statistically significant relationship between socioeconomic status (education level of parents, household expenditure, and type of residence) and household cost of treatment of diarrhea disease among children under the age of 5 in Uganda, controlling for place of treatment.

H_a1: There is a statistically significant relationship between socioeconomic status (education level of parents, household expenditure, and type of residence) and household

cost of treatment of diarrhea disease among children under the age of 5 in Uganda, controlling for place of treatment.

Research Question 2: What is the relationship between WASH (source of drinking water, type of toilet facility, presence of hand washing facility) and household cost of treatment of diarrhea disease among children under the age of 5 in Uganda, controlling for place of treatment?

$H_0$2: There is no statistically significant relationship between WASH (source of drinking water, type of toilet facility, presence of hand washing facility with water and soap) and household cost of treatment of diarrhea disease among children under the age of 5 in Uganda, controlling for place of treatment.

H_a2: There is a statistically significant relationship between WASH (source of drinking water, type of toilet facility, presence of hand washing facility with water and soap) and household cost of treatment of diarrhea disease among children under the age of 5 in Uganda, controlling for place of treatment.

Theoretical Foundation

The theoretical foundation for this study was the MEME model published by WHO in 2003. The model/framework is a further development of the driving force-pressure-state-exposure-effect-action (DPSEEA) framework published by WHO in 1999 (Hambling, Weinstein, & Slaney, 2011). While the DPSEEA framework separates more proximal causes of disease (exposures) from more distal causes (the state and pressure components), the MEME framework instead combines all of them generally as exposures

(Hambling et al., 2011). The model also has some roots in the works of Murray and Lopez, who in 1996 undertook the original assessment of the global burden of disease (GBD; Briggs & WHO, 2003). In their assessment, they made deductions on the environmental contribution to the GBD by attributing mortality and morbidity data to environmental causes (Briggs & WHO, 2003). Since then, their work has informed more detailed analysis of the GBD, which, in addition to other aspects, assesses the environmental contribution to the GBD from estimates of population exposures and exposure-response relationships (Briggs & WHO, 2003).

The MEME model postulates that there are many links and associations between environment and health (Briggs & WHO, 2003). It "emphasizes the complex relationships between environmental exposures and child health outcomes" (Hambling et al., 2011, p.14) while at the same time recognizing contextual factors. In the case of children, the model demonstrates that exposures to disease occur in various settings, including the home, the community, and the wider ambient environment (Briggs & WHO, 2003). It also recognizes that health effects may be expressed in different ways such as morbidity, mortality, incidence rate, or recurrence rate (Briggs & WHO, 2003). The model further "recognizes that both exposures and health outcomes may be affected by contextual factors such as social conditions, demographics and economic development that influence the susceptibility of the population to environmental health effects" (Briggs & WHO, 2003, p. 6). The model also clearly shows the many entry points for interventions, suggesting that interventions/actions can be targeted at either the health

outcome level or the exposure level in the short and medium-term (Briggs & WHO, 2003).

The MEME was designed for use in guiding studies, policy, and interventions in the context of children ‘s environmental health. According to Gary and Pilyoung (2010), multiple risk exposure is experiencing more than one risk at a time. The exposures may happen simultaneously, such as lack of a toilet facility and lack of nutritious food, or sequentially, such as a poor teenage girl getting pregnant and dropping out of school (Gary & Pilyoung, 2010). Each of the exposure risks can set off circumstances that may affect individual health leading to varied health outcomes (Gary & Pilyoung, 2010).

In the case of children, the model demonstrates that exposures to disease occur in various settings, including the home, the community, and the wider ambient environment (Briggs & WHO, 2003). It also recognizes that health effects may be expressed in different ways, such as morbidity, mortality, incidence rate, or recurrence rate. The model further “recognizes that both exposures and health outcomes may be affected by contextual factors such as social conditions, demographics and economic development that influence the susceptibility of the population to environmental health effects” (Briggs & WHO, 2003, p. 6). The model also clearly shows the many entry points for interventions, suggesting that interventions/actions can be targeted at either the health outcome level or the exposure level in the short and medium-term. In the longer term, actions may also be targeted at the underlying contextual factors (Briggs & WHO, 2003).

The rationale for selection of this model was based on the need to establish effects of multiple risk factors on children's health outcomes as opposed to a singular risk factor approach. According to Gary and Pilyoung (2010), most research on risk factors and health has addressed how singular risk factors uniquely contribute to health. However, in reality, and more so in the case of children under 5 years, health outcomes may not be comprehensively explained by singular risk factors. In addition, a significant amount of literature on child development postulates that multiple risk exposures have more adverse effects on child development than singular risk exposures (Gary & Pilyoung, 2010). Burbure et al. (2006) also confirmed that most of the studies carried out on the effects of metals to population health have focused on individual metals, with limited studies on the effects of the combinations and interactions of different metals.

Using the MEME model, it was assumed that exposure risks such as inadequate WASH that share similar pathways of health impacts would have combined effects that are different from exposure risks that are unique in their impacts (Gary & Pilyoung, 2010). The model also assumes that socioeconomic risk factors such as no or low education, low expenditures, and type of residence (poor housing conditions) influence the WASH pathways of health impacts. Therefore, in the present study, I investigated how the multiple risk factors--WASH, education level, expenditure level, and residence type simultaneously and interactively affect the household cost of treatment of diarrheal diseases among children under 5years old in Uganda. The two research questions related to and build upon the MEME model/theory. The questions related to both the singular

and multiple risk factors that influence the prevalence of diarrhea and consequent treatment costs among children. The present study builds upon the MEME model/theory by establishing how both singular and multiple risk factors and their interactions influence the cost of treatment of diarrhea among children under the age of 5 in Uganda.

Nature of the Study

The nature of this study was quantitative, as guided by Campbell and Stanley (1963) and Vogt, Vogt, Gardner and Haeffele (2017). Specifically, a correlational retrospective-cross-sectional survey design was used to analyze the relationships between the independent variables of socioeconomic status (education level, household expenditure, and residence type), WASH (source of drinking water, type of toilet facility, presence of hand washing facility with water and soap), and the dependent variable of household cost of treatment of diarrheal diseases. The control variable was place of treatment. The design facilitated the use of existing secondary data to establish associations between the study variables (see Campbell & Stanley, 1963) and linking present events to past events (see Walden University, 2010). The data were from the 2015/16 Uganda National Panel Survey (UNPS), carried out by the Uganda Bureau of Statistics. A multiple linear regression analysis was carried out to test the relationships and interactions between variables using SPSS Version 25.

Definitions

Burden of disease: According to WHO (2011), burden of disease is an indicator that measures the gap between a populations' current health status and the ideal situation

of being disease and disability free, with the highest possible life expectancy. The GBD has been defined as the sum of life-limiting disease on the human population estimated in terms of disability-adjusted life years (DALYs; Briggs & WHO, 2003). DALYS are a measure of the years lost to either premature death or life-limiting disease.

Hand washing facility with soap and water: This is simply the availability of a facility with soap and water to wash hands at any time when needed. Hand washing with a detergent such as soap limits the transmission of pathogens/microorganisms from fecal matter and contaminated water to the body and food (UBOS, 2011b). According to WHO and United Nations Children's Fund [UNICEF] (2017), a hand washing facility can be either fixed or mobile. The facility should contain any of the following equipment:

> "A sink with tap water, buckets with taps, tippy-taps, and jugs or basins designated for hand washing. Soap includes bar soap, liquid soap, powder detergent, and soapy water but does not include ash, soil, sand or other hand washing agents" (WHO &UNICEF, 2017, p. 15).

The new WHO and UNICEF JMP ladder for hygiene has further disaggregated the criteria for access to a hand washing facility into basic hygiene facility (a household with a hand washing facility with soap and water), limited (a household with a facility but lack water or soap), and having no facility for those with no facility at all.

Hygiene: WHO and UNICEF (2017) defined hygiene as the conditions and practices that help maintain health and prevent spread of disease at the individual, household, and community level. Hand washing and food hygiene have been identified as

some of the key practices and conditions for preventing transition of pathogens. UBO (2011b) added that observance and promotion of basic hygiene is a fundamental public health practice.

Improved sanitation facility: The WHO and UNICEF (2017), under the joint monitoring program have defined sanitation services to include the management of excreta from the facilities used by individuals, through emptying and transporting it for treatment and eventual discharge or reuse. Accordingly, an improved sanitation facility has been defined as one designed to hygienically separate excreta from human contact. The joint program revealed that a household only meets the criteria of having a safely managed sanitation service if the facility is not shared with another household and the excreta is either treated or disposed in situ, stored temporarily, and is then emptied and transported to treatment off-site or is transported through a sewer with wastewater and is then treated off-site. The UBOS (2011b, 2014) defined an improved toilet facility to include one that has a flush system, a VIP latrine, a covered with a slab pit latrine, a private with a slab pit latrine, a composting toilet (which separates solid waste from water), and an Ecosan. If a household does not meet these criteria, then it is classified as having a limited sanitation facility (if shared) and a basic sanitation facility (if excreta are not properly managed). An unimproved sanitation facility, therefore, is the use of any sanitation facility that does not meet the above definition and description. These include pit latrines without a slab or platform, hanging latrines, or bucket latrines.

Improved source of drinking water: According to UBOS (2016a), improved sources of water include piped water, public taps, standpipes, tube wells, boreholes, protected dug wells and springs, and rainwater. Households that use bottled water for drinking are classified as using an improved source only if the water they use for cooking and hand washing comes from an improved source. Any household water source that does not meet the above criteria is classified as unimproved.

Open defecation: The WHO and UNICEF (2017), JMP has defined open defecation as the disposal of human faeces in any of the following places: fields, forests, bushes, open bodies of water, beaches, and other open spaces or with solid waste.

Place of treatment: This was defined in the 2015/16 UNPS as the place where treatment was sought (UBO, 2016b). The places included healthcare service providers such as government, private, and Non -governmental Organizations' (NGO) facilities, as well as traditional healers (UBO, 2016b).

Prevalence of diarrheal disease: This is the number of occurrences of a diarrheal episode. Diarrhea is a disease involving frequent passage of loose or liquid stools per day (WHO, 2017). It is caused by an infection(s) in the gastrointestinal tract, a result of infections by a variety of bacterial, viral, and parasitic organisms (WHO, 2017). The key main pathogens that cause moderate-to-severe diarrhea in low-expenditure countries are Rotavirus and Escherichia coli. Rotavirus is the leading cause of acute diarrhea and is responsible for about 40% of all hospital admissions due to diarrhea among children under 5 worldwide (UNICEF & WHO, 2009). Clinically, diarrhea presents itself in three

main forms of acute watery diarrhea (lasts several hours or days and includes cholera), acute bloody diarrhea/dysentery, and persistent diarrhea, which lasts 14 days or longer (WHO, 2017). The most severe threat posed by diarrhea is dehydration (WHO, 2017). The most common pathway for diarrheal infection is consumption of contaminated food, water, and undernutrition.

Socioeconomic status (education level, household expenditure level, type of residence): This includes socioeconomic indicators such as education level, expenditure level, and type of resident of individuals and households. Education level is the highest formal education attainment of an individual (UBO, 2016b). For the case of Uganda, the lowest education level is primary, and the highest is tertiary. According to UBO (2016b), household expenditure level, which is a proxy of income, is the highest economic earning of a household. It is mainly categorized in five quintiles of poorest, second poorest, middle, second richest, and richest (UBO, 2016b). Type of residence is the location where people reside, and for the case of Uganda, it categorized as rural and urban (UBO, 2016b).

Assumptions

Assumption 1: In this study, I employed secondary data. Therefore, the first assumption was that the selected 2015/16 UNPS followed all the requisite procedures required for an accurate and valid survey.

Assumption 2: The second assumption was that the respondents were truthful in providing information and that the information was accurately recorded, with no duplication, no inaccurate coding, and no missing data.

Scope and Delimitations

In this study, I focused on assessing the relationship between one dependent variable, household cost of treatment of diarrheal diseases, two main independent variables with six sub-variables, socioeconomic status (education level of mother, household expenditure and residence type) and WASH (source of drinking water, type of toilet facility, and presence of hand washing facility with water and soap), and place of treatment as the control variable. The focus on these variables was due to the multiple exposures for the high burden of diarrheal diseases in Uganda and globally, with yet limited scholarly evidence on the topic. Using the MEME model, I examined the various risk factors associated with the burden of diarrheal diseases in Uganda.

The cross-sectional design selected for this study only assessed the associations between the dependent and independent variables while controlling for place of treatment. This limited the study to only establishing the cause-and-effect relationships among variables. The study population was children under 5 years old, and the study respondents were children's parents/care givers in the selected households.

The geographical location for this study was all sampled locations in Uganda, including rural and urban areas. Because the study employed a large sample of nationally representative survey data, the results can be generalized to all children under 5 years old

in Uganda, and it will be possible to make inferences about certain characteristics of the study population (see Creswell, 2014).

Limitations

In this study, I employed a cross-sectional survey design, which did not allow for manipulation of the order of independent variables, consequently leading to an inability to establish the cause-effect-relationship among the study variables (see Walden University, 2010). In addition, the design did not allow for random assignment of groups, and it presented effects of uncontrolled variables. These would have weakened the study internal validity. According to Trochim (2006), nonexperimental designs are weak in determining the cause-effect relationships among study variables, making them generally weak in internal validity. The study depended on existing secondary data from the 2015/16 UNPS. This limited exploration and assessment of important variables or indicators were data may not have been collected. In addition, the collection of survey data largely relies on the participant's ability to recall information, which could have affected the provision of accurate information. This could have affected the findings of the study. The gaps in secondary data were supplemented with information from related scholarly literature and published national reports.

Significance of the Study

This study can contribute to existing scholarly evidence and confirmation of the MEME theory in explaining environmental determinants of child health. It can inform

practice in this field and can subsequently contribute to positive social change at individual, household, community, and national levels.

Significance to Theory

This study contributed to scholarly evidence in this field. It validated the MEME theory in explaining environmental determinants of child health. The study can produce current country specific evidence on how singular and multiple socioeconomic and WASH variables interact to predict the household cost of treatment of diarrheal diseases among children under the age of 5. This will address a knowledge gap in Uganda and elsewhere. Overall, the study has the potential for making an original contribution to the field, especially in Uganda, as well as validating existing theories on the phenomenon (see Rudestam & Newton, 2015).

Significance to Practice

The study could be used to inform and convince policy makers and practitioners on the need for a multiple intervention approach to reduce the burden of diarrheal diseases in the country. The findings could also be used to design more appropriate healthcare financing models and interventions that focus on health from a systems approach. This could lead to better prioritization of interventions and rationalizing financial and other resources to increase allocation and technical efficiency. Ultimately, the study has the potential to provide clues to decision makers on the multiple environmental hazards and risks surrounding children in Uganda and the issues that matter for their health and wellbeing (see Briggs & WHO, 2003).

Eventually, the study can provide information to inform national policies on WASH and socioeconomic factors. Using the findings of this study, household, community, and national education programs could be designed to create awareness and impact knowledge on promotion of improved WASH and socioeconomic status.

Significance to Social Change

This study can contribute to positive social change at all levels. At the individual and household level, the evidence could be used to inform parents and care takers and enable them to appreciate the need for improving WASH practices. With increased knowledge, appreciation, and positive practices, the households, communities, and entire country could reduce the burden of diarrheal diseases and consequently save resources spent on diseases that could otherwise be prevented.

The cost savings could then be used for more productive activities such as improved farming, trade, child education, and better household nutrition. At the national and global levels, the study findings could serve as a wake-up call to policy makers, politicians, and development partners to play a more important role in ensuring that the people they serve live in healthy environments.

Summary and Transition

In this chapter, I made the case for the study by defining the problem and providing an evidence-based background to support the problem. I also described the scope and limitations of this study and its significance to theory, practice, and positive social change. I identified the study variables supported by a theoretical foundation and

presented the questions and hypotheses that were investigated as elaborated on in the next chapter.

Chapter 2: Literature Review

Introduction

There is sufficient global literature on the effect of inadequate WASH on diarrhea prevalence among children under the age of 5. However, little was known on how socioeconomic status (education level, household expenditure, and residence type), WASH (water source, type of toilet facility, presence of hand washing facility with soap), and their interactions influence the household cost of treatment of diarrheal diseases among the study population. In Uganda specifically, no current scholarly evidence had been found on this topic. Worldwide, diarrheal diseases continue to be the second leading cause of morbidity and mortality in children under the age of 5.

A study in Uganda to establish the factors responsible for the increase in the under-5 mortality rate in Uganda for the period of 1995 to 2000 revealed no significant statistical relationships between under-5 mortality and poverty, maternal conditions, level of nutrition, access to health, and other social services (Nuwaha, Babirye, & Ayiga, 2011). Nuwaha et al (2011), suggested further studies to explain the increase in the under-5 mortality rate.

A case study on sanitation and hygiene practices in Uganda revealed that Uganda lacks basic sanitation facilities and practices, leading to infections that translate into the high cost of healthcare (Abalo, 2016). A global study on sanitation for all revealed that about 2.4 billion people are not able to access adequate sanitation (Mishra et al., 2017).

A study on the effects of sanitation on child health across countries revealed that sanitation coverage strongly impacts on under-5 child health, and the most health gains would be attained if sanitation coverage increased to over 80% (Hunter & Pruss-Ustun, 2016). In a study to establish the monetary cost of diarrhea diseases to households in an urban slum area in India, it was revealed that households each lost about 409 rupees due to diarrheal illness (Patel et al., 2013).

The purpose of this retrospective cross-sectional survey study was to assess the correlation between socioeconomic status, WASH, and household cost of treatment of diarrheal diseases among children under age 5 in Uganda using the MEME model. In this chapter, I also present the literature search strategy, the theoretical framework guiding the study, and a detailed review of current literature and historical perspectives of the problem.

Literature Search Strategy

The literature search strategy included focused navigation through the Walden University library databases, searching Google scholar resources and WHO and UNICEF websites. The accessed library databases included CINAHL & MEDLINE Simultaneous Search, Dissertations & Theses @ Walden University, Health and Environmental Research online (HERO), ProQuest Central, ProQuest Dissertations & Theses Global, ProQuest Health & Medical Collection, SAGE Journals (formerly SAGE premier), SAGE Knowledge (formerly SAGE Encyclopedias), SAGE Research Methods Online, ScienceDirect, Thoreau Multi-Database Search, UNICEF, Walden Library Books, World

Bank Open Knowledge Repository (The), and World Health Organization. The search engines used included field searching, employing limiters in searching for articles from a certain date, full text, and peer reviewed. The key search terms and combinations of search terms were *the burden of water, sanitation, and hygiene diseases; the burden of diarrheal diseases; socioeconomic factors and access to WASH; the economic burden of diarrheal diseases; the burden of water,* and *sanitation and hygiene diseases in Uganda.*

The scope of the literature review was limited to 5 years before the expected time of graduation (2019). However, some older articles were included to provide a historical perspective and justification of the problem. In terms of types of literature, the scope covered mainly peer reviewed articles, professional books, Ph.D. and master's Dissertations, WHO and UNICEF reports, and country level reports and publications. These were searched in journals, databases, and websites.

Theoretical Foundation

The theoretical framework for this study was the MEME model published by WHO in 2003. This model postulates that there are many links and associations between environment and health (Briggs & WHO, 2003). It "emphasizes the complex relationships between environmental exposures and child health outcomes" (Hambling et al., 2011, p.14) while at the same time recognizing contextual factors. The MEME was designed for use in guiding studies, policy, and interventions in the context of children 's environmental health. According to Gary and Pilyoung (2010), multiple risk exposure is experiencing more than one risk at a time. The exposures may happen simultaneously,

such as lack of a toilet facility and lack of nutritious food, or sequentially, such as a poor teenage girl getting pregnant and dropping out of school (Gary & Pilyoung, 2010). Each of the exposure risks can set off circumstances that may affect individual health, leading to varied health outcomes (Gary & Pilyoung, 2010).

The model/framework is a further development of the DPSEEA framework published by WHO in 1999 (Hambling et al., 2011). While the DPSEEA framework separates more proximal causes of disease (exposures) from more distal causes (the state and pressure components), the MEME framework instead combines all of them generally as exposures (Hambling et al., 2011). In the case of children, the model demonstrates that exposures to disease occur in various settings, including the home, the community, and the wider ambient environment (Briggs & WHO, 2003). Figure 2 reveals that children's exposures to most environmental health hazards occur in the home environment because that is where they spend most of their time as compared to the community and wider environments.

The model also recognizes that health effects may be expressed in different ways such as morbidity, mortality, incidence rate, or recurrence rate. The model further "recognizes that both exposures and health outcomes may be affected by contextual factors such as social conditions, demographics and economic development that influence the susceptibility of the population to environmental health effects" (Briggs & WHO, 2003, p. 6). The model also clearly shows the many entry points for interventions, suggesting that interventions/actions can be targeted at either the health outcome level or

the exposure level in the short and medium-term. In the longer term, actions may also be targeted at the underlying contextual factors (Briggs & WHO, 2003). However, from a statistical point of view, application of this model in examining a big number of singular risk variables and their interactions requires a large sample size (Gary & Pilyoung, 2010). Even with a large sample size to detect interaction effects, Gary and Pilyoung (2010) highlighted that interpretation of the meaning of higher order interaction terms is impossible. However, the authors indicated that the limitation can be addressed by standardizing singular risk variables and forming an additive composite (Gary & Pilyoung, 2010). Figure 1 and 2 elaborate on the model.

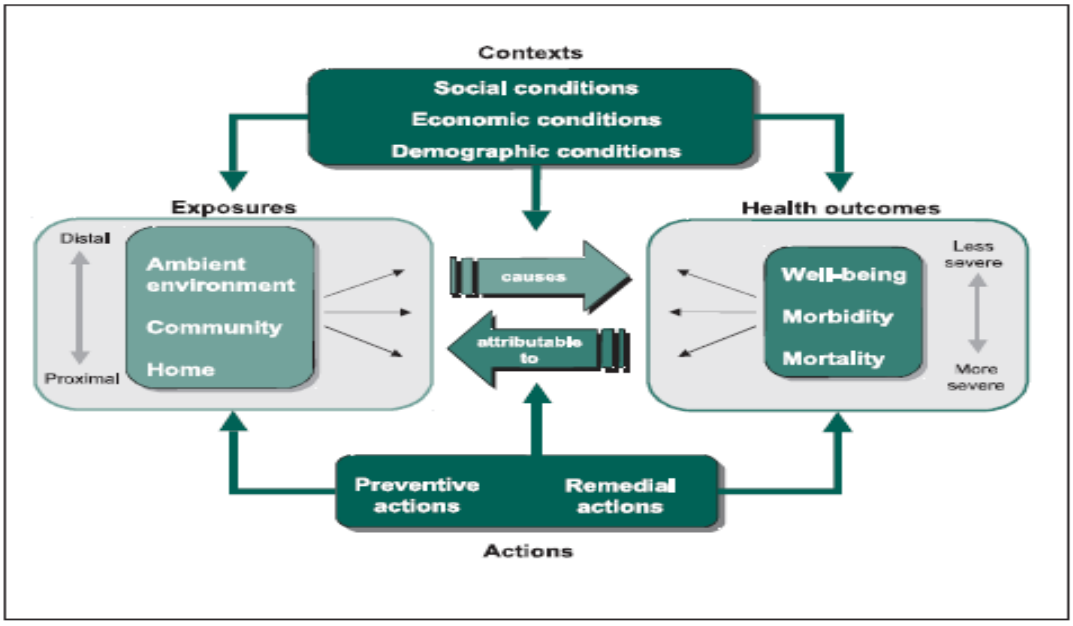

Figure 1. The MEME model/framework. Adopted from WHO 2003 framework for indicators to improve children's environmental health.

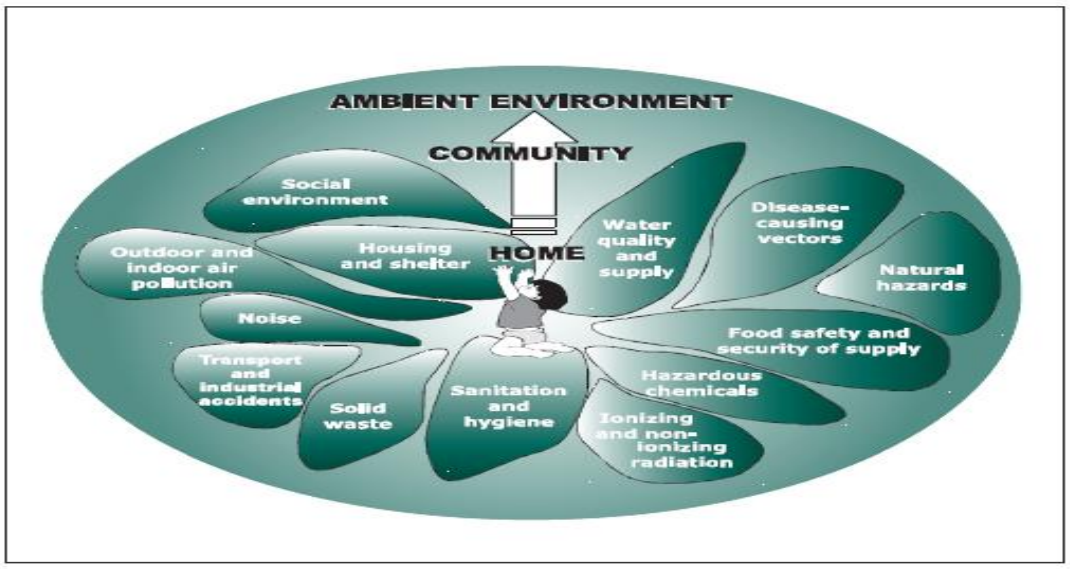

Figure 2. Children's hazard spaces: An elaboration of child multiple risk exposures. Adopted from WHO 2003 framework for indicators to improve children's environmental health.

The MEME model/framework has been applied by WHO to design and define a core set of indicators to improve children's environmental health (Briggs & WHO, 2003). The indicators are targeted at the main childhood diseases globally and serve a number of purposes. These are

> "providing a basis for assessing environmental risks to children's health, in order to help prioritize policy at national and global level; acting as a basis for monitoring and evaluating the effectiveness of national and international initiatives to reduce environmental health risks for children; and providing a template for developing other indicators as needed to address issues of specific local or national concern" (Briggs & WHO, 2003, p. iv).

The main childhood diseases discussed in the indicator framework/tool are perinatal diseases, respiratory diseases, diarrheal diseases, insect-borne diseases, and physical injuries (Briggs & WHO, 2003).

The constructs of the MEME model were applied in a research study to establish the renal and neurologic effects of the combined impact of cadmium, lead, mercury, and arsenic in children in industrialized countries (Burbure et al., 2006). Burbure et al. (2006) focused on establishing evidence of early effects and multiple interactions at environmental exposure levels in a cross-sectional survey of over 800 children in three European countries of France, Poland, and the Czech Republic. Analysis of blood and urine samples taken from children indicated that all the four metals had renal and neurologic effects with complex interactions (Burbure et al., 2006). The authors also highlighted that persistent existence of these pollutants in soil, sediments, and food chains still pose health risks associated with chronic multiple environmental exposures (Burbure et al., 2006). Burbure et al. further indicated that "natural contamination such as geologic arsenic or lifestyle related factors such as the inorganic mercury in dental amalgam can further contribute to increase in the burden of human exposure to these toxicants" (p. 584). Burbure et al. emphasized the need to control and regulate potential sources of contaminations by heavy metals in industrialized countries.

Gary and Pilyoung (2010) used the multiple risk exposure mechanism to provide potential explanation for socio-economic status-health gradient. They noted that socio-economic factors such as income and class often determine individual settings and

systematic differences in environmental quality. Through systematic reviews of previous studies on multiple risk exposures, Gary and Pilyoung, indicated that exposure to multiple risk factors is higher in individuals with lower socio-economic status and is associated with worse health outcomes in both childhood and adulthood. For example, a review of a national sample of high-risk infants indicated that 35% of low-income toddlers in follow-up as compared to only 5% of middle income toddlers had been exposed to six or more risk factors at similar levels of high cumulative risk (Gary & Pilyoung, 2010).

The rationale for selection of this model was based on the need to establish effects of multiple risk factors on child health outcomes as opposed to a singular risk factor approach. According to Gary and Pilyoung (2010), most research on risk factors and health has examined how singular risk factors uniquely contribute to health. However, in reality, more so in the case of children under age 5, health outcomes may not be comprehensively explained by singular risk factors.

In addition, a significant number of literatures on child development postulate that multiple risk exposures have more adverse effects on child development than singular risk exposures (Gary & Pilyoung, 2010). Burbure et al (2006), also confirmed that most of the studies carried out on the effects of metals to population health have focused on individual metals, with limited studies on the effects of the combinations and interactions of different metals.

Using the MEME model, it's assumed that exposure risks such as WASH that share similar pathways of health impacts would have combined effects that are different from exposure risks that are unique in their impacts (Gary & Pilyoung, 2010). It's further assumed that socioeconomic status could influence the WASH pathway to determining child health outcomes. Therefore, my study was intended to investigate how the multiple risk factors of WASH and socioeconomic status simultaneously and interactively influence the household cost of treatment of diarrheal diseases among the study population. The research questions relate to and build upon the MEME model/theory. The two questions relate the burden of singular and multiple risk factors and their interactions to household cost of treatment of diarrheal diseases. My study builds upon the MEME model/theory by establishing how singular and multiple risk factors and their interactions influence the household cost of treatment of diarrheal diseases among children under age 5.

The model was useful in explaining the singular and multiple risk factors of WASH, socioeconomic status, and associated diarrheal disease prevalence and household cost of treatment from an environmental and health perspective. The model helped in relating social, demographic, environmental and economic factors to the economic burden of diarrheal diseases in Uganda. Overall, the model provided a theoretical framework for this study. It further informed the formulation of study recommendations that will guide future actions/interventions in improving children's environment, health and the broader policy factors that affect their well-being.

Access to WASH

A case study by Abalo (2016), on sanitation and hygiene practices in Uganda in three host villages of the CLTS program confirmed the magnitude of the problem identified in this current study. Abalo (2016), revealed that Uganda lacks basic sanitation facilities and practices leading to infections which translate into high cost of healthcare. Abalo, further revealed that Uganda's stagnation in improving water and sanitation conditions is strongly attributed to limited political prioritization of the sector and limited translation of policy into practice. Using the positive deviance approach as a conceptual framework, Abalo, revealed that communities implementing the CLTS program were able to realize significant household sanitation improvements. Abalo, also revealed that the high costs of treating sanitation diseases among households as well as other social factors were important in motivating households to practice better sanitation. Abalo, recommended further studies of such factors and targeting them for future interventions to improve sanitation in similar households (Abalo, 2016). The study was qualitative, covering a small sample and did not focus on establishing the economic burden and or benefits of improved sanitation. In this present study, I addressed this gap and provided a nationally representative picture of the problem to better inform the politicians to improve their policy and financial decisions on sanitation and hygiene in the Country. In this study, I also employed a different theoretical perspective.

A cross-sectional study was carried out in Nigeria to establish if the risk of death among children under age 5 as a result of lack of access to improved water and sanitation

conditions was higher compared to their counter parts with access in the entire country (Ezeh, Agho, Dibley, Hall, & Page, 2014). Ezeh et al. revealed that all children under age 5 with no access to water and sanitation were at a significantly higher risk of death due to both predictors but higher among the post-neonates. In my study, I included hygiene and socioeconomic factors as predictors and analyzed the economic burden of associated diarrheal diseases.

Mishra et al. (2017), in their global study on sanitation for all revealed that about 2.4 billion people are not able to access adequate sanitation. In addition, 950 million people mainly in low and middle-income countries do not have access to any sanitation facility (Mishra et al., 2017). In their study, Mishra et al. revealed that for a period of 25 years, sanitation coverage only increased from 54% in 1990 to 68% in 2015. The situation was even worse in less developed countries like Uganda, where the coverage increased from 20% to only 38% in the same period (Mishra et al., 2017). The study was qualitative focusing on theoretical perspectives. Mishra et al recommended more studies that can quantify health and economic effects to guide policies for realizing the goal of sanitation. In my study, I addressed this knowledge gap, by employing quantitative methods and quantifying the economic costs of diarrheal diseases.

Another study on the effects of sanitation on child health across countries, using a generalized additive model panel analysis of global data on child mortality and malnutrition, confirmed the importance of good sanitation (Hunter & Pruss-Ustun, 2016). The findings indicated that sanitation coverage strongly impacts on under-5 child health

and that the most health gains would be attained if sanitation coverage increased to over 80% of the population (Hunter & Pruss-Ustun, 2016). The results further indicated that an increase of sanitation coverage to about 70% lead to a 60% reduction in diarrheal mortality among children under age 5 and 80% among neonates (Hunter & Pruss-Ustun, 2016). Hunter and Pruss-Ustun, revealed a less strong association of sanitation coverage with stunting and underweight among the same age groups. The researchers recommended further studies on the beneficial impact of sanitation on child health using community coverage as the primary predictor variable instead of personal access to improved sanitation. Hunter and Pruss-Ustun, concluded that most health gains would be attained if sanitation coverage increased. The researchers did not establish the economic gains that would be made if sanitation coverage improved. In addition, the study covered several countries, thus not making it country specific. This knowledge gap was addressed in my study, through establishing the economic cost of diarrhea to households and focusing on a specific country.

A cross-sectional study was carried out to assess the implementation of a community-led total sanitation and hygiene (CLTSH) program in Ethiopia (Tessema, 2017). The study findings indicated that after program implementation, 66% of the respondents had knowledge of CLTSH, 89% had a latrine of which 78% were constructed after the introduction of the program (Tessema, 2017). In addition, only 11% reported to practice open defecation and only 15% reported to have suffered a diarrheal disease (Tessema, 2017). Overall, the program increased latrine ownership and decreased

open defecation. Tessema, did not quantify the economic losses associated with poor WASH conditions and the corresponding benefits at both household and health system levels. In this study, I attempted to address this knowledge gap.

A report on the status of water and sanitation in health facilities in 54 low middle-income countries compounded the problem of poor WASH (WHO & UNICEF, 2015). The report indicated that out of the 66,000 health facilities where data was collected, 40% did not have readily available water, more than one third did not have soap for hand washing and a fifth lacked toilets (WHO & UNICEF, 2015). Health facilities are expected to be role models as regards to health practices. This finding compounds the magnitude of the problem. The report did not include the economic burden associated with poor WASH at the health facilities, a knowledge gap that I addressed in this study.

Burden of Diarrheal Diseases

Nuwaha et al. (2011) conducted a study to establish the factors responsible for the increase in under-five mortality rate in Uganda for the period 1995-2000 using a comparative retrospective design. The researchers revealed no significant statistical relationships between under- five mortality and poverty, maternal conditions, level of nutrition, access to health and other social services (Nuwaha et al., 2011). Further studies to explain the increase in under-five mortality rate were suggested. In this study, I further investigated this problem with specific reference to WASH and socioeconomic predictors.

In a water and sanitation focused quasi-experimental (non-randomized) study involving 176 children below two years in an urban slum in India, Sarker et al. (2013), recorded a total of 3932 episodes of illness in two years. This translated into 12.5 illnesses per child or three months of illness in a year (Sarker et al., 2013). The researchers further revealed that respiratory and diarrheal diseases were the major causes of morbidity and mortality among the study children, resulting in 87% of all childhood morbidities (Sarker et al., 2013). About 70.9% of the morbidities were recorded to have resulted in healthcare visits either in a clinic or a hospital outpatient unit (Sarker et al., 2013). Of these visits, 87.8% and 52.9% were respiratory and gastrointestinal illnesses respectively (Sarker et al., 2013). While Sarker et al. demonstrated the impact of frequent episodes of illness on children's health and development and established health system contacts, they did not establish the associated economic burden. The study also focused on only children under two years, in an urban slum area, leaving out children between two and five years and other children in non-urban slum areas, who are also at high risk of poor WASH conditions. In this present study, I covered the entire demographic group of children under age 5 across rural and urban areas in a nationally representative sample. I also attempted to establish the economic burden of diarrheal diseases by analyzing household cost of treatment of diarrhea.

A study on the burden of disease worldwide indicated that diarrheal and nutritional diseases are among the top ten causes of disease burden (Michaud, Murray, & Bloom, 2001). The study findings indicated that malnutrition accounted for 6 million

deaths and the combined effects of poor water supply, sanitation and personal hygiene accounted for 2.6 million deaths in 1990 (Michaud et al., 2001). The researchers suggested further research to improve allocative and technical efficiency of health systems in order to reduce the major causes of burden of disease. Although the study is old, earlier evidence presented in this dissertation indicated that the magnitude of the problem remains big even after a long period of time, making the problem justified and relevant for both scholarly work and practice.

Another study to determine the prevalence and factors associated with diarrhea in children under age 5 in rural Burundi indicated that diarrhea prevalence remains a big problem (Diouf, Tabatabail, Rudolph, & Marx, 2014). Using a sample of 903 children, Diouf et al. revealed that diarrhea prevalence was 32.6%, 46% of households collected drinking water from improved water sources and only 3% had access to improved sanitation. Lower prevalence of diarrhea was associated with access to hygiene education, use of boiled water and higher age groups (Diouf et al., 2014). The study design was a cross-sectional survey, focusing on children under age 5. Variables of study included; socio-demographic characteristics, diarrhea period prevalence and treatment, behavior and knowledge, socio-economic indicators, access to water, water chain and sanitation and personal/children's hygiene (Diouf et al., 2014). In this study, I employed the MEME model to further analyze the multiple factors that affect the prevalence of diarrhea among children. I also attempted to establish the economic burden of diarrhea by findings out the treatment costs associated with diarrheal diseases.

A retrospective study on the burden of disease from inadequate WASH in 145 low-and middle-income countries confirmed the burden of diarrheal diseases (Pruss-Ustun et al., 2014). The researchers revealed that in 2011, about 768 million people did not have access to improved water sources, 2.5 billion lacked access to an improved sanitation facility and about 80% of the population worldwide were affected by inadequate hand hygiene practices (Pruss-Ustun et al., 2014). The study confirmed the importance of improving WASH in such settings. Pruss-Ustun et al. estimated the impact of WASH on diarrhea and attributable deaths and disability. Using comparative risk assessment methods to estimate the burden of diarrhea, the researchers revealed that about 842,000 diarrhea deaths in 2012 were caused by risk factors associated with poor WASH conditions (Pruss-Ustun et al, 2014). Of these, 502,000 were caused by inadequate drinking water, 280,000 by inadequate sanitation and 297,000 by inadequate hand hygiene (Pruss-Ustun et al, 2014). All these put together accounted for 58% of total diarrheal diseases in the 145 countries studied (Pruss-Ustun et al, 2014). The study findings also indicated that about 361,000 deaths among children under- five years could be prevented if interventions were put in place to reduce the WASH risk factors (Pruss-Ustun et al., 2014). In addition, the findings showed that improving access to quality water would result into a significant reduction in diarrhea by an effect size of about 32% (Pruss-Ustun et al., 2014). Access to an improved sanitation facility and promotion of hand washing with soap would result in a 28% and 23% effect size reduction in diarrhea morbidity respectively (Pruss-Ustun et al., 2014). In addition, the study indicated that

improved WASH significantly reduces under-nutrition-a major cause of mortality among children aged under-5 (Pruss-Ustun et al., 2014). The study was strong in establishing the burden of diarrhea diseases attributed to the three risk factors of inadequate WASH and how much diarrheal disease could be prevented through improved conditions. The researchers, however, did not establish the economic burden of diarrheal diseases or the savings that would result from improved interventions. In this study, I contributed to filling this knowledge gap by assessing the cost of treatment of diarrhea among Ugandan households.

Economic Burden of Diarrheal Diseases

Matovu, Nanyiti & Rutebemberwa (2014) conducted a study to assess the rural-urban differences in direct and indirect costs of seeking care from formal health facilities compared to Community Medicine Distributors (CMD) in Uganda. They studied 282 caregivers (159 rural and 123 urban) of children under age 5 who had received treatment for fever-related illnesses at selected health centers in Iganga and Mayuge Districts. Matovu et al. (2014), also collected data from a total of 470 caregivers (304 rural and 166 urban) on household level direct and indirect costs of seeking care from CMDs. The researchers then compared costs incurred at health facilities with costs of seeking care from CMDs. Matovu et al. revealed that 59% (166/282) of the caregivers at health centers and 9% (42/470) from CMD incurred costs while seeking care and these were significantly greater for households in urban areas ($p < 0.0001$). Drugs at health facilities were free at least for children under age 5. However, some caregivers reported not

receiving some drugs prescribed by the health worker and therefore would have to buy them from drug shops and pharmacies (Matovu et al., 2014). Other categories of treatment-related costs comprised mostly expenditure on soft drinks at UGX.200 (US$0.09), snacks and mineral water bought during the visit, and an exercise book for recording the prescription by the health worker (Matovu et al., 2014). Thus, use of CMD especially for rural caregivers significantly reduces the household costs of seeking care (Matovu et al., 2014). These findings informed my study in terms of understanding the influence of residence type (rural, urban) on healthcare seeking and associated cost implications. In my study, I built upon these findings by analyzing the influence of type of residence on WASH and its consequent effect on diarrheal prevalence and cost of treatment. The present study also used secondary data and covered a nationally representative sample.

A study to establish the economic costs of malaria in children under age5 in three sub-Saharan countries of Ghana, Tanzania and Kenya indicated that malaria exerts a significant economic burden on the country's health systems and households (Sicuri, Vieta, Lindner, Constenla & Sauboin, 2013). The study was aimed at estimating "(a) the costs of treatment per malaria episode by severity and presence of co-morbidities and clinical complications; (b) the expected treatment cost per episode per child; and (c) the annual economic costs of malaria, including both prevention and treatment costs." (Sicuri et al., 2013, p.2). The study methods included use of previously estimated costs from other studies that generated primary data from health facilities, use of key informant

interviews with health/clinical experts to establish standards of care and associated costs, household surveys to generate data on household costs and use of international drug supplier prices to establish the cost of drugs (Sicuri et al., 2013). Several models were used to estimate the expected treatment cost for each episode per child and by level of severity of the illness (Sicuri et al., 2013). The findings indicated that the combined household and health system costs for each malaria episode costed differently in each country, ranging from US $ 5 for non-complicated malaria to US $ 288 for a complicated malaria case (Sicuri et al., 2013). The results also indicated that households in the three countries bear the greatest burden for malaria treatment ranging from 55% to 70% of the total cost of care (Sicuri et al., 2013). The treatment costs per episode and the total annual costs also differed per country ranging from a minimum of US $ 1.29 to US $22.9 and US $ 37.8 to US $ 131.9 respectively (Sicuri et al., 2013). The researchers concluded that their study findings provide policy makers with relevant economic evidence of the burden of malaria which can be used to guide the design of preventive measures and improve current control strategies and interventions. In my study, I used similar methods to analyze the household cost of treatment of diarrheal diseases among the study population.

In a study to establish the monetary cost of diarrhea diseases to households in an urban slum area in India, Patel et al. (2013), revealed that each household lost about 409 rupees due to diarrheal illness. The total loss for the study community was estimated at 163,600 rupees, an equivalent of US Dollars 3,635 (Patel et al., 2013). The researchers undertook a two-stage cohort study, starting with a random survey of all households to

establish the socioeconomic conditions, including the water and sanitation status of the household (Patel et al., 2013). This was followed by a systematic longitudinal survey of all households affected by diarrhea diseases in a period of five weeks. Patel et al. revealed that the cost of diarrhea diseases is too high to ignore and justifies the need for investment in improved water and sanitation facilities. While diarrhea affects children aged under 5 most, the study covered all demographic groups in the household. In my study, I built on the methods and findings of this study by isolating the economic burden of diarrheal diseases among children aged under 5 in Uganda.

Another study in the United States of America (USA) aimed at evaluating the potential economic impacts of a set of preventive interventions for obesity both in child and adult populations on national healthcare expenditure and use of health services (Cecchini & Sassi, 2015). The study findings indicated that preventive interventions led to healthcare cost reductions of about USD 2 billion in one year, especially arising from savings in inpatient care and drugs (Cecchini & Sassi, 2015). The preventive interventions included; education, counseling, long-term drug treatment regulation and fiscal measures (Cecchini & Sassi, 2015). This present study benefited from the measures and analyses used to establish the healthcare costs for inpatient and outpatient treatment, as well as costs of medicines.

Burke et al. (2014) conducted a study on the economic burden of pediatric gastroenteritis to Bolivian families using a cross-sectional study of correlates of catastrophic cost and overall cost burden from 2007 to 2009. Burke et al. interviewed

1107 caregivers of pediatric patients (<5years old) seeking treatment for diarrhea in six Bolivian hospitals. The results indicated that hospital type, treatment behavior, and appointment type were significant predictors of overall cost burden and catastrophic cost associated with pediatric diarrhea episodes in Bolivia (Burke et al., 2014). The researchers revealed that outpatient status, seeking care at a private hospital, having previously sought treatment for a diarrheal episode and the number of days the child had diarrhea prior to the current visit were significant predictors of catastrophic costs (Burke et al., 2014). They recommended further research to understand why parents incur treatment costs despite accessing public hospitals and why some chose private over public facilities (Burke et al., 2014). The predictors of cost established in the study were used to inform the present study using the MEME model.

Loganathan et al. (2016) conducted a study in Malaysia on health service utilization and household expenditure related to rotavirus gastroenteritis using national income quintiles obtained from local data sources. Using a static model, multiple birth cohorts were distributed into income quintiles and followed from birth over the first 5 years of life in a multi-cohort (Loganathan et al., 2016). Data was got from the National Health and Morbidity Survey (NHMS) of 2011 for out of pocket healthcare expenditure and utilization patterns for inpatient and outpatient care at public and private health facilities in Malaysia (Loganathan et al., 2016). The researchers revealed that direct costs paid out of pocket for rotavirus resulted in catastrophic expenditure among all income groups and impoverishment among the poorest two quintiles (Loganathan et al., 2016).

Also, 43% of the rich used more expensive private care thus spending more than 10% of their household income on treatment of illnesses, although none were impoverished (Loganathan et al., 2016). However, the poorest 7% who sought private care were impoverished (Loganathan et al., 2016). In this study, I built on the study findings by assessing the household cost of treatment of diarrheal diseases in both public and private health facilities across household socioeconomic status.

Moench-Pfanner et al. (2016), conducted a study to assess the economic burden of malnutrition in pregnant women and children aged under 5 in Cambodia. The researchers adopted a consequence model to apply the coefficient risk-deficit to develop a national estimate of the value of economic losses due to malnutrition (Moench-Pfanner et al., 2016). The results indicated that malnutrition costed the Cambodian economy an estimate of 266 million USD annually, an equivalent of 1.7% of GDP (Moench-Pfanner et al., 2016). Stunting was reducing the Cambodian economic output by more than 120 million USD and iodine deficiency disorders alone by 57 million USD (Moench-Pfanner et al., 2016). The researchers recommended that the government should expand a range of low-cost effective nutrition interventions to break the current cycle of increased mortality, poor health and ultimately lower work performance, productivity, and earnings (Moench-Pfanner et al., 2016). This present study built on the study by assessing the economic costs associated with treatment of diarrheal diseases among children aged under 5 in Uganda.

Menon, McDonald and Chakrabarti (2016), conducted a study estimating national and subnational costs of delivering recommended nutrition specific interventions using the Scaling Up Nutrition (SUN) costing approach. The researchers compared costs of delivering the SUN interventions at 100% scale with those of nationally recommended interventions for target populations (Menon et al., 2016). Using national population and nutrition data, the cost of delivering an intervention at 100% coverage was calculated (Menon et al., 2016). The results showed that cost estimates for SUN interventions were lower than estimates for nationally recommended interventions because of differences in choice of intervention, target group and unit cost (Menon et al., 2016). Cash transfers (49%) and food supplements (40%) contributed most to costs of nationally recommended interventions, while food supplements to prevent and treat malnutrition contributed most to the SUN costs (Menon et al., 2016). Further costing studies on the true unit costs for nutrition specific interventions in different local contexts were recommended. The study informed the current study discussion of findings and recommendations, specifically on cost effective interventions for reducing both the health and economic burden of diarrhea.

Gargano et al. (2015), conducted a cost-effectiveness analysis comparing outcomes of no vaccine; and two-dose rotavirus SIA and two-dose of RI for the 424,592 births in the 2012 Somali cohort. Gargano et al. developed disease-specific decision-tree models for diarrhea and rotavirus incidence; vaccine coverage, effectiveness, and cost (administrative and price of vaccine); medical care service costs and proportion utilizing services; and mortality rate. The study did not cover direct non-medical costs such as

transportation costs or indirect costs such as time lost to parents (Gargano et al., 2015). The findings showed that the introduction of a full series of rotavirus RI and SIA would save 908 and 359 lives respectively and consequently save US$63,793 and US$25,246 in direct medical costs respectively (Gargano et al., 2015). The cost of an RI strategy was US$309,458 and that of an SIA strategy was higher at US$715,713 due to high operational costs (Gargano et al., 2015). The results further indicated that US$5.30 was spent per DALY averted for RI and US$37.62 per DALY averted for SIA (Gargano et al., 2015). The Variables that most substantially influenced the cost-effectiveness for both RI and SIA were vaccine program costs, mortality rate, and vaccine effectiveness against death (Gargano et al., 2015). In my study, I built on the findings of the study by assessing the household treatment costs for diarrhea among children aged under 5 in Uganda. These costs could also be saved if children in these households were immunized using rotavirus.

Socio-economic Predictors of Diarrheal Diseases and Cost

A study by Muhoozi et.al. (2016), on nutritional and developmental status among 6- to 8-month-old children in South Western Uganda indicated that there are multiple predictors of under-nutrition. Muhoozi et.al. used a cross-sectional study method with a sample of 512 households and the results of the regression analysis indicated that gender, sanitation, child dietary diversity and poverty were predictors of under-nutrition ($p<0.05$). The researchers expressed a challenge in fitting good models to explain the outcomes due to a complex network of variables affecting the outcomes. They recommended multi-intervention programs addressing dietary diversity, food hygiene, infant feeding and care

practices to improve infant and child growth and development (Muhoozi et.al 2016). In my study, I used the MEME model, contributing to filling the knowledge gap of a theoretical framework that best explains how the complex network of variables affect nutrition outcomes of children aged under 5 in Uganda.

Mukunya et.al. (2014), in their community based cross-sectional study with a sample of 442 caretaker-child pairs in Gulu district-Uganda, further revealed multiple variables affecting under-nutrition The study was aimed at determining the level of knowledge and practices of C-IMCI among caretakers and its association with under-nutrition in children between 6 and 60 months (Mukunya et.al, 2014). The researchers assessed the four practices of breastfeeding, immunization, micronutrient supplementation and complementary feeding as predictors of child under-nutrition (Mukunya et.al, 2014). Using a logistic regression analysis reporting Odds Ratios (OR) with 95% confidence intervals (CI) to explore associations, the results indicated a low level of overall knowledge of the C-IMCI at 13.3% (n = 59) (Mukunya et.al, 2014). This was attributed to low level of education in the northern region, with attendance at 51% in primary schools as compared to the national average at 81% (Mukunya et.al, 2014). The post war effects in the study area could also explain the low knowledge levels. Mukunya et.al. recommended further health interventions to reduce the knowledge gap. The MEME model used in the current study will be useful in exploring appropriate interventions and thus contributing to filling the knowledge gap in the study.

Studies Applying Constructs of the MEME Model/Framework

A study aimed to establish the individual and combined effects of water quality, sanitation, hand washing and nutrition interventions on diarrhea and growth among infants and young children applied the MEME constructs (Arnold et al., 2013). The study design was two cluster- randomized trials on pregnant women in two countries- Kenya and Bangladesh. Both primary (child length for age and reported diarrhea) and secondary (stunting and developmental scores) outcomes were measured (Arnold et al., 2013). This present study used similar constructs in addition to socioeconomic variables, guided by the MEME model.

A study by Fierstein (2017), indicated that millions of cases of infectious diarrhea in children under age 5 have been documented to be mainly caused by lack of safe WASH. Fierstein, revealed that increased risk of infections leads to impaired immunity and disruption of food and nutrient absorption pathways. This consequently leads to malnutrition, inflammation and ultimately stunted growth (Fierstein, 2017). The researcher also revealed that malnutrition weakens the immune system increasing the risk of infections (Fierstein, 2017). The evidence further indicates that nearly 156 million children under age 5 from areas where inadequate WASH is widespread are stunted (Fierstein, 2017). In my study, I built on this literature by using the MEME model to explain the effects of singular and multiple risk factors and their interactions, on children's health.

Fierstein (2017), established that there is no conclusive empirical evidence of the association between WASH and stunting, despite the existence of a solid theoretical framework underlying the relationship. The researcher documented that many WASH interventions for disease control do not include a dietary component (Fierstein, 2017). In addition, Fierstein, established that there is limited evidence on the synergistic relationships between the individual components of household WASH and child height. To fill this knowledge gap, Fierstein, undertook a study in Uganda, using the 2011 UDHS. The results of multiple linear regressions adjusted for dietary intake of children under age 2 indicated existence of associations between WASH and child stunting (HAZ). Fierstein, revealed that "HAZ of children under age 5 was positively associated with the practice of household water treatment in rural households (HAZ: +0.25; 95% Confidence Interval [CI]: 0.02 to 0.50). In urban households, HAZ of children under age 5 was positively associated with the presence of a household hand washing station with soap and water (HAZ: 0.43; 95% CI: 0.02 to 0.8)." (Fierstein, 2017, p.90). The findings also indicated that improved sanitation of the neighboring households had a significant positive impact on the height of children who lived in households with unimproved sanitation infrastructure (Fierstein, 2017). The MEME model that guided this present study was used to further explore these relationships in Uganda.

Studies Related to Key Independent and Dependent Variables

Socioeconomic factors such as a child's mother's education level have been documented to predict child nutrition outcomes such as child height (Fierstein, 2017).

Educated mothers generally live in wealthier and healthier households making them better able to provide healthy and hygienic complementary foods for their children (Fierstein, 2017). They are also more likely to access and effectively apply child nutrition information (Fierstein, 2017). This present study expanded on this deduction, by assessing the relationships between children's access to WASH, socioeconomic status and household cost of treatment of diarrhea.

Studies in Burkina Faso and Bangladesh confirmed that increased access to WASH leads to reduction in stunting (Fierstein, 2017). In Burkina Faso, a panel study revealed that "children from one to five years of age from a contaminated household environment were 30% more likely to be stunted than children from a clean household environment (Prevalence ratio: 1.30; 95% Confidence interval: 1.07 to 1.58), as indicated by a water, sanitation, and hand washing index." (Fierstein, 2017, p. 11). Similar results were observed in Bangladesh. In this study, I expanded on these findings by focusing on child diarrhea in terms of prevalence and household cost.

Hirai, Roess and Graham (2016), in their study on exploring geographic distributions of high-risk WASH practices and their association with child diarrhea in Uganda, revealed a two-week prevalence of child diarrhea. The researchers carried out a hot spot analysis of a sample of 7,019 children from the 2011 UDHS to establish how high-risk WASH practices and child diarrhea are geographically clustered (Hirai et al., 2016). At the individual level, none of the high-risk WASH practices were significantly associated with child diarrhea (Hirai et al., 2016). Being in the highest WASH quintile

was however, significantly associated with 24.9% lower prevalence of child diarrhea compared to being in the lowest quintile (Hirai et al., 2016). The researchers recommended exploration of the potential utility of the WRI on WASH-induced burden (Hirai et al., 2016). However, the study did not focus on economic effects and or benefits of improved WASH on diarrhea. In this study, I attempted to address this gap.

Attia et al. (2016), investigated diarrhea, enteropathogens, and systemic and intestinal inflammation for their interrelation and their associations with mortality in children with Severe Acute Malnutrition (SAM). A sample of 79 children was drawn using a randomized clinical trial originally designed to compare the outcomes of three commonly used WHO rehabilitation diets (Attia et al., 2016). The three diets were isocaloric but varied in their composition of carbohydrate and fat ratios (Attia et al., 2016). The researchers revealed that more than 44% of the children harbored multiple intestinal pathogens, which may indicate colonization or active infection (Attia et al., 2016). The results also indicated a significant variability in pathogen prevalence among children with SAM, which may have been associated with regional differences, patient selection, sampling protocols, and analyses methods (Attia et al., 2016). On the contrary, Attia et al. did not find associations between the presence of pathogens and diarrhea. In this study, I expanded the focus and findings of the study by assessing the economic impact of diarrhea on households in Uganda and how the socioeconomic and WASH variables influence diarrhea cost.

Grenov et al. (2017), conducted a study to assess the effect of probiotics treatment on diarrhea among in-patient and out-patient children with severe acute malnutrition. In a randomized, double-blind, placebo-controlled design involving 400 children admitted with SAM, patients received a one-day doze of a blend of Bifidobacterium, animalis, subsp lactis and lactobacillus rhamnosus or placebo during hospitalization, followed by an 8 to 12-week outpatient treatment period depending on the patient's recovery rate (Grenov et al., 2017). All the outcomes were reported for in-patient and out-patient treatment separately. The primary outcome was number of days with diarrhea during hospitalization and the secondary outcomes were other diarrhea outcomes-pneumonia, weight gain and recovery (Grenov et al., 2017). The researchers revealed that Bifidobacterium, animalis, subsp lactis and lactobacillus rhamnosus had no effect on diarrhea in children with SAM during hospitalization but reduced the number of days with diarrhea in-outpatient treatment by 26% (Grenov et al., 2017). Further studies were recommended to confirm whether probiotics have a role in the follow up of hospitalized children with SAM or in community-based treatment of malnourished children. In this study, I expanded these findings by assessing the cost of treatment of diarrhea to households in Uganda.

Summary and Conclusions

The major themes in the literature review are: Access to WASH; burden of diarrheal diseases; socioeconomic predictors of access, disease burden and economic cost

of care; studies applying constructs of the MEME model/framework and studies related to key independent, dependent, mediating and confounding variables.

The review revealed that access to improved WASH remains low globally and is lowest in Low- and Middle-Income Countries (LMIC) like Uganda. Consequently, the burden of diarrheal disease is high among children under age 5 globally and is highest among children in LMICT. The literature review further revealed that socioeconomic status of children determines levels of access to improved WASH and associated diarrheal illnesses. The review also establishes that the health-related burden (morbidity and mortality) of WASH diseases is widely known globally and in Uganda specifically. However, knowledge on socioeconomic status, WASH and their interactions on the influence of household cost of treatment of diarrheal diseases among children aged under 5 is limited with almost no current scholarly evidence in Uganda. Therefore, the present study focused on contributing to filling the identified knowledge gap of lack of scholarly evidence on this topic. To address this gap, this study employed a retrospective cross-sectional survey involving a nationally representative sample of children under age 5 in Uganda, as elaborated in the next chapter.

Chapter 3: Research Method

The purpose of this retrospective cross-sectional survey study was to assess the correlation between socioeconomic status, WASH, and household cost of treatment of diarrhea among children under the age of 5 in Uganda using the MEME model. I focused on children under the age of 5 across the country, which is the demographic group where the burden of disease due to poor sanitation, hygiene, and nutrition is the highest. The independent variables of the study were (a) socioeconomic status (education level of mother, household expenditure, and residence type) and (b) WASH (source of drinking water, type of toilet facility, presence of hand washing facility). The dependent variable of the study was household cost of treatment of diarrhea. The control variable of the study was place of treatment of diarrhea.

This chapter includes the research design and rationale, the methodology (target population and sample, sampling and sampling procedures, and archival data [recruitment, participation, and data collection associated with the main study and access to the data set]). It also includes the data analysis statistical methods used, threats to validity (internal, external, construct, statistical conclusion validity, and ethical procedures), and the chapter summary.

Research Design and Rationale

The key variables of this study included independent variables-- socioeconomic status (education level of parents, household expenditure, and residence type) and WASH (source of drinking water, type of toilet facility, presence of hand washing facility),

dependent variable--cost of diarrhea treatment, and control variable --place of treatment of diarrhea.

The research design was a retrospective cross-sectional survey. This was selected because of its ability to correlate the relationship between WASH, socioeconomic status, and household cost of treatment of diarrhea. The design facilitated the use of existing secondary data to establish associations between the study variables (see Campbell & Stanley, 1963) and linking present events to past events (see Walden University, 2010). It allowed me to use a large sample size, thus enabling generalization of findings and making inferences about certain characteristics of the study population (see Creswell, 2014). It also enabled me to save time and financial resources associated with collecting primary data (see Creswell, 2014).

Methodology

The study was quantitative, employing a correlational retrospective cross-sectional survey design using secondary data from the 2015/16 UNPS. This UNPS is the fifth wave of panel surveys in Uganda conducted by UBOS since 2009/10.

This survey collected data on various socioeconomic development indicators at individual, household, and community levels, of which key variables of interest to this study were captured. It was a nationally representative sample size and the data were collected in English (UBOS, 2016b).

Target Population

The study population was children aged under 5 sampled across the country. This is the demographic group where the burden of diseases due to poor sanitation, hygiene, and nutrition is the highest. In Uganda, this age group constitutes about 17.7% of Uganda's population, an equivalent of 6,089,600 million children (UBOS, 2016c).

Sampling and Sampling Procedures

During the 2015/16 UNPS, all the 112 districts in Uganda were covered, 3,300 households were sampled, and 19,246 individuals were interviewed. The sample was nationally representative of households. The target sample for the survey was all the core members of households, that is parents and biological children; however, the overall household sample data included all persons who live with these core members. The households were distributed over 322 enumeration areas (EAs), selected out of 783 EAs that had been visited during the UNHS in 2005/06. The distribution of the EAs covered by the 2015/16 UNPS included all 34 EAs in the Kampala District and 72 EAs (58 rural and 14 urban) in each of the other regions, that is . Central, excluding Kampala, and Eastern, Western, and Northern, which make up the strata. In Uganda, an EA is a geographic area that covers an average of 130 households.

The sampling frame contained information about EA location, type of residence (urban or rural), and the estimated number of residential households. Within each stratum, the EAs were selected with equal probability with implicit stratification by urban/rural and district (in this order). However, the probabilities of selection for the rural

portions of 10 districts that had been oversampled by the UNHS 2005/06 were adjusted accordingly. Because most internally displaced people camps in the Northern region were unoccupied at the time of the survey, the EAs that constituted internally displaced people camps were not part of the UNPS sample. This allocation allowed for reliable estimates at the national, rural-urban, and regional levels, that is at the level of strata representativeness including (a) Kampala City, (b) Other Urban Areas, (c) Central Rural, (d)Eastern Rural, (e) Western Rural, and (f) Northern Rural.

Guided by Cohen (1988), statistical power analysis for the behavioral science, a priori sample size calculator was used to determine the adequate sample size for this study. The effect size used was 0.35, desired statistical power was 0.8, number of variables was six, and the probability level was 0.05. The results yielded a minimum sample size of 46 for a multiple regression and a minimum sample size of 39 for a hierarchical multiple linear regression (see Cohen, 1988). Additionally, a post-hoc statistical power calculator for hierarchical multiple regression was used to determine the statistical power for a sample size of 71. The results indicated a 0.99 statistical power (see Cohen, 1988). Therefore, the sample size of 71 was adequate for this study. After eliminating the missing data, the remaining sample size used in the regression was 68. The results of the post-hoc statistical power calculator for hierarchical multiple linear regression yielded a power of 0.98 (see Cohen, 1988). Therefore, the sample size of 68 used for the regression model was adequate for the study.

Guided by Cohen's $f2 = r2 / (1 - r2)$ method for measuring the effect size for linear regression, an effect size of 0.35 is interpreted as the largest in measuring the strength of the relationship between two variables on a numeric scale (Warner, 2013). The 0.05 alpha level was selected in order to reduce a Type 1 error risk (Warner, 2013). In most behavioral and other sciences, results yielding a *p* value of 0.05 are considered on the border of statistical significance because the level gives only a 5%chance for rejecting the null hypothesis (Warner, 2013). A high statistical power of 0.98 was used because of the need for the sample size to produce accurate estimates and increase the probability of achieving statistically significant results.

Archival Data

In Uganda, panel surveys are conducted every financial year by the UBOS in cooperation with other government agencies, development partners, and nongovernmental organizations. The UBOS website provides comprehensive information on the collection, processing, analysis, and dissemination of panel surveys. To access the required data, permission was sought in writing from the authorities of the UBOS, and a data use agreement was signed to lay out the details of the data needed, the responsibilities of the data provider, and the obligations of the data user, including the boundaries of data use.

For the 2015/16 UNPS, UBOS, in collaboration with the local governments, other government agencies, and the World Bank, conducted the survey by collecting data from Ugandan households. The survey was carried out over a 12-month period (a wave) by

conducting two visits (about 6 months apart) for the purpose of accommodating the two agricultural seasons as well as households' consumption expenditure patterns. The respondents in each sampled household were the household head, spouse, and children over age 15. The questions for collecting data for children aged below 15 were answered by either the household head or the spouse.

The data collection procedure was centrally managed by employing nine mobile field teams and dispatching them to the various sampled areas (UBOS, 2016b). Each of the teams constituted of a supervisor, three enumerators, and a driver. One of the criteria used in recruiting and composing teams was the ability to communicate in the key languages used in the four main statistical regions of the country.

The data were collected using a structured questionnaire comprised of four separate modules (UBOS, 2016b). These are socioeconomic, agriculture, woman, and community. For purposes of this study, the socioeconomic module was the major focus of analysis. The module covered a wide range of variables on household background characteristics, such as education and literacy levels (UBOS, 2016b). It covered variables on the health status of household members, their health seeking behaviors, and variables on child nutrition and health. The module further captured information on the labor force status of household members, the housing conditions, household water and sanitation conditions, as well as energy use (UBOS, 2016b). It also included variables of household incomes and nonagricultural household enterprises, household assets, household

consumption expenditure, shocks and coping strategies, and welfare indicators (UBOS, 2016b).

The UBOS rigorously trained data personnel prior to the survey. Data collection, processing, and management was done using a computerized system (UBOS, 2016b). All the data collection was done by directly entering the respondent's information in a data entry application installed on the ultra-mobile personal computers (UBOS, 2016b).

To ensure data quality, the application was designed in such a manner that consistency checks are automatically done while still in the household. The team leaders then carried out additional system checks to ensure that the data entered were accurate and consistent. The data were then immediately electronically transmitted to the UBOS headquarters for verification. To avoid the challenges of power shortages and inaccessibility to the Internet that would interrupt the exercise, the field teams were provided with an internet modem, a generator, and extra ultra-mobile personal computer batteries (UBOS, 2016b).

The interviewers first sought consent from the participants before the start of the interviews. In the case of children under 15 years old, consent was sought from their parents/care takers who were the respondents for questions relating to children of that age group.

Operationalization of Variables

Independent Variables

Main source of water for drinking for household: This was defined as the main point of access of water for drinking for the household (UBOS, 2016b). According to UBOS (2016b), it was categorized into two (a) improved sources (piped water, public taps, standpipes, tube wells, boreholes, protected dug wells, springs, and rainwater), and (b) unimproved sources (a household water source that is not among the improved sources). It was measured as the respondent's household having access to an improved water source (UBOS, 2016b). The same variable and its two categories were used in the analysis.

Type of toilet facility mainly used in household: This was defined as the main toilet facility used in the household (UBOS, 2016b). It was categorized into three (a) improved toilet facility (one that has a flush system, a Ventilated Improved Pit (VIP) latrine, a covered with a slab pit latrine, a private with a slab pit latrine, a composting toilet [which separate solid waste from water] and an Ecosan), (b) unimproved toilet facility (any facility that is not improved including pit latrines without a slab or platform, hanging latrines or bucket latrines), and (c) no toilet facility (use of bushes, disposal in water bodies and waste areas) (UBOS, 2016b). It was measured as the respondent's household having access to an improved toilet facility (UBOS, 2016b). The same variable and its three categories were used in the analysis in this study.

Presence of a hand washing facility at the toilet: This was defined as the availability of a household hand washing facility at the toilet facility (UBOS, 2016b). It was measured by interviewers observing and recording the place where household members most often wash their hands after toilet use (UBOS, 2016b). The variable was categorized into three (a) no facility, (b) presence of facility with water only, and (c) presence of facility with water and soap (UBOS, 2016b). The same variable and its three categories were used in the analysis in this study.

Highest level of mother's education completed: Education level was defined in the survey as the highest formal education attainment of an individual (UBOS, 2016b). It was measured in many categories which are grouped into 7 main ones (a) never attended school, (b) completed primary, (c) completed secondary, (d) completed post-primary specialized training (certificate), (e) completed post-secondary specialized training (diploma), and (f) completed degree and above (UBOS, 2016b) .For the purpose of this study, the variables were further grouped into three main categories (a) no education, (b) primary education, and (c) secondary education.

Household expenditure: It was defined as the amount of household cash spent in shillings and or estimated cash value for in-kind expenditure in the past 12 months (UBOS, 2016b). It was grouped into consumption and non-consumption expenditure (UBOS, 2016b). In Uganda, household expenditure is used as a proxy for measuring household income. This study grouped this variable into five categories in line with the five wealth quintiles used to measure household income in the panel survey. These

categories were (a) high expenditure, (b) moderately high expenditure, (c) moderate expenditure, (d) moderately low expenditure, and (e) low expenditure (UBOS, 2016b). In my study, I used the same variable and its five categories.

Type of residence: Type of residence was defined as the geographical location of the household (UBOS, 2016b). It was categorized into two (a) urban and (b) rural (UBOS, 2016b). The same variable and its two categories were used in study.

Dependent Variable

Household cost of treatment of diarrhea: This was defined in the survey as the cost of consultation, including any medicine prescribed even if purchased elsewhere (UBOS, 2016b). The same variable was used in my study.

Control Variable

Place of treatment: This was defined in the survey as the place where treatment was sought (UBOS, 2016b). The places were categorized into nine main healthcare service providers (a) government hospital (b) government health center, (c) private hospital, (d) Pharmacy/ drug shop, (e) private doctor/ nurse/ midwife, (f) private outreach, (g) shop, (h) religious institution, (i) traditional healer (UBOS, 2016b). The same categories were used in my study.

Variable Categorization and Coding

The analysis included one outcome variable (household cost of treatment of diarrhea), which is a continuous variable and two main independent variables comprising of six sub-variables. The first main variable was socioeconomic status comprising of

three sub-variables (a) education level of household mother (coded, 0. no education, 1. primary, 2. secondary), (b) residence type (coded 0. rural, 1. urban), (c) household expenditure (coded, 5. high, 4. moderately high, 3. moderate, 2. moderately low, 1. low). The second main variable was household status of WASH comprising of three sub-variables (a) main source of water for drinking (coded, 1. improved source, 2. unimproved source), (b) type of toilet facility (coded, 1. improved, 2. unimproved, 3. no facility), (c) presence of hand washing facility at toilet (coded, 1. no, 2. yes with water only, 3. yes with water and soap).

Data Analysis

Statistical Software

All data analysis was carried out using the IBM SPSS statistical software of version 25.

Data Cleaning and Screening Procedures

The 2015/16 UNPS dataset contains all the variables of study that were included in the analysis. Data on the main variables and sub-variables were coded and entered into the SPSS data set. To check and ensure that there were no irregular entries, coding errors, missing data and outliers, frequency tables were produced.

Research Questions and Hypotheses

This study employed two research questions:

Research Question 1: What is the relationship between socioeconomic status (education level of parents, household expenditure, and type of residence) and household cost of treatment of diarrhea disease among children under the age of 5 in Uganda, controlling for place of treatment?

$H_0$1: There is no statistically significant relationship between socioeconomic status (education level of parents, household expenditure, and type of residence) and household cost of treatment of diarrhea disease among children under the age of 5 in Uganda, controlling for place of treatment.

H_a1: There is a statistically significant relationship between socioeconomic status (education level of parents, household expenditure and type of residence) and household cost of treatment of diarrhea disease among children under the age of 5 in Uganda, controlling for place of treatment.

Research Question 2: What is the relationship between WASH (source of drinking water, type of toilet facility, presence of hand washing facility), and household cost of treatment of diarrhea disease among children under the age of 5 in Uganda, controlling for place of treatment?

$H_0$2: There is no statistically significant relationship between WASH (source of drinking water, type of toilet facility, presence of hand washing facility), and household

cost of treatment of diarrhea disease among children under the age of 5 in Uganda, controlling for treatment.

H_a2: There is a statistically significant relationship between WASH (source of drinking water, type of toilet facility, presence of hand washing facility), and household cost of treatment of diarrhea disease among children under the age of 5 in Uganda, controlling for treatment.

Statistical Analysis

Statistical Tests

The statistical tests included both descriptive statistics and inferential analysis.

Descriptive Statistics

Descriptive statistics covered the entire scope of WASH and socioeconomic status variables, as well as demographic characteristics of both participants and the study population. It also indicated the percentages of children with and without diarrheal diseases.

Inferential Analysis

The inferential statistical analysis included; bivariate ANOVA and multiple linear regression analyses to answer the two research questions and test the corresponding hypotheses based on a sample of 71 households who met the inclusion criteria. The first test was the bivariate analysis using ANOVA which focused on establishing the association between the independent variables and the dependent variable. The second step was a hierarchical multiple linear regression test to establish if the six independent

variables significantly predicted the outcome variable at a *p*-value < .05. The effect of the control variable on the outcome variable was also tested.

This test allows the investigation of the effect of two or more categorical predictor variables on one continuous quantitative variable (Warner, 2013). The test further allows for examination of the interaction effects of variables (Warner, 2013). It also allows for controlling of confounding variables (Warner, 2013). In addition, the test assumes that the dependent variable is quantitative and almost normally distributed. It also assumes that the scores across variables are independence (Warner, 2013).

Interpretation of Results

The results of the various statistical tests were interpreted as confidence intervals; which indicate the interval within which a population parameter is likely to be found. First, the intervals for each hypothesis were determined by the sample data and a fixed 95% confidence level-translating into a 0.05 level of significance α. The smaller the α, the higher the standard for rejecting the null hypothesis. Second, an observed significance level (*p*-value) was computed using the sample data, then the appropriate probability distribution was used to find the probability of observing a sample statistic that differs at least that much from the null hypothesis value for the population parameter.

The smaller the *p*-value, the better the evidence against the null hypothesis (Warner, 2013). Since the *p*-value also represents the smallest significance level α at which H_0 can be rejected, the *p*-value results were used with a fixed significance level by rejecting the level of statistical significance H_0 if *p*-value $\leq \alpha$.

Specifically, the test of statistical significance for the first null hypothesis was interpreted as the observed significance levels of the main effects of singular socioeconomic factors of education level of parents, household expenditure and type of residence, and their interaction effects on household cost of treatment of diarrhea (Warner, 2013). The F ratios were computed to compare Mean Square (MS) between variable categories (i.e improved and unimproved toilet facility) with the MS that summarized the amount of variability of scores within variables (Warner, 2013). Were the MS between were far apart relative to the within-variables variability in score, the conclusion was no statistically significant relationship (Warner, 2013).

The test of statistical significance for the second null hypothesis followed the same procedure as the first one. The singular effects of WASH variables and their interaction effects on household cost of treatment of diarrhea were computed.

Treats to Validity

External Validity

According to Creswell (2014), external validity threats occur when the sample findings are generalized, or incorrect inferences of the sample data are made to other persons, settings and future situations that may not have similar characteristics with the sampled groups and locations. The key external threats to validity are (a) interaction of selection and treatment, (b) interaction of setting and treatment, and (c) interaction of history and treatment (Creswell, 2014). To minimize the threats, the 2015/16 UNPS primary data collection procedures were statistically correct to enable generalization of

findings (UBOS, 2016b). The procedure enabled national and regional representation of the survey sample (UBOS, 2016b). The researchers ensured that the number of households surveyed in each region contributed to the size of the total (national) sample in proportion to size of the region (UBOS, 2016b). In addition, threats to validity were minimized by ensuring that the data was collected and verified by different stakeholders at various levels. The Uganda Bureau of Statistics coordinated, implemented and monitored the entire survey process (UBOS, 2016b). At the field level, external validity threats were minimized by employing trained supervisors, team leaders, interviewers, and reserve interviewers (UBOS, 2016b). The present study further addressed the threats to external validity by generalizing the findings only to similar population groups and settings.

Internal Validity

Creswell (2014), defines internal validity threats as "experimental procedures, treatments, or experiences of the participants that threaten the researcher's ability to draw correct inferences from the data about the population in an experiment." (p. 174). The types of threats to internal validity include history, maturation, regression, selection, mortality, diffusion of treatment, compensatory/demoralization, compensatory rivalry, testing, and instrumentation (Creswell, 2014). Threats to internal validity were limited by employing a cross-sectional survey design with no experiments thus avoiding majority of the threats mentioned above. The use of secondary data also limited the threats related to instrumentation. In addition, the 2015/16 UNPS used the same instrument for pre-testing

and the actual survey thus limiting threats to instrumentation (see UBOS, 2016b). The sampling design also ensured random selection of participants, allowing for probability of equal distribution of characteristics across the sample thus, limiting threats to selection (UBOS, 2016b).

Construct Validity

Threats to construct validity occur when study variable definitions and measures are inadequate (Creswell, 2014). In the 2015/16 UNPS, the standard definitions and measures of the study variables that include source of drinking water, type of toilet facility, presence of hand washing with soap, education level, expenditure level, type of residence, and cost of treatment of diarrhea were maintained as per WHO, National and World Bank definitions (see UBOS, 2016b). This present study maintained the same definitions and measures.

Statistical Conclusion Validity

The threats to statistical conclusion validity arise when inaccurate inferences are made from the sample data because the statistical power was inadequate and the key statistical assumptions were violated (Creswell, 2014). To address this threat, a computed statistical power of 0.98 for hierarchical multiple linear regression was attained on a sample size of 68 cases after excluding missing variables. The researcher also ensured that the statistical tests met the key theorized assumptions of multiple linear regression.

Ethical Procedures

In the entire research process, the key ethical considerations were protection of participants' rights and data protection.

- Protection of Participants' Rights. The first step in protecting the participant's rights was to enhance my skills and knowledge in conducting research on human subjects. To achieve this, I read available literature and took a web-based training of the National Institutes of Health (NIH) Office of Extramural Research. I also used secondary data from the 2015/16 UNPS making me not to directly interact with the study participants. In addition, when requesting for data from the UBOS, I limited my-self to only the variables of interest to this study, thus minimizing the inclusion of personal identifiers of the survey participants. In the 2015/16 UNPS, the UBOS also ensured protection of participant's rights by seeking their consent to answer questions. The objectives of the survey and specifically the tests were clearly stated to the participants before their responses (see UBOS, 2016b). The data collectors also informed the participants that their responses were to be kept strictly confidential and not be shared with anyone other than members of the survey team (see UBOS, 2016b). Approval of my research proposal was also sought from the Walden University Institutional Review Board (IRB) to ensure that the study fully met the required ethical standards. The IRB approval number is 10-19-18-0480732.

- Data Protection. The first step was to seek permission and request for the required data from the UBOS. A Written request clearly indicating the general objective of the study and the specific data requirements was delivered in person to the UBOS. A verbal explanation was also provided in addition to the written communication. After accessing the data, it was safely stored in a password protected computer and a flush disc backup. For only purposes of the research process, the dataset will be kept for not more than 5 years after the end of the study and after that it will be appropriately destroyed. The findings of the study were also presented in such a manner that they protected the privacy of the participants. Were possible, the findings of this study will be disseminated to UBOS and other stakeholders at national and international levels. Possibilities of publishing the study in peer-reviewed journals will also be explored.

Summary

The study was quantitative employing a retrospective cross-sectional survey design to assess the correlation between the independent and dependent variables, using the MEME model. I used secondary data collected by UBOs during the 2015/16 UNPS. The study population was children aged under 5 in Uganda. The study was approved by Walden University IRB to ensure its validity, including meeting the necessary ethical standards.

The main independent variables were socioeconomic status and WASH, which were investigated for their singular and multiple interactive effects on one dependent

variable- household cost of treatment of diarrhea. The control variable was place of treatment.

The sample included all the 3300 households and 19,246 individuals that participated in the survey. Data analysis was done using the IBM SPSS Statistical software version 25. The analysis included both descriptive and inferential analyses. Inferential statistics included both bivariate and multiple linear regression analyses to answer the two research questions and test the corresponding hypotheses based on a sample size of 71(bivariate analysis) and 68 (regression analysis) households who met the inclusion criteria.

Chapter 4: Results

Introduction

The purpose of this retrospective cross-sectional survey study was to assess the correlation between socioeconomic status, WASH, and household cost of treatment of diarrheal diseases among children under the age of 5 in Uganda using the MEME model. The study participants included 19,246 individuals in 3,300 households who participated in the 2015/16 UNPS. The statistical software used to answer the questions and test the hypotheses was IBM SPSS Statistics Version 25. The research questions and hypotheses are listed below.

RQ1: What is the relationship between socioeconomic status (education level of household mother, household expenditure, and type of residence) and household cost of treatment of diarrhea disease among children under the age of 5 in Uganda, controlling for place of treatment?

$H_0$1: There is no statistically significant relationship between socioeconomic status (education level of household mother, household expenditure, and type of residence) and household cost of treatment of diarrhea disease among children under the age of 5 in Uganda, controlling for place of treatment.

H_a1: There is a statistically significant relationship between socioeconomic status (education level of household mother, household expenditure, and type of residence) and household cost of treatment of diarrhea disease among children under the age of 5 in Uganda, controlling for place of treatment.

RQ2: What is the relationship between WASH (source of drinking water, type of toilet facility, presence of hand washing facility) and household cost of treatment of diarrhea disease among children under the age of 5 in Uganda, controlling for place of treatment?

$H_0$2: There is no statistically significant relationship between WASH (source of drinking water, type of toilet facility, presence of hand washing facility) and household cost of treatment of diarrhea disease among children under the age of 5 in Uganda, controlling for place of treatment.

H_a2: There is a statistically significant relationship between WASH (source of drinking water, type of toilet facility, presence of hand washing facility) and household cost of treatment of diarrhea disease among children under the age of 5 in Uganda, controlling for place of treatment.

In this chapter, I present a review of the purpose of study, the research questions and hypotheses, and the data collection procedures. I also present the data analysis procedures, the results, and conclusions.

Data Collection

The data set for the 2015/16 UNPS was accessed with permission from the UBOS officials after signing a data use agreement. Overall, there was no discrepancy between the data collection plan presented in Chapter 3 and the actual data collection. Primary data for the 2015/16 UNPS was collected by UBOS in collaboration with other government agencies, development partners, and nongovernmental organizations. The

survey was carried out over a 12-month period (a wave) by conducting two visits (about 6 months apart) for the purpose of accommodating the two agricultural seasons as well as households' consumption expenditure patterns. All the 112 districts in Uganda were covered, 3,300 households were sampled, and 19,246 individuals were interviewed.

The sample was nationally representative of households, regional, and rural/urban divides. The target sample for the survey was all the core members of households, that is, parents and biological children; however, the overall household sample data included all persons who live with these core members. The respondents in each sampled household were the household head, spouse, and children over age 15. The questions for collecting data for children under 15 were answered by either the household head or the spouse. The interviewers first sought consent from the participants before the start of the interviews.

The data collection procedure was centrally managed by employing nine mobile field teams and dispatching them to the various sampled areas (UBOS, 2016b). Each of the teams constituted of a supervisor, three enumerators, and a driver. The data were collected using a structured questionnaire comprised of four separate modules (UBOS, 2016b). These are socioeconomic, agriculture, woman, and community. For purposes of this study, the socioeconomic module was the major focus of analysis. The module covered a wide range of variables on household background characteristics, such as education and literacy levels (UBOS, 2016b). It covered variables on the health status of household members, their health seeking behaviors, and variables on child nutrition and health. The module further captured information on labor force status of household

members, the housing conditions, household water and sanitation conditions, as well as energy use (UBOS, 2016b). It also included variables of household incomes and nonagricultural household enterprises, household assets, household consumption expenditure, shocks and coping strategies, and welfare indicators (UBOS, 2016b).

Inclusion and Exclusion Criteria

The original 2015/16 UNPS dataset included records of 19,246 individuals and 3,300 households in Uganda. The records were assessed for eligibility based on the inclusion and exclusion criteria. Households were included if they had children aged under 5. Of these, households were included if they had an under-5 child diarrhea case.

Study Results

Review of Statistical Assumptions

The analysis included multiple regressions on one outcome variable (household cost of treatment of diarrhea) and six independent variables (type of toilet mainly used in household, main source of water for drinking for household, presence of a hand washing facility at the toilet, education level of mother, residence type, and household expenditure [proxy for household income level]). Responses to 79 questions that best represented the study variables were collected and grouped to form composite variables for the bivariate ANOVA and multiple linear regression analysis. These included responses to six questions under general information on the household members, five questions on education of all persons above 3 years in the household, nine questions on the health of household members, 20 questions on child nutrition and health for all children 0 to 59

months old, 27 questions on housing conditions, water, and sanitation, and 12 questions on household consumption expenditure.

The key assumptions for the multiple linear regression tests were reviewed. In particular, the multiple linear regression test has about four main assumptions. All the quantitative variables, more so the Y outcome variable, should have approximately normal distribution shapes, and extreme outliers should either be modified or removed (Warner, 2013). A linear relationship between the outcome variable and the independent variable is required. The test also assumes multivariate normality, requiring residuals to be normally distributed. The test further assumes no multicollinearity--the independent variables should not be highly correlated with each other. The test also assumes homoscedasticity (Warner, 2013). The test also requires that the two groups of dummy-coded predictors have approximately equal *N*s and that no group should have less than 10 cases (Warner, 2013). The plot should also reveal homogenous variance for the variable plotted on the vertical axis, at the different score values, of the variables plotted on the horizontal axis and should have no extreme outliers. The possible multivariate outliers can be detected by an examination of plots of residuals from the multiple regression or examining information on individual cases such as Mahalanob D or leverage statistics (Warner, 2013).

Assumptions of multicollinearity, outliers, normality, linearity, homoscedasticity, and independence of residuals were checked to ensure that they were met. Because the data on the dependent variable was not normally distributed as required, a transformation

was undertaken to normalize it, as guided by Warner (2013). Transformation was performed using a technique of taking the data to log base 10 (see Warner, 2013).

After transformation, the test showed that the general household cost of treatment of diarrhea data was normally distributed (*p* value for Shapiro-wilk test = 0.291). The normal P-P scatter plot of regression standardized residual indicated a linear relationship between the WASH and socioeconomic variables (independent) and the cost of diarrhea variable (outcome) because the points laid along the line. The assumption for multivariate normality, requiring residuals to be normally distributed, was checked using the histogram (see Figure 3) and the Shapiro Wilk test. The values of the correlation between variables were less than 0.8, which shows that there was no multicollinearity between the WASH and socioeconomic variables. The residual statistics results indicated that the maximum cook's distance was in the acceptable range (less than 1). Homoscedasticity was met. A plot of standardized residuals versus predicted values showed that points were equally distributed across all values of the independent variables.

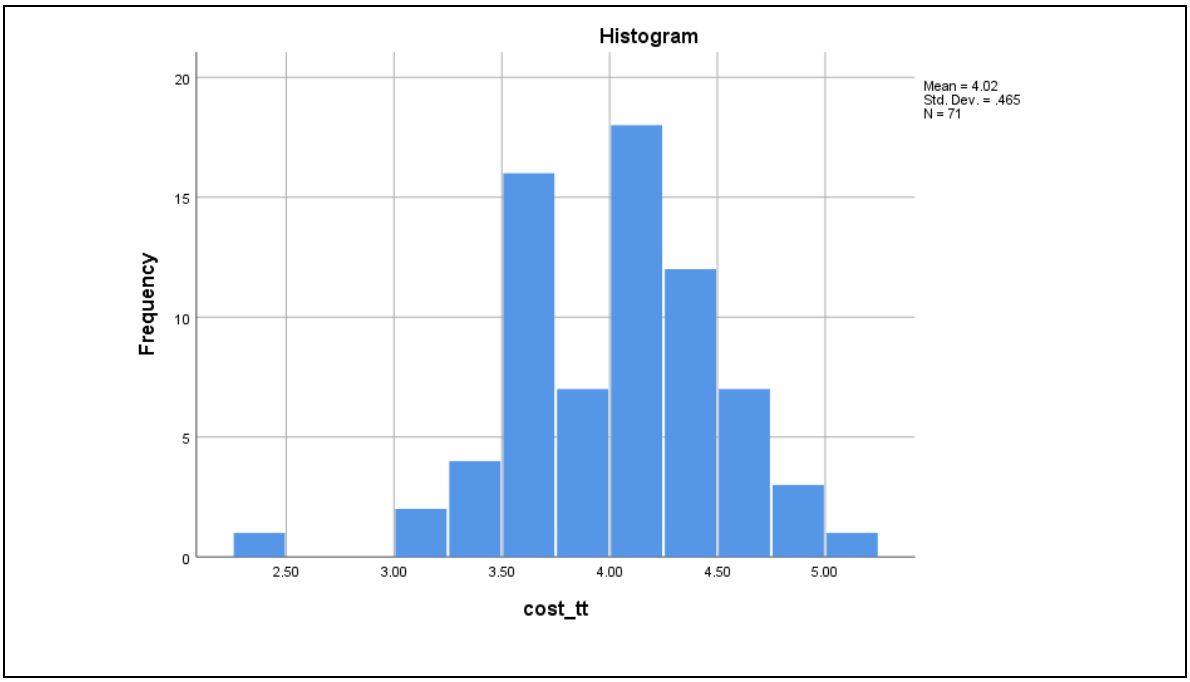

Figure 3. Tests of normality: Histogram indicating transformation of data for the dependent variable.

Missing data. There were12 missing observations on the variable of hand washing, two on education level and household expenditure, four on water source and three on type of toilet. Missing values were included at the univariate and bivariate analysis when describing the nature and basic features of the data. However, at multivariate level, on the final model (regression) they were not included as SPSS provides a way of excluding missing cases. The pairwise deletion method was used to analyze the correlations (see Warner, 2013). This yielded a total sample size (N) of 68 cases with different N across the computation of each correlation depending on the pattern of missing values. The remaining sample used after dropping the missing data is provided in the output of the final ANOVA table of the hierarchical model on the column

of degrees of freedom (df) and the residual statistics tests table. The df in the total column are 67 and because df=N-1, then N=68 (see Warner 2013).

According to Warner (2013), SPSS provides two ways of analyzing all possible correlations among a set of variables. The first is listwise deletion in which all data for a participant are not included in any of the correlations if there are missing values in any one of the variables (Warner 2013). The second is pairwise deletion in which "each correlation is computed using data from all the participants who had no missing values on that particular pair of variables." (Warner, 2013, pg.134). Therefore, when using pairwise deletion, "depending on the pattern of missing values, each correlation may be based on a different N and a different subset of participants than those used for other correlations." (Warner, 2013, pg.134). Accordingly, "pairwise deletion preserves the maximum possible N for the computation of each correlation." (Warner, 2013, pg.134).

Multicollinearity. There was no multicollinearity. The independent variables were not highly correlated with each other. This was checked using the Variance Inflation Factor (VIF) values (see table 4). The correlation matrix was also used, and the magnitude of the correlation coefficients were less than 0.8 (see table 6).

Descriptive Analysis

There were 2,000 children aged under 5 in the 3, 300 households that participated in the survey (see UBOS, 2016b). Of these households, only 81 had children aged under 5 with a diarrhea case recorded in the last two weeks before and or during the survey (see UBOS, 2016b). Since most households had only one diarrhea case and about five had two

cases, only one case (the first case listed) was considered per household to ensure equal cost analysis. Therefore, 71 households passed the inclusion criteria for analysis.

The descriptive statistics for the independent and dependent variables are presented in table 1 and table 2 respectively.

Table 1

Descriptive Statistics of the Independent Variables

Variable	Frequency	Percent
Socioeconomic		
Education level		
Secondary level education	13	18.3
Primary level education	37	52.1
No education	19	26.8
Missing data	02	2.8
Residence type		
Rural	62	87.3
Urban	9	12.7
Household expenditure		
Low household expenditure	18	25.4
Moderately low household expenditure	16	22.5
Moderate household expenditure	15	21.1
Moderately high household expenditure	13	18.3
High household expenditure	7	9.9
Missing data	02	2.8
WASH		
Water source		
Improved water source	43	60.6
Unimproved water source	25	35.2
Missing data	03	5.6
Toilet type		
Improved toilet	20	28.2
Unimproved toilet	30	42.3
No toilet	18	25.4
Missing data	03	4.2

Note. N = 71. Presence of handwashing facility was not significant, thus not included.

The descriptive statistics of the independent variables in table 1 reveal that majority (52%) of the household mothers had attained primary level as their highest level

of education. The highest proportion (87%) of the households resided in rural areas of Uganda. The highest proportion (69%) of the household lied in the moderate to low expenditures, meaning that majority had low to moderate incomes. Majority (61%) of the households had improved sources of drinking water for their households. Majority (42%) of the households mainly used unimproved toilets and the highest proportion (74%) of the households had no hand washing facilities at the toilet.

Table 2

Household Cost of Diarrhea Treatment and Where Treatment Was Sought

Variable/place of treatment	Freq./*N*	Percent	Minimum cost in Uganda shillings	Maximum cost in Uganda shillings	Mean cost in Uganda shillings	Std. Deviation
Diarrhea cost			300	100,000	17,534	
Government hospital	4	5.6	13,000	75,000	33,000	29,063
Government health center	20	28.2	4,000	45,000	14,000	11,655
Private hospital	2	2.8	20,000	20,000	20,000	0
Pharmacy/ drug shop	21	29.6	300	100,000	14,300	22,279
Private doctor/ nurse/ midwife	15	21.1	3,000	80,000	22,200	20,512
Private outreach	2	2.8	10,000	10,500	10,200	354
Shop	1	1.4	2,100	2,100	2,100	.
Religious institution	1	1.4	7,000	7,000	7,000	.
Traditional healer	2	2.8	50,000	60,000	55,000	7,071
Total	68	95.8	300	100,000	18,000	19,703
Missing system	3	4.2				

The descriptive statistics of the dependent variable in table 2 indicate that the mean household cost of treatment of diarrhea for one child was Uganda Shillings 17,534,

translating into about 5 US dollars. The highest proportion (30%) of households sought healthcare from a pharmacy/drug shop. This was closely followed by Government health centre (28%) and private Doctor/ nurse/ midwife (21%).

Inferential Statistical Analysis Findings by Research Questions and Hypotheses

The inferential statistical analysis included bivariate ANOVA and multiple linear regression analyses to answer the two research questions and test the corresponding hypotheses based on a sample of 71 households who met the inclusion criteria. The first test was the bivariate analysis using ANOVA which was focused on assessing the association between the independent variables and the dependent variable. The results indicated that five of six independent variables (education of mother, household expenditure, residence type, water source and type of toilet facility) had statistically significant associations with the dependent variable; household cost of treatment of diarrhea, *p*-value < .05. The independent variable of presence of a hand washing facility at the toilet had a negative association with the household cost of treatment of diarrhea, *p*-values >.05.

The second step was a hierarchical multiple linear regression test to establish if the six independent variables significantly predicted the outcome variable at a *p*-value < .05. The effect of the control variable on the outcome variable was also tested. The results indicated that only three of the six variables significantly predicated household cost of treatment of diarrhea. These were highest education level of household mother (*p*= 0.001), source of drinking water (*p*= 0.022) and type of toilet facility (*p*= 0.012). At *p*-

value < .05, the results revealed that about 67% of the variation in the cost of treatment of diarrhea was explained by the WASH and socioeconomic variables. The control variable did not significantly cause variation in the cost of treatment of diarrhea (p value >0.05).

Question 1: What is the relationship between socioeconomic status (education level of household mother, household expenditure, and type of residence) and household cost of treatment of diarrhea disease among children aged under 5 in Uganda, controlling for place of treatment?

$H_0$1: There is no statistically significant relationship between socioeconomic status (education level of household mother, household expenditure, and type of residence) and household cost of treatment of diarrhea disease among children aged under 5 in Uganda, controlling for place of treatment.

H_a1: There is a statistically significant relationship between socioeconomic status (education level of mother, household expenditure, and type of residence) and household cost of treatment of diarrhea disease among children aged under 5 in Uganda controlling for place of treatment.

An ANOVA bivariate analysis was carried out to examine the correlations between the three socioeconomic independent variables and the outcome variable. The analysis indicated statistically significant associations between highest education level of mother (F (2, 68) =53.323, p=0.000), household expenditure (F (4, 68) =10.398, p=0.000), residence type (F (1, 70) =5.083, p=0.027), and household cost of treatment of diarrhea. The findings revealed that households with mothers who had attained secondary

education spent more on diarrhea treatment (48, 923 ug shs) as compared to households with mothers who never attained any education level (6,100 ug shs). The households with a high expenditure spent more on diarrhea treatment (48,900 ug shs) as compared to the households with low expenditure (6,655 ug shs). The households in urban areas spent more on diarrhea treatment (30, 778 ug shs) than households in rural areas (15, 611 ug shs). See Table 3.

Table 3

Mean Cost of Diarrhea Treatment Across Socioeconomic and WASH Variables (Uganda Shillings)

Variable	Mean	Std. Deviation
Socioeconomic		
Secondary level Education	48,923	23,603
Primary level education	12,600	8,958
No education	6,100	4,920
Total	17,700	19,623
Rural	15,611	15,584
Urban	30,778	34,867
Total	17,534	19,401
Low household expenditure	6,656	5,116
Moderately low household expenditure	10,600	6,976
Moderate household expenditure	18,400	19,803
Moderately high household expenditure	24,000	15,599
High household expenditure	48,900	32,365
Total	17,700	19,623
WASH		
Improved water source	23300	22626
Unimproved water source	7375	5846
Total	17600	19930
Improved toilet	39200	24111
Unimproved toilet	10200	1039
No toilet	5578	3839
Total	17500	19627

Note. $N = 71$. Presence of handwashing facility was not significant, thus not included.

The hierarchical multiple linear regression test that followed did not retain all the three statistically significant associations between the independent and outcome variables. A significant positive relationship was only found between the education level of the household mother and household cost of treatment of diarrhea (p=0.001). The households with mothers who completed secondary level of education spent more on treatment of diarrhea as compared to households with mothers who never attended school (coefficient= .769). See Table 4.

There were no significant relationships between residence type of a household, household expenditure and household cost of treatment of diarrhea (p> 0.05).

Therefore, I reject the null hypothesis for the predictor variable highest education level of the household mother and accept the null hypothesis for the predictor variables household expenditure and residence type. I conclude that household cost of treatment of diarrhea disease can be predicted by education level of the household mother.

Question 2: What is the relationship between WASH (source of drinking water, type of toilet facility, and presence of hand washing facility) and household cost of treatment of diarrhea disease among children aged under 5 in Uganda, controlling for place of treatment?

$H_0$2: There is no statistically significant relationship between WASH (source of drinking water, type of toilet facility, and presence of hand washing facility) and household cost of treatment of diarrhea disease among children aged under 5 in Uganda, controlling for place of treatment.

H_a2: There is a statistically significant relationship between WASH (source of drinking water, type of toilet facility, and presence of hand washing facility) and household cost of treatment of diarrhea disease among children aged under 5 in Uganda, controlling for place of treatment.

An ANOVA bivariate analysis was carried out to examine the correlations between the three WASH independent variables and the outcome variable. The analysis indicated statistically significant associations between type of water source (F (1,66) = 11.459, p=0.001), type of toilet facility (F (2,67) = 36.062, p=0.000), and household cost of treatment of diarrhea. There was no statistically significant association between presence of hand washing facility at the toilet and household cost of treatment of diarrhea (p value > 0.05). The households with improved water source spent more (23,300 ug shs) on diarrhea treatment as compared to those with unimproved water sources (7,375 ug shs). The households with improved toilet facilities spent more (39, 200 ug shs) on diarrhea treatment as compared to those with unimproved (10,210 ug shs) and those with no toilet facilities (5,577 ug shs). See Table 3.

The hierarchical multiple linear regression test that followed retained the two statistically significant associations between the independent and outcome variables. There were significant positive associations between the source of drinking water (p=0.022), type of toilet facility (p=0.012) and household cost of treatment of diarrhea. The households with unimproved water sources spent less on treatment of diarrhea as compared to household with improved water sources (coefficient = -.199). The

households with improved toilet facilities spent more on treatment of diarrhea as compared to households with no toilet facilities (coefficient = .344). See Table 4. There was no significant relationship between presence of a hand washing facility at the toilet and cost of treatment of diarrhea ($p > 0.05$).

Therefore, I reject the null hypothesis for the predictor variables source of water for drinking, type of toilet facility and accept the null hypothesis for the predictor variable hand washing facility at the toilet. I conclude that household cost of treatment of diarrhea disease can be predicted by source of water for drinking and type of toilet facility.

Table 4

Results of Hierarchical Multiple Linear Regression to Predict Household Cost of Treatment of Diarrhea from Education Level, Household Expenditure, Residence Type, Water Source, Toilet Facility and Handwashing

Predictors	Unstandardized Coefficients (B)	95% Confidence Interval for B	*P* value	VIF
Model 1: Place of consultation	.002	[-.038-.043]	.911	1.000
Model 2:				
Place of consultation, socioeconomic	-.025	[-.055-.005]	.102	1.153
Secondary education	.769	[.476-1.062]	.000	2.076
Primary education	.257	[.061-.452]	.011	1.541
High household expenditure	.488	[.145-.830]	.006	1.685
Moderately high household expenditure	.254	[-.013-.522]	.062	1.729
Moderate household expenditure	.167	[-.077-.410]	.176	1.593
Moderately low household expenditure	.123	[-.112-.358]	.299	1.556
Urban residence	.050	[-.209-.309]	.702	1.203

(*table continues*)

Predictors	Unstandardized Coefficients (B)	95% Confidence Interval for B	*P* value	VIF
Model 3: Place of consultation,	-.012	[-.040-.017]	.421	1.227
Socioeconomic,				
Secondary education	.562	[.254-.869]	.001	2.729
Primary education	.176	[-.015-.366]	.070	1.749
High household expenditure	.269	[-.071-.609]	.118	1.982
Moderately high household expenditure	.135	[-.125-.395]	.303	1.954
Moderate household expenditure	.070	[-.158-.298]	.540	1.675
Moderately low household expenditure	.118	[-.100-.337]	.283	1.610
Urban residence	.034	[-.210-.279]	.780	1.278
WASH				
Unimproved water source	-.199	[-.368--.030]	.022	1.236
Improved toilet	.344	[.080-.609]	.012	2.730
Unimproved toilet	.166	[-.025-.356]	.087	1.707
Handwashing with water & soap	-.225	[-.861-.412]	.482	1.085
Handwashing with water only	.159	[-.123-.441]	.263	1.185
R = 0.821**				
R^2= 0.674				
Adj R^2= 0.596				

Note. N = 68. ** $p < 0.05$

The 6 predictors were entered at two intervals starting with the socioeconomic category and then the WASH category. Because all the six predictor variables were dummy variables, mean and standard deviation were not reported (see Warner, 2013).

The overall regression, including all the six predictors was statistically significant for three predictors (mothers' education level, source of drinking water and type of toilet facility), R =.821, R^2=0.674, adjusted, R^2 =. 596, F (13, 54) = 8.500, $p < .05$. Household cost of treatment of diarrhea could be predicted well from the three mentioned variables

with approximately 67% of the variance in cost of treatment of diarrhea accounted for by the socioeconomic and WASH predictors.

Table 5

Summary of R2 Values and R2 Change at Each Step in the Hierarchical Regression in Table 4

Model	Predictors	R^2 for model	*F* for model	R^2change	*F* for R^2 change
1	Place of treatment	0.000	*F* (1,66) =0.013	0.000	*F* (1,66) =0.013
2	Place of treatment, socio economic	0.573	*F* (8,59) =9.900**	0.573	*F* (7,59) =11.311**
3	Place of treatment, socio economic, WASH	0.674	*F* (13,54) =8.596**	0.101	*F* (5,54) =3.352**

Note. *N* = 68. ***p* < 0.05

Table 6

Results of Hierarchical Linear Multiple Regression to Predict Household Cost of Treatment of Diarrhea from Residence Type, Household Expenditure, Education Level, Water Source, Toilet Type, and Handwashing Facility: Correlations and Descriptive Statistics

Variable		1	2	3	4	5	6	7	8	9	10	11	12
1.	Urban	_	.016	-.071	.114	-.104	-.143	.257*	-.116	-.046	-.155	.138	-.272*
2.	High expenditure	.016	_	_	_	_	-.061	.332**	.069	-.040	-.187	.423***	-.136
3.	Moderately high expenditure	-.071	_	_	_	_	-.056	.247*	.249*	-.057	-.184	.270	-.030
4.	Moderate expenditure	.114	_	_	_	_	.082	.023	-.033	-.062	.046	.059	-.078
5.	Moderately low expenditure	-.104	_	_	_	_	.180	-.168	-.164	.222*	.221*	-.263*	.042
6.	Primary education	-.143	-.061	-.056	.082	.180	_	_	-.013	.115	.306**	-.152	.029
7.	Secondary education	.257*	.332**	.247**	.023	-.168	_	_	-.013	-.057	-.331**	.594***	-.261*

(*table continues*)

Variable	1	2	3	4	5	6	7	8	9	10	11	12
8. Handwashing facility-with water only	-.116	.069	.249*	-.033	-.164	-.013	-.013	_	_	.048	.147	-.003
9. Handwashing facility-with water and soap	-.046	-.040	-.057	-.062	.222*	.115	-.057	_	_	.140	-.075	-.085
10. Unimproved toilet facility	-.155	-.187	-.184	.046	.221*	.306**	-.331**	.048	.140	_	_	.233*
11. Improved toilet facility	.138	.423***	.270*	.059	-.263*	-.152	.594***	.147	-.075	_	_	-.315**
12. Unimproved water source	-.272*	-.136	-.030	-.078	.042	.029	-.261*	-.003	-.085*	.233**	-.315	_

Note. $N = 68$. a. Because all variables were dummy coded, mean and standard deviations were not reported. b. *$p < .05$. **$p < .01$. ***$p < .001$.

Summary

This study had two research questions and two hypotheses. It focused on assessing the correlation between socioeconomic status, WASH and household cost of treatment of diarrhea among children aged under 5 in Uganda.

The analysis was done at both bivariate and multivariate levels. At the bivariate level, the results indicated that five of the six predictor variables (highest education level of mother, household expenditure, residence type, drinking water source, and type of toilet facility) had a statistically significant association with household cost of treatment of diarrhea with a p -value < .05. Presence of a handwashing facility had no statistically significant association with household cost of treatment of diarrhea $p > .05$.

At the multivariate level of analysis, the results indicated that only three of the six predictors (highest level of mothers' education, drinking water source, and type of toilet facility) had a statistically significant association with household cost of treatment of diarrhea with a p -value < .05. Households with higher education levels, improved sources of drinking water, and improved types of toilet facilities spent more on diarrhea treatment as compared to those with less education, unimproved drinking water sources and unimproved toilet facilities.

I conclude that household cost of treatment of diarrhea disease among children aged under 5 can be predicted by education level, source of water for drinking and type of toilet facility.

Chapter 5 includes a discussion of socioeconomic and WASH factors that showed a statistically significant association with household cost of treatment of diarrhea among children aged under 5 in Uganda. It also includes a comparison of these findings with previous studies. The chapter further presents the study limitations, its implications for positive social change, conclusions, and recommendations for research, policy and practice.

Chapter 5: Discussion, Conclusions, and Recommendations

This study was a quantitative cross-sectional survey using secondary data from the 2015/16 UNPS conducted by UBOS. I examined the correlation between socioeconomic status (education level of mother, household expenditure, and residence type), WASH (source of drinking water, type of toilet facility, presence of hand washing facility) and household cost of treatment of diarrhea among children under the age of 5 in Uganda, controlling for place of treatment. I employed the MEME model. Diarrhea disease, although preventable and treatable, is the second leading cause of death in children under the age of 5 globally (WHO, 2017). The prevalence is high at about 1.7 billion cases of childhood diarrhea every year resulting into about 525,000 deaths (WHO, 2017). In Uganda, diarrhea contributed to 69% of childhood illnesses in 2014 (UBOS, 2016a), and acute diarrhea accounted for 204 cases of under-5 in-patient mortality (MOH, 2017). Although global evidence has indicated that diarrhea can be prevented through improved WASH conditions, in 2015, nearly 2.4 billion people still lacked adequate sanitation (Mishra et al., 2017). The situation is worse in less developed countries like Uganda, where the average coverage was about 38% in 2015 (Mishra et al., 2017). This may explain in part the high prevalence of diarrheal diseases and associated treatment costs. This study was conducted to establish the socioeconomic and WASH determinants of household treatment costs for diarrhea among children under 5 years old in Uganda.

The data analysis included descriptive, bivariate, and multivariate analyses. The bivariate analysis indicated a significant positive association between the highest education level of the household mother and household cost of treatment of diarrhea (F [2, 68] = 53.323, p = 0.000). The results also showed significant positive associations between two WASH variables: source of drinking water (F (1,66) = 11.459, p = 0.001), type of toilet facility (F (2,67) = 36.062, p = 0.000) and household cost of treatment of diarrhea. The multivariate analysis further showed significant associations between education level of the household mother (p = 0.001), source of drinking water (p = 0.022), type of toilet facility (p = 0.012) and household cost of treatment of diarrhea.

The findings further indicated that households with mothers who had attained secondary education level spent more on diarrhea treatment (48, 923 ug shs) as compared to households with mothers who never attained any education level (6,100 ug shs). The households with a high expenditure spent more on diarrhea treatment (48,900 ug shs) as compared to the households with low expenditure (6,655 ug shs). The households in urban areas spent more on diarrhea treatment (30, 778 ug shs) than households in rural areas (15, 611 ug shs). The households with improved water sources spent more (23,300 ug shs) on diarrhea treatment as compared to those with unimproved water sources (7,375 ug shs). The households with improved toilet facilities spent more (39, 200 ug shs) on diarrhea treatment as compared to those with unimproved (10,210 ug shs) and those with no toilet facilities (5,577 ug shs).

These findings are in accordance with Matovu et al. (2014), who, in a study to assess the rural-urban differences in direct and indirect costs of seeking care in Uganda, established that 59% of the caregivers at health centers incurred costs while seeking care, and the costs were significantly greater for households in urban areas ($p < 0.000$).

The findings are also in accordance with Loganathan et al. (2016), who, in their study in Malaysia on health service utilization and household expenditure related to rotavirus gastroenteritis, established that direct costs paid out of pocket for rotavirus resulted in catastrophic expenditure among all income groups. The results showed that 43% of the rich used more expensive private care, thus spending more than 10% of their household income on treatment of illnesses (Loganathan et al., 2016).

Interpretation of Findings

Study Findings and Past Research

The findings of this study indicated that the household cost of treatment of diarrhea among children aged under 5 in Uganda can be predicted by the mother's level of education, source of drinking water and type of toilet facility. These finding are in agreement with those of previous related studies and disagrees with some studies as presented below.

Highest level of mother's education and household cost of treatment of diarrhea. In this study, I examined the correlation between the highest level of education of the household mother and the household cost of treatment of diarrhea. The results in both bivariate and multivariate analyses showed that households with mothers who

attained secondary education spent more on diarrhea treatment (48,923 ug shs) as compared to households with mothers who never attained any education level (6,100 ug shs).

The results are in accordance with a study by Tarekegn, Lieberman, and Giedraitis (2014) on the determinants of maternal health service utilization, which indicated that education of women, place of residence, and household wealth had a significant association with the use of maternal health services. The researchers revealed that

> "women who completed higher education were more likely to use ANC (AOR = 3.8, 95% CI = 1.8-7.8), skilled delivery attendants (AOR = 3.4, 95% CI = 1.9-6.2) and PNC (AOR = 3.2, 95% CI = 2.0-5.2). Women from urban areas use ANC (AOR = 2.3, 95% CI = 1.9-2.9), skilled delivery attendants (AOR = 4.9, 95% CI = 3.8-6.3) and PNC services (AOR = 2.6, 95% CI = 2.0-3.4) more than women from rural areas." (Tarekegn et al., 2014, p.161).

The findings of my study also agree with Fierstein (2017), who deduced that educated mothers generally live in wealthier and healthier households, making them better able to provide healthy and hygienic complementary foods for their children. They are also more likely to access and effectively apply child nutrition information (Fierstein, 2017).

The findings of this present study disagree with those of Fitzpatrick et al. (2015) on the socioeconomic status gradients among future high-cost users of health care, which

instead revealed that people who tend to be of lower household income and less than postsecondary education and those who lived in areas of higher dependency were found to be high cost users of health care. However, the authors highlighted that future high-cost healthcare use was strongly associated with multiple dimensions of socioeconomic status, including income, education, homeownership, food security, and neighborhood marginalization (Fitzpatrick et al., 2015), which is what I also found in this present study.

Fitzpatrick et al. (2015), also agreed with the MEME model by recommending that the high-cost use of healthcare should be understood from a broader perspective, including a comprehensive understanding of socioeconomic status. They indicated that this would inform policies and interventions aimed at mitigating high-cost use of health care and achieving the common goal of improved population health (Fitzpatrick et al., 2015).

Source of drinking water and household cost of treatment of diarrhea. In this study, I examined the correlation between the source of drinking water and the household cost of treatment of diarrhea. The results in both bivariate and multivariate analyses showed that households that accessed their drinking water from an improved source spent more on diarrhea treatment (23,300 ug shs) as compared to households that accessed their water from an unimproved source (7,375 ug shs).

A study by Nandi, Megiddo, Ashok, Verma, & Laxminarayan (2017), on the reduced burden of childhood diarrheal diseases through increased access to water and sanitation in India, showed that an estimated savings of US $357,788 in 2013 in out-of-

pocket diarrhea treatment expenditure and $1,646 in incremental value of insurance per 100,000 under-5 children per year over the baseline could be saved by averting 43,352 diarrheal episodes and 68 diarrheal deaths per 100,000 under-5 children per year. They revealed that poorer subpopulations and states obtained higher benefits of water and sanitation (Nandi et al, 2017).

Type of toilet facility and household cost of treatment of diarrhea. In this study, I examined the correlation between the type of toilet facility and the household cost of treatment of diarrhea. The results in both bivariate and multivariate analyses showed that households with an improved toilet facility spent more on diarrhea treatment (39, 200 ug shs) as compared to households with unimproved (10,210 ug shs) and those with no toilet facilities (5,577 ug shs).

These findings are supported by a study by Corburn and Hildebrand (2015) on slum sanitation and the social determinants of women's health in Nairobi. The researchers revealed that during an episode of diarrhea, increased toilet use (paid use) combined with treatment expenses and lost wages from missed work accounted for up to 10% of monthly expenditures (Corburn & Hildebrand, 2015). Some of the healthcare costs when a child was sick included transportation to the clinic, medicines, and doctor's fees (Corburn & Hildebrand, 2015). The study revealed that on average, 85% households in Mathare shared one toilet and 83% of households without a private toilet reported poor health, with diarrhea accounting for 30% as the most frequent physical burdens (Corburn & Hildebrand, 2015).

The findings of this study are further supported by a Ugandan study by Kwesiga et al. (2015) which indicated that the richest quintile of the population pay more for health care as compared to the poorest. Kwesiga et al. revealed that the richest paid an out of pocket for health care of an average of about 10.2% of their household consumption expenditure compared to the poorest who paid about 6%. The researchers also revealed that the richest quintile had the least need (15.7%) for health services and yet benefited the most share (19.2%) of available health services (Kwesiga et al., 2015). On the other hand, the poorest quintile experienced the greatest need (22.8%) of health services and yet received the least share (17.9%) of benefits from available health services (Kwesiga et al., 2015). The study further showed that the richest people benefited 23.7% of the services by public hospitals compared to 17.4% by the poorest (Kwesiga et al., 2015). On the contrast the poorest benefited more (27.7%) of public lower health units than the richest at 11.6% (Kwesiga et al., 2015). A similar trend was observed in for profit and not-for profit health facilities.

Study Findings and the MEME Model

In my study, I employed the MEME model which postulates that there are many links and associations between environment and health (Briggs & WHO, 2003). According to Hambling et al. (2011), the model puts emphasis on the complex associations between various environmental exposures and child health outcomes. In the case of children, the model demonstrates that exposures to disease occur in various settings including the home, the community and the wider ambient environment (Briggs

& WHO, 2003). It also recognizes “that both exposures and health outcomes may be affected by contextual factors such as social conditions, demographics and economic development that influence the susceptibility of the population to environmental health effects.” (Briggs & WHO, 2003, p.6). The model also clearly shows the many entry points for intervention; at either health outcome level or exposure level.

The model was used to illustrate the relationships between household cost of treatment of diarrhea and the socioeconomic and WASH factors that influence this outcome. It was also used to provide more insights into the socioeconomic and environmental factors that influence child health.

In my study, I examined the interactive relationships between socioeconomic and WASH factors and their influence on the household cost of treatment of childhood diarrhea. The findings of this study supported the MEME model. They showed that households with higher education levels, improved sources of drinking water and toilet facilities had lower diarrhea prevalence levels but surprisingly spent more money on diarrhea treatment as compared to those with lower education and unimproved facilities which had higher diarrhea prevalence levels. While I expected that a higher prevalence would lead to a higher cost, the results showed otherwise, confirming the complexity of child health determinants and outcomes as postulated by the model.

As guided by the model in the analyses, the findings of this study confirmed that socioeconomic and WASH factors singularly and interactively influence the cost of treatment of diarrhea among children. The findings of this study surprisingly showed that

high prevalence of disease is not a key determinant of cost of treatment. Overall, I revealed that households with higher socioeconomic status and those living in improved WASH environments incurred higher costs of treatment as compared to households with lower socioeconomic and WASH status. These results provide evidence and justification for multiple interventions to address the burden of diarrheal diseases. They suggest that the interventions should be holistic targeting both the poor and non-poor, educated and non-educated, and households in rural and urban areas.

The model is supported by a study by Sicuri et al. (2013) which showed that various factors affect the economic burden of malaria among children in endemic areas including treatment seeking behavior, age of child and epidemiological conditions.

The model is further supported by a study by Patunru (2015), on access to safe drinking water and sanitation in Indonesia which had various control variables. The researchers included sex, age, education of household head, urban/rural, percent of household in the village practicing open defecation, district GDP per capita, number of health centres per 1,000 population, percent of district population with access to improved water and sanitation, as control variables (Patunru, 2015). This implied that there were multiple factors that determined the prevalence of diarrhea in the study area. Patunru, revealed that the odds of getting diarrhea were 12% higher in a house with unimproved water, and 27% higher in a house with unimproved sanitation.

Overall, the MEME model was useful in guiding this study through the entire process from identifying the problem, documenting available literature, identifying the

study variables, designing the questions and hypotheses, data analysis, and interpreting of findings.

Limitations of the Study

This study had five main limitations. First, the cross-sectional survey design did not allow for manipulation of the order of independent variables, consequently leading to inability to establish the cause-effect-relationships among the study variables (Walden, 2010; Trochim, 2006). In addition, the design could not allow for random assignment of groups, presenting effects of uncontrolled variables.

Second, the study depended on existing secondary data from the 2015/16 UNPS. This limited exploration and assessment of important variables or indicators were data was not collected. Third, the collection of survey data largely relies on participant's ability to recall information, which could have affected the provision of accurate information. This could have affected the findings of the study. Fourth, although the hierarchical multiple linear regression yielded a statistical power of 0.98 for a sample size of 68 excluding the missing variables, it was relatively small, which could have affected the study findings. It was also smaller than required to perform other statistical analyses such as mediation which could have probably strengthened the findings of the study. Fifth, the study did not analyze other important variables such as health seeking behavior, severity of diarrhea and treatment standards that could have a significant effect on household cost of treatment of diarrhea.

Recommendations

This study was the first cross-sectional study to assess the correlation between socioeconomic factors, WASH and household cost of treatment of diarrheal diseases among children aged under 5 in Uganda. The findings indicate the important role of household education level, type of water source and toilet facility in predicting household cost of treatment of diarrhea among children. In this study, I have highlighted the existing knowledge gaps and areas for further research.

The cross-sectional quantitative nature of this study could neither allow me to make any cause-effect-relationships among the study variables nor was it possible to make any explanations about the observations. Future researchers interested in a similar topic could undertake prospective studies using primary data to be able to determine casual -effect relationships, with a more understanding of the sequencing of events in this phenomenon. Use of primary data could also enable the researchers to use a larger sample size. Furthermore, other researchers could also validate the findings of this study by using a larger sample size and undertaking other statistical analyses such as mediation and moderation tests.

Future researchers could also explore other predictors of household cost of treatment of diarrhea such as health behavioral patterns, health system treatment standards and costs, and severity of illnesses. Exploration of the qualitative aspects of the determinants of cost of diarrhea treatment could also add value to this field. Additional studies could also focus on the Government costs of diarrhea treatment as a key health

system player. This combined with the results of household costs could bring out a more comprehensive outlook of the economic burden of diarrheal diseases at country level.

The complex nature of the determinants of diarrheal diseases and associated treatment costs require multiple strategies and interventions to reduce both the health and economic burden of diarrhea in Uganda. Therefore, more systematic reviews into this area could be important in highlighting the multitude of actions required at various intervention levels.

Implications

Implications for Positive Social Change

In this study, I examined an important public health issue of a high diarrhea burden globally, especially in low and middle-income countries. Limited understanding of the multiple factors that influence the economic cost of diarrhea could be one of the reasons that have kept the prevalence high for over two decades. The findings of this study will therefore contribute to positive social change at all levels. At individual and household level, the evidence could be used to inform parents and care takers of all socioeconomic status and household WASH conditions, about the high cost of diarrhea which could otherwise be prevented, money saved and put to productive use for improving household welfare.

The results showed that the wealthier, more educated, and urban dwellers ironically are incurring a higher cost of treatment as compared to the poor, less educated and rural counter parts. These results could provide a reflection point and a cause for

behavior change across all household groups. With increased knowledge, appreciation and positive practices, the households, communities and the entire country could reduce the burden of diarrheal diseases and consequently save resources spent on diseases that could otherwise be prevented.

The cost savings could then be used for more productive activities such as improved farming, trade, child education and better household nutrition. At the national and global levels, the study findings could serve as a 'wake-up call' to policy makers, politicians and development partners to focus their policy interventions on all population groups as opposed to focusing on only the poor and perceived vulnerable populations.

Implications for Practice

The study could be used to inform policy makers and practitioners on the need for a multiple intervention approach to reducing both the health and economic burden of diarrheal diseases in the country. The findings could also be used to design more appropriate healthcare financing models and interventions that focus on health from a systems approach. This could lead to better prioritization of interventions and rationalizing financial and other resources to increase allocation and technical efficiency. Ultimately, the study has the potential to provide clues to decision makers on the multiple environmental hazards and risks surrounding children in Uganda and the issues that matter for their health and wellbeing (see Briggs & WHO, 2003).

The study also flags key socioeconomic and WASH factors that influence the economic cost of diarrhea. This will provide quick entry points into designing appropriate

multi-sectoral interventions to reduce the burden of diarrhea. Eventually, the study will provide information to guide national policies on WASH and socioeconomic factors. The findings of this study could be used to inform the design of household, community and national education programs to create awareness and impact knowledge on promotion of improved WASH practices and socioeconomic status.

Conclusions

The prolonged high burden of diarrheal diseases globally and specifically in Uganda calls for urgent action. Multiple policies, strategies and interventions are critical in averting the high prevalence of this preventable and treatable disease that has denied many children to live a healthy and productive life. The findings show that the disease affects all population groups in both health and economic terms, making it a double burden of disease.

This study was the first in Uganda to assess the correlation between socioeconomic factors, WASH and household cost of treatment of diarrheal diseases among children aged under 5 in Uganda. The study findings support the hypothesis that socioeconomic and WASH factors particularly; education level of the mother, source of drinking water, and type of toilet facility can predict household cost of treatment of diarrhea among children aged under 5 in Uganda. This new knowledge will be critical in informing policy design and actions for preventive and curative interventions for diarrhea disease that are customized for the different household categories. It will be further useful in guiding policy makers and practitioners to structure their interventions at household,

community, and broader environment level in order to have a holistic response mechanism.

Overall, the successful implementation of multilevel interventions should be able to drastically reduce the health and economic burden of diarrheal diseases to households and the nation at large. Further research is needed in understanding how other factors influence the economic cost of diarrhea in low developing countries such as Uganda.

References

Abalo, J. (2016). *Sanitation and health practices: A positive deviance study of three community led total sanitation (CLTS) host villages in Uganda.* (master's thesis). The University of Bergen.

Attia, S., Versloot, C. J., van Vliet, SJ., Di Giovanni, V., Voskuijl, W., Zhang, L., ... Bandsma, R. H. (2016). Mortality in children with complicated severe acute malnutrition is related to intestinal and systemic inflammation: an observational cohort study. *American Journal of Clinical Nutrition*, *104*(5), 1441-1449. doi:10.3945/ajcn.116.130518

Arnold, B. F., Null, C., Luby, S. P., Unicomb, L., Stewart, C. P., Dewey, K.G., … Colford, J.M. Jr. (2013). Cluster-randomized controlled trials of individual and combined water, sanitation, hygiene and nutritional interventions in rural Bangladesh and Kenya: The WASH Benefits study design and rationale. *BMJ Open*, *3*(8), e003476. doi:10.1136/bmjopen-2013- 003476

Batte, A., Lwabi, P., Lubega, S., Kiguli, S., Otwombe, K., Chimoyi, L., & Karamagi, C. (2017). Wasting, underweight and stunting among children with congenital heart disease presenting at Mulago hospital, Uganda. *BMC Pediatrics, 17*(10). doi: 10.1186/s12887-017-0779-y.

Briggs, D. & World Health Organization. (2003). Making a difference: Indicators to improve children's environmental health. ISBN 92 4 159059 9

Burbure, C., Buchet, J., Leroyer, A., Nisse, C., Haguenoer, J., Mutti, A., … Bernard, A. (2006). Renal and neurologic effects of cadmium, lead, mercury, and arsenic in children: Evidence of early effects and multiple interactions at environmental exposure levels. *Environmental Health Perspectives, 114*(4), 584-590. doi: 10.1289/ehp.8202

Burke, R. M., Smith, E. R., Dahl, R. M., Rebolledo, P. A., Calderón, M.del. C., Cañipa, B., … & Leon, J. S. (2014). The economic burden of pediatric gastroenteritis to Bolivian families: A cross-sectional study of correlates of catastrophic cost and overall cost burden. *BMC Public Health, 14(*642). doi:10.1186/1471-2458-14-642

Campbell, D. T., Stanley, J. C., & Gage, N. L. (1963). Experimental and quasi-experimental designs for research. Boston, MA, Houghton, Mifflin and Company.

Cecchini, M., & Sassi, F. (2015). Preventing obesity in the USA: Impact on health service utilization and costs. *PharmacoEconomics; Auckland33*(7),765-776. doi 10.1007/s40273-015-0301-z

Cohen, J. (1988). Statistical Power Analysis for the Behavioral Sciences (2nd ed.). Hillsdale, NJ Lawrence Erlbaum Associates, Publishers.

Corburn, J. & Hildebrand, C. (2015). Slum sanitation and the social determinants of women's health in Nairobi, Kenya. *Journal of Environmental and Public Health 2015, 1-6.* doi:10.1155/2015/209505

Creswell, W. J. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches. (*4th ed). Thousand Oaks, CA, SAGE Publications, Inc.

Diouf, K., Tabatabail, P., Rudolph, J., & Marx, M. (2014). Diarrhoea prevalence in children under five years of age in rural Burundi: An assessment of social and behavioural factors at the household level. *Glob Health Action, 7*(1). doi:10.3402/gha.v7.24895

Ezeh, O. K., Agho, K. E., Dibley, M. J., Hall, J., & Page, A. N. (2014). The impact of water and sanitation on childhood mortality in Nigeria: Evidence from Demographic and Health Surveys, 2003-2013. *International Journal of Environmental Research and Public Health; Basel 11*(9), 9256-9272. doi:10.3390/ijerph110909256

Fierstein, L. J. (2017). Expanding the WASH perspective: How do water, animals, sanitation, and hygiene relate to child height? (doctoral thesis). Tufts University.

Fitzpatrick, T., Rosella, C. L., Calzavara, A., Petch, J., Pinto, D. A., Manson, H.,… Wodchis, P. W. (2015). Looking beyond income and education: Socioeconomic status gradients among future high-cost users of health care. A*merican Journal of Preventive Medicine, 49*(2),161-171. doi:10.1016/j.amepre.2015.02.018

Grenov, B., Namusoke, H., Lanyero, B., Nabukeera-Barungi, N., Ritz, C., Molgaard, C.,… Michaelsen, K. F. (2017). Effect of probiotics on diarrhea in children with severe acute malnutrition: A randomized controlled study in Uganda. *Journal of pediatric gastroenterology and nutrition, 64(3), 396-403. doi: 10.1097/MPG.0000000000001515*

Gargano, L. M., Tate, J. E., Parashar, U. D., Omer, S. B., & Cookson, S. T. (2015). Comparison of impact and cost-effectiveness of rotavirus supplementary and routine immunization in a complex humanitarian emergency, Somali case study. *Conflict and health, 9*(5), doi:10.1186/s13031-015-0032-y

Gary, W. E., & Pilyoung, K. (2010). *Multiple risk exposure as a potential explanatory mechanism for the socioeconomic status-health gradient*. Annals of the New York Academy of Sciences. doi:10.1111/j.1749-6632.2009.05336.x

Hirai, M., Roess, A., Huang, C., & Graham, J. (2016). Exploring geographic distributions of high- risk water, sanitation, and hygiene practices and their association with child diarrhea in Uganda. *Global health action, 9*(1). doi:10.3402/gha.v9.32833

Hunter, P. R. & Pruss-Ustun, A. (2016). Have We Substantially Underestimated the Impact of Improved Sanitation Coverage on Child Health? A Generalized Additive Model Panel Analysis of Global Data on Child Mortality and Malnutrition. *Plos One, 11* (10), *e0164571*. doi:10.1371/journal.pone.0164571

Hambling, T., Weinstein, P., & Slaney, D. (2011). A Review of Frameworks for Developing Environmental Health Indicators for Climate Change and Health. *International Journal of Environmental Research and Public Health, 8* (7), *2854-2875. Doi:10.3390/ijerph8072854*

Habaasa, G. (2015). An investigation on factors associated with malnutrition among underfive children in Nakaseke and Nakasongola districts, Uganda. *BMC Pediatrics*, *15* (134). doi:10.1186/s12887-015-0448-y

Kuziga, F., Adoke, Y., & Wanyenze, R. K. (2017). Prevalence and factors associated with anemia among children aged 6 to 59 months in Namutumba district, Uganda: a cross- sectional study. *BMC Pediatrics*, *17*(25). doi: 10.1186/s12887-017-0782-3

Kwesiga, B., Ataguba, E. J., Abewe, C., Kizza, P., & and Zikusooka, M. C. (2015). Who pays for and who benefits from health care services in Uganda? *BMC Health Services Research, 15*(44). doi: 10.1186/s12913-015-0683-9

Lungu, E. A., Guda, A. O., Darker, C., & Biesma, R. (2018). What influences where they seek care? Caregivers' preferences for under-five child healthcare services in urban slums of Malawi: A discrete choice experiment. *PloS one*, *13*(1). doi: 10.1371/journal.pone.0189940

Lanyero, B., Namusoke, H., Nabukeera-Barungi, N., Grenov, B., Mupere, E., Michaelsen, K. F., & Briend, A. (2017). Transition from F-75 to ready-to-use therapeutic food in children with severe acute malnutrition, an observational study in Uganda. *Nutrition journal*, *16* (52). doi:10.1186/s12937-017-0276-z

Legason, I. D., Atiku, A., Ssenyonga, R., Olupot-Olupot, P., & Barugahare, J. B. (2017). Prevalence of Anaemia and Associated Risk Factors among Children in North-

western Uganda: A Cross Sectional Study. *BMC Hematology, 17*(10). doi:10.1186/s12878-017-0081-0

Loganathan, T., Jit, M., Hutubessy, R., Ng, C. W., Lee, W. S., & Verguet, S. (2016). Rotavirus vaccines contribute towards universal health coverage in a mixed public-private healthcare system. *Tropical medicine & international health*, *21*(11), 1458-1467. doi:10.1111/tmi.12766

Ministry of Health. (2017). *Annual Health Sector Performance Report 2016/2017*. Government of Uganda.

Mishra, S. R., Dhimal, M., Parash, M. B., Adhikari, B. (2017). Sanitation for all: the global opportunity to increase transgenerational health gains and better understand the link between NCDs and NTDs, a scoping review. *Tropical Diseases, Travel Medicine and Vaccines*,*3*(8*).* doi: 10.1186/s40794-017-0051-3

Menon, P., McDonald, C. M., & Chakrabarti, S. (2016). Estimating the cost of delivering direct nutrition interventions at scale: national and subnational level insights from India. *Maternal & child nutrition*, *12*(S1), 169-185. Doi: 10.1111/mcn.12257

Moench-Pfanner, R., Silo, S., Laillou, A., Wieringa, F., Hong, R., Hong, R., ... & Bagriansky, J. (2016). The economic burden of malnutrition in pregnant women and children under 5 years of age in Cambodia. *Nutrients*, *8*(5), 292. doi: 10.3390/nu8050292

Muhoozi, G. K. M., Atukunda, P., Mwadime, R., Iversen, P. O., & Westerberg, A. C. (2016). Nutritional and developmental status among 6- to 8-month-old children in

South Western Uganda: A cross-sectional study. *Food & Nutrition Research, 60* (1*)*. doi:10.3402/fnr.v60.30270

Ministry of Health. (2015). *Health Sector Development Plan 2015/16 - 2019/20.* Government of Uganda.

Matovu, F., Nanyiti, A., & Rutebemberwa, E. (2014). Household health care-seeking costs: experiences from a randomized, controlled trial of community-based malaria and pneumonia treatment among under-fives in eastern Uganda. *Malaria journal, 13*(222). doi:10.1186/1475-2875-13-222

Mukunya, D., Kizito, S., Orach, T., Ndagire, R., Tumwakire, E., Rukundo, G. Z.,… Kiguli, S. (2014). Knowledge of integrated management of childhood illnesses community and family practices (C-IMCI) and association with child under-nutrition in Northern Uganda: A cross-sectional study. *BMC Public Health,14*(976). doi:10.1186/1471-2458-14-976

Michaud, M.C., Murray, J.L.C., & Bloom, R.B. (2001). Burden of Disease-Implications for Future Research. *JAMA, 285*(5), *535-539.* doi:10.1001/jama.285.5.535

National Planning Authority & World Food Programme. (2017). *Towards Zero-Hunger: A Strategic Review of Sustainable Development Goal2 in Uganda.* Government of Uganda.

Nandi, A., Megiddo, I., Ashok, A., Verma, A., Laxminarayan, R. (2017). Reduced burden of childhood diarrheal diseases through increased access to water and

sanitation in India: A modeling analysis. *Social Science & Medicine, 180,* 193-195. doi:10.1016/j.socscimed.2016.08.049

Nuwaha, F., Babirye, J., & Ayiga, N. (2011). Why the increase in under five mortality in Uganda from 1995 to 2000? A retrospective analysis. *BMC Public Health 11*(725). doi:10.1186/1471-2458-11-725

Patunru, A. A. (2015). Access to Safe Drinking Water and Sanitation in Indonesia. Special Research Article on Health Policy. *Asia & the Pacific Policy Studies, 2*(2), 234–244. doi: 10.1002/app5.81

Pruss-Ustun, A., Bartram, J., Clasen, T., Colford Jr, M. J., Cumming, O., Curtis, V., … Cairncross, S. (2014). Burden of disease from inadequate water, sanitation and hygiene in low- and middle expenditure settings: a retrospective analysis of data from 145 countries. *Tropical Medicine and International Health, 19* (8), 894–905. doi:10.1111/tmi.12329

Patel, R. B., Stoklosa, H., Shitole, S., Shitole, T., Sawant, K., Nanarkar, M.,… Patil-Deshmuk, A. (2013). The high cost of diarrheal illness for urban slum households-a cost-recovery approach: a cohort study. *BMJ Open, 3*(e002251). doi:10.1136/ bmjopen-2012-00225.

Rudestam, K. E., & Newton, R. R. (2015). *Surviving your dissertation: A comprehensive guide to content and process* (4th ed.). Thousand Oaks, CA, SAGE.

Sarkar, R., Sivarathinaswamy, P., Thangaraj, B., Sindhu, K. N. C., Ajjampur, S. S. R., Muliyil, J.,… Kang, G. (2013). Burden of childhood diseases and malnutrition in

a semi-urban slum in southern India. *BMC Public Health, 13*(87). doi:10.1186/1471-2458-13-87

Sicuri, E., Vieta, A., Lindner, L., Constenla, D., & Sauboin, C. (2013). The economic costs of malaria in children in three sub-Saharan countries: Ghana, Tanzania and Kenya. *Malaria Journal, 12* (307*).* doi:10.1186/1475-2875-12-307

Tessema, R. A. (2017). Assessment of the implementation of community-led total sanitation, hygiene, and associated factors in Diretiyara district, Eastern Ethiopia. *PLos ONE 12*(4): *e0175233.* doi: 10.1371/journal.pone.0175233

Tzioumis, E., Kay, M. C., Bentley, M. E., & Adair, L. S. (2016). Prevalence and trends in the childhood dual burden of malnutrition in low- and middle-expenditure countries, 1990-2012. *Public Health Nutrition; Cambridge 19*(8), *1375-1388*. doi:10.1017/S1368980016000276

Tamara, G. R., Rachel, M. R., & Aspa, S. (2015). Burnout and Engagement in Health Profession Students: The Relationships Between Study Demands, Study Resources and Personal Resources. *Australasian Journal of Organisational Psychology,* 8, e1. doi:10.1017/orp.2014.7

Tarekegn, M. S., Lieberman, S. L., & Giedraitis, V. (2014). Determinants of maternal health service utilization in Ethiopia: analysis of the 2011 Ethiopian Demographic and Health Survey. *BMC Pregnancy and Childbirth*, *14* (161). doi.10.1186/1471-2393-14-161

Trochim, W. M. (2006). *Research methods knowledge base* (2nd.ed). Cincinnati, OH: Atomic Dog Publishing; 2005. Available at: http://www.socialresearchmethods.net/kb/index.htm

Uganda Bureau of Statistics (2016a). *The Uganda Demographic and Health Survey Report*. Measure DHS ICF International, Calverton, Maryland, USA

Uganda Bureau of Statistics (2016b). *The Uganda National Panel Survey 2015/16, Wave V Report*. Government of Uganda.

Uganda Bureau of Statistics (2016c). *National Population and Housing Census 2014-Main Report*. Kampala, Uganda.

Uganda Bureau of Statistics (2014*). Uganda National Household Survey report*. Measure DHS ICF International, Calverton, Maryland, USA.

Uganda Bureau of Statistics (2011a). *The Uganda Demographic and Health Survey Report*. Measure DHS ICF International, Calverton, Maryland, USA

Uganda Bureau of Statistics (2011b). *Uganda National Household Survey report.* Measure DHS ICF International, Calverton, Maryland, USA.

UNICEF&WHO (2009). *Diarrhoea: Why children are still dying and what can be done.* Retrieved from WHO Databases. http://apps.who.int/iris/bitstream/handle/10665/44174/9789241598415_eng.pdf?sequence=1

Vogt, W.P., Vogt, R. E., Gardner, C. D., & Haeffele, M.L. (2017). *Selecting the right analyses for your data: Quantitative, qualitative, and mixed methods*. New York,

NY. The Guilford Press. Retrieved from fromhttps://www.guilford.com/books/Selecting-the-Right-Analyses-for-Your-Data/Vogt-Vogt-Gardner-Haeffele/9781462515769

World Health Organization (WHO) and the United Nations Children's Fund (UNICEF). (2017). *Progress on drinking water, sanitation and hygiene: 2017 update and SDG baselines.* ISBN 978-92-4-151289-3. Retrieved from https://washdata.org/sites/default/files/documents/reports/2018-01/JMP-2017-report-final.pdf

World Health Organization. (2017). *WHO Media. Diarrheal disease.* Retrieved from http://www.who.int/mediacentre/factsheets/fs330/en/. Accessed April 1, 2018.

World Health Organization & United Nations Children's' Fund (2015). *Water, sanitation and hygiene in health care facilities: Status in low- and middle-income countries and way forward*. ISBN 978 92 4 150847 6

WHO & UNICEF JMP. (n.a). *The new JMP ladder for hygiene*. WHO website. Accessed March 31, 2018. https://washdata.org/monitoring/sanitation.

World Health Organization. (2011). *Health Systems Strengthening Glossary.* Retreived from http://www.who.int/healthsystems/Glossary_January2011.pdf. Accessed April 1, 2018.

Walden University. (2010). *Research design: Some thoughts on the research process.* Retrieved from

http://mym.cdn.laureatemedia.com/2dett4d/Walden/COUN/8551/07/Research_Design._ ome_Thoughts_on_the_Research_Process.doc.

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