

Georgia State University

ScholarWorks @ Georgia State University

Public Health Theses

School of Public Health

Spring 4-19-2016

Examining The Influence Of HIV Status Upon The Access To Improved Water And Sanitation In Households In Kenya

Miriam Makali

Follow this and additional works at: https://scholarworks.gsu.edu/iph_theses

Recommended Citation

Makali, Miriam, "Examining The Influence Of HIV Status Upon The Access To Improved Water And Sanitation In Households In Kenya." Thesis, Georgia State University, 2016.
doi: <https://doi.org/10.57709/8550875>

This Thesis is brought to you for free and open access by the School of Public Health at ScholarWorks @ Georgia State University. It has been accepted for inclusion in Public Health Theses by an authorized administrator of ScholarWorks @ Georgia State University. For more information, please contact scholarworks@gsu.edu.

EXAMINING THE INFLUENCE OF HIV STATUS UPON THE ACCESS TO IMPROVED
WATER AND SANITATION IN HOUSEHOLDS IN KENYA

By MIRIAM N. MAKALI

B.Ed. Science (Biology and Chemistry) MASENO UNIVERSITY, KENYA

A Thesis Submitted to the Graduate Faculty of Georgia State University in Partial Fulfillment of
the Requirements for the Degree

Master of Public Health
Atlanta, GA 30303

EXAMINING THE INFLUENCE OF HIV STATUS UPON THE ACCESS TO IMPROVED
WATER AND SANITATION IN HOUSEHOLDS IN KENYA

By

MIRIAM N. MAKALI

Approved:

Dr. Christine Elizabeth Stauber, PhD

Committee Chair

Dr. Matthew Hayat, PhD

Committee Member

Date

April 19th 2016

ABSTRACT

Introduction: Access to water, sanitation and hygiene (WASH) is a basic human right, yet globally 748 million people lack access to improved drinking water, 2.5 billion lack access to improved sanitation and 946 million still practice open defecation. Sub-Saharan Africa accounts for 66% of the global new HIV infections. Access to improved WASH is an important issue, especially for people living with HIV/AIDS. They are more prone to opportunistic infections like diarrhea arising from the lack of proper sanitation and access to clean water. In Kenya, there is a dearth of literature examining the association between HIV status and the access to improved water and sanitation. This study sought to address this topic.

Aim: We set out to determine the association between HIV status and the access to improved water and sanitation in Kenya using the 2008 -2009 Kenya Demographic and Health Survey (KDHS).

Methods: The study analyzed 3753 HIV negative households and 422 HIV positive households. For descriptive statistics, a weighted sample was used to obtain the frequencies and percentages. Weighted bivariate and multivariable logistic regression was used to establish the association between HIV status and the independent variables of interest.

Results: There were no statistically significant associations in access to improved water or improved sanitation comparing HIV status and covariates measuring the access to improved water and sanitation. We did find, however, a statistically significant higher odds of HIV positive households reporting treating their drinking water compared to HIV negative households (adjusted odds ratio = 1.4; 95% confidence interval 1.11, 1.84).

Discussion: HIV positive patients are more vulnerable to opportunistic infections than the rest of the population. It is imperative for the Kenyan government to tailor specific interventions that are targeted to this particular group, through scaling up the access to basic sanitation and piped water as well as emphasizing appropriate water treatment methods at the point of use.

Keywords: Improved Water; Sanitation; Hygiene; Kenya; Demographic and Health Survey; Access; HIV/AIDS

Acknowledgements

First, I would like to thank God for the gift of life, good health and endurance throughout this program. Am eternally grateful for the support of my family and friends who have helped me walk through this far.

Special acknowledgment goes to the US-State Department, under the Foreign Fulbright Scholarship Program for offering me this opportunity to pursue my studies. The entire faculty and staff from School of Public Health, particularly my thesis committee chair Dr. Christine Stauber, for the invaluable insight, guidance and support throughout my thesis writing. Also to Dr. Matthew Hayat, my thesis committee member for the immense guidance, especially in statistical analysis of my thesis dataset.

Authors' Statement

In presenting this thesis as a partial fulfillment of the requirements for an advanced degree from Georgia State University, I agree that the Library of the University shall make it available for inspection and circulation in accordance with its regulations governing materials of this type. I agree that permission to quote from, to copy from, or to publish this thesis may be granted by the author or, in her absence, by the professor under whose direction it was written, or in his absence, by the Associate Dean, College of Health and Human Sciences. Such quoting, copying, or publishing must be solely for scholarly purposes and will not involve any potential financial gain. It is understood that any copying from or publication of this dissertation which involves potential financial gain will not be allowed without written permission of the author.

Miriam Makali

Signature of the Author

Notice to Borrowers

All these deposited in the Georgia State University Library must be used in accordance with the stipulations described by the author in the preceding statement.

The author of this thesis is:

Miriam Makali
2207 Briarcliff Rd NE, Apt 1
Atlanta, GA 30329

The Chair of the committee for this thesis is:

Dr. Christine Stauber, PhD
Environmental Health Division,
School of Public Health

Georgia State University,
School of Public Health
P.O. Box 3995 Atlanta,
Georgia 30302-3995

Users of this thesis who not regularly enrolled as student as Georgia State University are required to attest acceptance of the preceding stipulation by signing below. Libraries borrowing this thesis for the use of their patrons are required to see that each user records here the information requested.

NAME OF USER	ADDRESS	DATE	TYPE OF USE (EXAMINATION ONLY FOR COPYING)

TABLE OF CONTENTS

Acknowledgements	iv
LIST OF TABLES	viii
LIST OF FIGURES	ix
CHAPTER 1	1
INTRODUCTION	1
1.1 Background	1
1.2 Purpose of the Study	3
1.3 Research question and hypothesis	3
CHAPTER II	5
LITERATURE REVIEW	5
2.1 Improved water and Sanitation: An overview of the global access	5
2.2 Definitions of access to improved water and sanitation	6
2.3 Millennium development goals (MDG) and sustainable development goals (SDG) related to water, sanitation and hygiene (WASH)	7
2.4 Regional differences in the access to improved water and sanitation	8
2.5 Urban and rural disparities in the access to water and sanitation	9
2.7 Kenya: Country profile and WASH statistics	11
2.8 WASH situational analysis in Kenya	15
2.9 HIV/AIDS in Kenya and WASH	18
CHAPTER III	20
METHODS AND PROCEDURE	20
3.1 Data source	20
3.2 Study population	20
3.3 Sample design	20
3.4 Analysis	21
3.5 Dependent variable	21
3.6 Independent variables	21
3.7 Statistical methods	23
CHAPTER IV	25
RESULTS	25
4.2 Bivariate analysis of HIV status and independent variables of interest	27
4.4 Multivariable analysis of HIV status and independent variables of interest	29
CHAPTER V	32
DISCUSSION AND CONCLUSION	32
5.1 Discussion	32
5.2 Limitations	35
5.3 Implications	35
REFERENCES	37

LIST OF TABLES

Table 2.1 Definition of Improved and unimproved drinking water sources and sanitation facility	7
Table 2.2 Estimated trends of drinking water coverage in Kenya	13
Table 2.3 Estimated trends of sanitation coverage in Kenya	13
Table 3.1 Description of variables used in the study	23
Table 4.1 Weighted summary statistics on the water and sanitation variables	25
Table 4.2 Unadjusted logistic regression	27
Table 4.3 Adjusted multivariate logistic regression analysis	29

LIST OF FIGURES

Figure 2.1 Map of Kenya	14
--------------------------------------	----

CHAPTER 1

INTRODUCTION

1.1 Background

Access to water, sanitation and hygiene (WASH) is fundamental to humankind, yet many people living in developing countries lack access. Currently, 748 million people lack access to improved drinking water (WHO, 2016a), and about 1.8 billion people consume water from fecally contaminated sources (WHO, 2016a). Regarding sanitation, 2.5 billion people worldwide still lack improved sanitation (WHO, 2016a). Sub-Saharan Africa remains on the bottom of the world listing regarding increased access to safe drinking water and sanitation. The coverage for drinking water and sanitation globally by 2015 stood at 91% and 68% respectively (WHO / UNICEF, 2015)

The Millennium Development Goal (MDG) number 7 focuses on Ensuring Environmental Sustainability. Target 7c on water, hygiene and sanitation is “to reduce by half the proportion of people without sustainable access to safe drinking water and basic sanitation” (United Nations [UN], 2015). Globally, the target for access to safe drinking water was met, but this is not to mean that all the regions of the world have attained it (WHO, 2015). Most developing countries, especially Sub-Saharan nations, continue to grapple with challenges of providing safe –drinking water to its citizens.

The Human Immunodeficiency Virus and the resulting Acquired Immunodeficiency Syndrome (HIV/AIDS) scourge has further complicated efforts geared towards increasing access to WASH and especially in developing countries, which bear the greatest burden of the disease. According to the UNAIDS (2015), 36.9 million people are living with HIV in the world, of which 1.4 million new HIV infections reported in 2014 were from Sub-Saharan Africa. Although the incidence rate reduced by about 41% since 2000, the region has the highest number of HIV/AIDS cases globally (UNAIDS, 2015)

Access to improved water and sanitation is an important issue, especially for people living with HIV/AIDS. They are more prone to opportunistic infections like diarrhea arising from the lack of proper sanitation and access to clean water (Wegelin et al., 2003).

There is overwhelming evidence corroborating the notion that poor sanitation leads to economic losses. A desk review study by the Water and Sanitation Program (World Bank, 2010), showed that Kenya loses 27 billion Kenya shillings yearly (an equivalent to US \$324 Million) due to poor sanitation.

In recent years, research into the relationship between HIV and WASH outcomes has been popular. Several publications have linked the following factors to have influenced WASH outcomes among HIV-positive populations: distance to water source, gender biased roles, urbanization, educational attainment, economic status and stigma (Montgomery & Elimelech, 2007). Most of the studies hypothesized that HIV-positive status influences the access to water, hygiene and sanitation. However, there is a dearth of literature that addresses the issue of how HIV status influences the lack of access to improved water and sanitation. Against this background, this study seeks to explore the association between HIV status and lack of access to improved water and sanitation among populations in Kenya using the 2008/09 Demographic and

Health Survey.

1.2 Purpose of the Study

The study purpose is to determine whether there are associations between HIV status and access to improved water and sanitation in Kenya. The study further seeks to determine if this association differs between urban and rural populations. Results of this study will provide insights into developing and implementing innovative and cost-effective water and sanitation facilities to target a particular population. WASH disparities that exists between rural and urban populations and among people with HIV/AIDS need to be addressed for the country to achieve better health outcomes and economic growth.

1.3 Research question and hypothesis

Null hypothesis

Alternative hypothesis

This study will address the following research questions:

1. Is there an association between HIV status and lack of access to improved water and sanitation in Kenya?

Null hypothesis (H₀): There is no association between HIV status and lack of access to improved water and sanitation in Kenya

Alternative hypothesis (H_a): There is an association between HIV status and lack of access to

improved water and sanitation in Kenya

2. How does this association differ in urban vs. rural populations?

Null hypothesis (H₀): There is no difference in the association between HIV status and access to water and sanitation in rural versus urban populations in Kenya.

Alternative hypothesis (H_a): There is difference in the associations between HIV status and access to water and sanitation between urban vs. rural populations in Kenya.

CHAPTER 11

LITERATURE REVIEW

2.1 Improved water and Sanitation: An overview of the global access

As of 2015, 91% of the world population gained access to improved water (WHO / UNICEF JMP, 2015). Of the 91% ,4.2 billion have access to piped water and a further 2.4 billion gained access to public taps, boreholes and protected wells (WHO/UNICEF JMP, 2015). However, globally 748 million people still lack improved water sources, with a total of 159 million people still relying on surface water (WHO, 2016a). As of 2010, the world met the Millennium Development Target (MDG) for drinking water, however a number of developing countries (48 countries) did not achieve this (WHO, 2016a).

For the target of universal access to water and sanitation to be achieved globally, it is imperative to reach out to the 748 Million people still lacking improved water source, 2.5 Billion without sanitation facilities and several other millions who do not have access to soap for cleaning their hands at critical times. (WHO / GLAAS, 2014)

As of 2015, 68% of the world population have access to improved sanitation, however 2.4 billion still lack access to basic sanitation (WHO, 2016a). Among developing nations, Sub-Saharan Africa remains the region with the greatest proportion of people lacking access to sanitation facilities (30%) followed by South Asia (47%) (WHO, 2016a). About 13% of the world population still practice open defecation, of which a majority comprise the rural population (90%), with the practice catching up in the urban areas (WHO, 2016a)

2.2 Definitions of access to improved water and sanitation

Basic access to water has been defined as "the availability of 20 liters /capita/day at a distance of no longer than 1,000 meters" (WHO, 2015b, p. 91). This definition may vary depending on the spatial distribution of populations and water sources. Therefore, in this chapter, the review will center on such factors like geographic distribution, gender, wealth among other factors that influence access to improved water.

The Joint Monitoring Programme (JMP), was established by the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) to monitor the progress made by nations in expanding access to improved water and sanitation (WHO / UNICEF, 2015). The Joint Monitoring Programme (JMP) defines improved water sources as; water sources when constructed and used appropriately, that offer protection against contamination from outside and fecal matter (WHO / UNICEF JMP, 2015). Improved sanitation refers to a facility that follows a hygienic standard to separate people from coming into contact with their fecal matter (WHO / UNICEF JMP, 2015). However, these definitions may vary in different countries depending on the national guidelines on improved water and sanitation. Table 1 summarizes the definition of improved drinking water sources and sanitation facilities.

<u>Drinking-water sources</u>	<u>Sanitation facilities</u>
<u>Improved</u>	<u>Improved</u>^b
1.Piped water into dwelling, plot or yard 2.Public tap/standpipe 3.Tube well/borehole 4.Protected dug well 5.Protected spring 6.Rainwater collection	1.Flush/pour flush to: piped sewer system <ul style="list-style-type: none"> • septic tank • pit latrine 2.Ventilation improved (VIP) latrine 3.Pit latrine with slab 4.Composting toilet
<u>Unimproved</u>	<u>Unimproved</u>
1.Unprotected dug well 2.Unprotected spring 3.Cart with small tank/drum 4.Tanker truck 5.Surface water (river, dam, lake, pond, stream, canal, irrigation channel) Bottled water ^a	Flush/pour flush to elsewhere ^c Pit latrine without slab/open pit Bucket Hanging toilet/hanging latrine No facilities or bush/field
<ul style="list-style-type: none"> • a Bottled water is considered to be improved only when the household uses water from an improved source for cooking and personal hygiene. • b only private facilities are considered to be improved. • c Excreta are flushed to the street, yard or plot, open sewer, ditch, drainage way, channel river or stream. 	

Table 2.1 Definition of Improved and unimproved drinking water sources and sanitation facility (UNICEF, 2006)

2.3 Millennium development goals (MDG) and sustainable development goals (SDG) related to water, sanitation and hygiene (WASH)

The onset of the new millennium in the year 2000 led to the unprecedented adoption of the Millennium declarations and the Millennium Development Goals (MDG's) by 189 nations (United Nations [UN], 2000). The eight MDG are as follows: 1). Achieve universal primary education, 2). Eradicate extreme poverty and hunger, 3). Promote gender equality and empower women, 4). Reduce child mortality, 5). Improve maternal health, 6). Combat HIV/AIDS,

Malaria, and other diseases, 7). Ensure environmental sustainability, 8). Develop a global partnership for development (UN, 2000). Within MDG 7, there is a target to "Halve, by 2015, the proportion of (1990) population without sustainable access to safe drinking-water and basic sanitation"(United Nations [UN], 2000).

There has been a paradigm shift to the Sustainable Development Goals (SDG's) after the closure of MDG's in 2015, with the monitoring indicators for improved water and sanitation made more robust. The JMP did not explicitly provide for the monitoring and definitions of the MDG target 7c on water safety and sustainability (Shaheed, Orgill, Montgomery, Jeuland, & Brown, 2014). This led to the post-2015 WASH goals, under which the SDG 6 of MDG target 7c was expanded (UN, 2016 b). It incorporates the management of water, water quality, wastewater and ecosystem resources (UN, 2016 b). Water quality is very significant because expanding access alone does not guarantee the quality and safety of drinking water. The concept of gender in increasing coverage to sanitation facilities among women, girls, and vulnerable groups has also been incorporated (UN, 2016 b)

2.4 Regional differences in the access to improved water and sanitation

In terms of improved drinking water, there has been immense progress made by low and middle-income countries, as most of them met the target for drinking water. As of 2015, the Latin America and Caribbean had the highest access (95%), followed by East Asia (96%), West Asia (95%), South Asia (93%), North Africa (93%), South East Asia (90%) and Caucasus & Central Asia (89%) (WHO/UNICEF JMP, 2015). The Sub-Saharan Africa region attained a 68% access, while the lowest region was the Oceania at 56% (WHO/UNICEF JMP, 2015). Even though Sub-Saharan Africa region did not meet the MDG target for drinking water, as of 2015

about 669 million people have access to improved drinking water sources in the region (WHO/UNICEF JMP, 2015)

There still exists disparities in the access to piped water on a regional level, with the highest access being West Asia (89%) and the Latin Americas and the Caribbean (89%) (WHO/UNICEF JMP, 2015). The region with the lowest access remain: Sub-Saharan Africa (16%), Oceania (25%), South Asia (30%) and South East Asia (33%) (WHO/UNICEF JMP, 2015). In comparison to improved water access, most of the region did not attain the MDG target for improved access to sanitation. The regions with the highest access as of 2015 are the Caucasus & Central Asia (96%) , Western Asia (94%), Eastern Asia (77%) and Northern Africa (89%) (WHO/UNICEF JMP, 2015). Lowest access was recorded for Sub-Saharan Africa and Oceania , at 30% and 35% respectively, as of 2015 (WHO/UNICEF JMP, 2015).

2.5 Urban and rural disparities in the access to water and sanitation

Concerning the global access to improved drinking water, majority of people residing in both urban and rural areas had relative access to improved drinking water. Still, urban populations have a slightly greater proportion of access (96%) compared to those in the rural locations (84%) (WHO, 2015a). Majority of the population in Sub-Saharan Africa that lack access to improved drinking water sources, 85% (270 million people) reside in the rural areas (WHO / UNICEF /JMP, 2015).

Jacobsen et al. (2012) argued that (as cited in Water & Sanitation Program, 2013, p. 1) a greater proportion of the world's population reside in urban areas. The urban-rural migration trend peaked in developing countries over the years: from 35% in 1990 to 45% in 2010 (Jacobsen et al., 2012). This migration has led to the rise in informal settlement in urban areas,

creating a strain on the provision of basic services like water and sanitation (Jacobsen et al., 2012). In Sub-Saharan Africa, 56% of the people that gained access to improved sanitation live in urban areas (WHO/UNICEF, 2015).

The JMP (2012) indicated that globally, whereas 91% of people who had access to improved sanitation came from the wealthy quintile, only 41% of the poor quintile had access to improved sanitation (JMP, 2012). Similar results by the World Bank (2015) indicated that open defecation was highest among the poor (JMP, 2013; Jacobsen et al., 2012; World Bank, 2015). The higher rates of open defecation in rural areas is attributable to the fact that most households do not own toilets and so end up relieving themselves in open land. It is therefore imperative to address the challenges faced by the urban poor populations while at the same time target sanitation interventions among the rural populace.

2.6 Disease and economic burden related to WASH

The disease burden of infectious diarrhea is greatly attributed to water, sanitation and hygiene (WHO, 2013). The mortality due to inadequate water, sanitation and hygiene is significant, with an estimated 502,000 diarrhea deaths occurring annually from contaminated drinking water (WHO, 2015a). Furthermore, children under the age of 5 years are mostly affected, accounting for an annual death of about 361,000 (WHO, 2015). Research by Corbun and Hidebrand (2015) stated that the disability adjusted life years (DALYs) due to poor sanitation and unimproved water globally stood at about 9% in 2010(as cited in Lim et al., 2012, p. 17). Lack of proper WASH facilities has serious health and financial implications especially in countries with inadequate WASH facilities. The Ebola pandemic in West Africa was amplified, in part by the lack of proper and adequate WASH facilities (WHO / GLAAS,

2014)

There has been a notable reduction in the number of diarrhea deaths among children over the years: from 1.5 M deaths in 1990 to about 600,000 in 2012 (UN / WHO, 2014). Several authors (Curtis & Cairncross, 2003; Clasen et al., 2007; Fewtrell et al., 2005.) demonstrated that the rate of diarrhea disease could be reduced by 30 - 40% if people practiced proper WASH behaviors. Curtis & Cairncross, (2003) analyzed and compared the effects of hand washing with soap on diarrhea risk at the household level. The findings indicated that hand washing reduced diarrhea risk by about 47%, severe intestinal infections by 48% and shigellosis by 59% (Curtis & Cairncross, 2003). However, most of the studies were based on self-reported responses about hand washing and therefore not an accurate reflection of the real world.

Rheingans et al. (2012) examined how the economic status of households influenced health-seeking behavior of childhood diarrhea disease in 3 African countries. The results indicated that most poor households avoided seeking medical care when their children fell ill from diarrhea illness, citing costs, thereby exacerbating the condition and thus child mortality (Rheingans et al., 2012).

2.7 Kenya: Country profile and WASH statistics

Kenya is located in the East Africa, along the equator covering an area of 582,646-kilometer squares, and shares borders with Ethiopia, Somalia, Tanzania, Uganda, and South Sudan (Kenya National Bureau of Statistics, 2014). It has a population of 46 million people and a GDP of \$145.650 Billion (KNBS, 2015). Agriculture and tourism industry are major contributors to the country's economy, with the former generating about one-third of the country income. Upon the promulgation of the new constitution in 2010, the country adopted the county system

(47 counties) as the administrative and political unit of government. The national government is in charge of coordination of the water and sanitation. However, service delivery of water and sanitation, remains with the county government (KNBS, 2015).

Kenya is considered a water scarce country by the fact that its renewable fresh water per capita is below the global benchmark of 1000 cubic meters (Kenya Water Report, 2006). Its renewable fresh water per capita now is 647 cubic meters, and it is predicted to reduce even further by the year 2020 to about 359 cubic meters (Kenya Water Report, 2006). Limited natural resources, depletion of water catchment areas, droughts, floods and an increase in the size of the population are the key issues affecting the availability of water in the country (Integrated Water Resource Management and Water Efficiency Plan for Kenya, August 2009).

For populations residing in rural areas in Kenya, water usage is determined by the region's potential, which is based on the annual rainfall, the topography, soil type, road, etc. High potential areas receive an annual rainfall of over 1000mm, middle potential receive between 500-1000mm and low potential receive less than 500mm (Kenya Water Report, 2006). For urban populations in Kenya, their water demand is classified according to the type of housing namely; high class, medium class and low class. High class and medium class housing are houses in low-density areas, fitted with laundry, dish areas, bathroom and water closet inside. Low class housing on the other hand is in densely populated housing units, fitted with an external water source area for laundry and dishwashing (Kenya Water Report, 2006)

Table 2.0 and Table 2.1 below summarizes the estimated trends of drinking water and sanitation coverage in Kenya as cited in the JMP.

Kenya	Drinking water coverage estimates					
	Urban (%)		Rural (%)		Total (%)	
	1990	2015	1990	2015	1990	2015
Piped onto premises	55	45	10	14	17	22
Other improved source	37	37	23	43	26	41
Other unimproved	5	13	19	15	16	15
Surface water	3	5	48	28	41	22

Table 2.2 Estimated trends of drinking water coverage in Kenya

Source: WHO/UNICEF JMP, 2015

Kenya	Sanitation coverage estimates					
	Urban (%)		Rural (%)		Total (%)	
	1990	2015	1990	2015	1990	2015
Improved facilities	27	31	24	30	25	30
Shared facilities	41	48	16	19	20	27
Other unimproved	29	18	38	36	36	31
Open defecation	3	3	22	15	19	12

Table 2.3 Estimated trends of sanitation coverage in Kenya

Source: WHO/UNICEF JMP, 2015



Figure 2.1 Map of Kenya (source: <http://www.mapsofworld.com/kenya/>)

2.8 WASH situational analysis in Kenya

2.8.1 Sanitation

As of 2015, only 30% of all households in Kenya had access to improved sanitation up from 25% in 1990, indicating a very slow progress (WHO/UNICEF JMP, 2015). Consistent with these results, the Kenya Demographic and Health Survey (2014) estimated less than a quarter of the household to have gained access to improved sanitation (KDHS, 2014). Furthermore, about 27% of the population share toilet facilities, 31% depend on unimproved sanitation and 12% practice open defecation (WHO/UNICEF JMP, 2015).

The lack of adequate sanitation in the Kenya informal settlements of urban areas forces residents to depend on commercialized toilets, commonly referred to as pay per use toilet, resulting in economic burden for most families (Corburn & Hildebrand, 2015). The average monthly cost of using a toilet for households was estimated to be 305Kenya shilling (\$3), accounting for about 3% of the expenses (Rheingans et al., 2012). The cost may be more depending on the number of people in the households and in the eventuality that a person experiences bout of diarrhea illness, then more toilet visits inflate the cost (Corburn & Hildebrand, 2015). Also, there is no hand washing stations next to the toilets, further worsening the already deplorable unhygienic conditions (Corburn & Hildebrand, 2015)

According to the African Population and Health Research Center (APHRC, 2000), diarrhea disease was found to be more prevalent, at 31% among children under 3 years who resided in the informal settlement compared to other parts of Nairobi (APHRC, 2000; Corburn & Hildebrand, 2015).

The issue of gender is pertinent in addressing equitable access to hygiene and sanitation because women and girls bear the greatest brunt. In Kenya, poor sanitation is ranked among the top six causes of years of life lost among women aged 15-49 years (World Bank & WSP, 2012). Out of the total annual reported diarrhea deaths in Kenya among children under the age of 3 years, about 65% were attributed to girls (World Bank & WSP, 2012). In Kenya, 49% of adult women are tasked with the responsibility of fetching water, a higher proportion (58%) being women in rural areas. Men are less tasked with such responsibility; about 9% of men in rural areas actually fetch water for their households (KDHS, 2014).

Upon a study of the social determinant of women's health in an informal settlement in Nairobi, Kenya, violence against women was the main hindrance in accessing sanitation facilities (Corburn & Hildebrand, 2015). Results from the focus group discussion on women responders, found that 68% of women experienced violence in different ways, including rape (36%) (Corburn & Hildebrand, 2015). Gender, coupled with extreme poverty increases vulnerability among women and girls in such settings, as they are forced to walk a longer distance to access these facilities (Corburn & Hildebrand, 2015). This in turn makes them resort to degrading ways of relieving themselves, e.g. using buckets. Menstrual hygiene for women and girls becomes a challenge too when there are no enough toilets where they can change and dispose used sanitary towels (Corburn & Hildebrand, 2015).

2.8.2 Drinking water

There has been progress in terms of access to improved water, from 43% in 1990 to 63% in 2015 (WHO/UNICEF JMP, 2015). However stark differences still exist in piped water access in rural (14%) vs urban (45%) populations, with a notable increase in other source of improved water among the rural populace (from 23% in 1990 to 43% in 2015) (WHO/UNICEF JMP, 2015).

Recently published report by the Kenya Demographic and Health Survey (KDHS) 2014 showed that 70% of household in Kenya use improved water source (KDHS, 2014). However, geographical disparities continue to persist. In terms of location of water sources, populations in rural areas (about 39%) travel a longer distance compared urban households (6%) to access water sources, with an estimated mean travel time to water sources being 30 minutes. Furthermore, only 33% of the rural households have water on the premises compared to the 67% of the urban households (KDHS, 2014).

Geographical disparities exist in terms of water treatment too. Overall, only 45% of households in Kenya treat their drinking water (KDHS, 2014). This is a worrisome trend, since 37% of Kenyans drink water from unimproved sources (WHO/UNICEF JMP, 2015), which might be highly contaminated with microbial hazards. More so, the rural population depends heavily on surface water (28 %) compared to their urban counterparts (5 %), making them more prone to WASH related diseases (WHO/UNICEF JMP, 2015). Out of those who treat their drinking water, 57 % are from the urban areas compared to 40% in the rural (KDHS, 2014).

Water quality is very critical while ensuring access to improved water to populations and especially to the urban poor. Research by Kimani-Murage and Ngindu (2007) in Langas slum in Kenya indicated that contamination was highest in the well water which may have been

associated with use of pit latrines and open defecation in the densely populated area (Elizabeth Wambui Kimani-Murage & Ngindu, 2007). This study highlights the fact that while populations in urban areas may have access to improved drinking water, they may be still prone to exposure from contaminated drinking water. The urban poor are often at risk for poor health conditions since they are not eligible to benefit from services like water, drainage, sewerage and garbage collection (APHRC, 2002 ; Elizabeth W. Kimani-Murage et al., 2011)

2.9 HIV/AIDS in Kenya and WASH

The HIV/AIDS prevalence in Kenya is 5.3 % (UNAIDS, 2015). The prevalence of HIV infections is higher among females than among males, with an estimated 58% of the adult HIV population being women (Kenya Aids Indicator Survey Report, 2014). The Prevalence in Kenya is lower compared to other countries like Swaziland (27.4%), South Africa (18.9%) and Uganda (7.3%) (UNAIDS, 2015). Overall Sub-Saharan Africa accounts for 66% of the new HIV infections in the world (UNAIDS, 2015). Poor sanitation has serious ramifications on People living with HIV and AIDS (PLWHVA) as their health is exacerbated by opportunistic infections like diarrhea and skin infections (Bery & Rosenbaum, 2010). Diarrhea disease is very common among PLWHVA, and the recurrent bouts of diarrheal infections might affect the metabolism of antiretroviral drugs and other vital nutrients (Bushen et al., 2004)

Findings from a randomized controlled trial study on the effectiveness of water filters in preventing diarrhea among HIV-infected people indicated that filtration reduced incidences of

diarrhea disease from 15% to 80%, depending on the usage (Pavlinac et al., 2014)). However, several factors hinder the effective use of water treatment methods among people living with HIV/AIDS, such as cost, knowledge and attitudes, access to improved water sources, amongst others (Clasen, Haller, Walker, Bartram, & Cairncross, 2007).

A study by Wanyiri et al (2013) on 164 HIV/AIDS patients in Nairobi (70 patients with infectious diarrhea and 94 without), found that lower odds of diarrhea was associated with consumption of treated drinking water. In that study, intestinal parasites were present in 70% of the patients, of whom were strongly associated with having incidences of diarrhea, as opposed to those who did not (Wanyiri et al., 2013). The results of that study provides a strong indication that in areas where there is lack of access to improved water sources, treatment of the water at point of use plays a vital role in disease prevention. A greater proportion (12%) of the urban poor residents in Nairobi are infected with HIV compared to 5% of the rest of the city population. Women in the slums are disproportionately affected compared to their male counterparts, with a prevalence of over 38% (Wanyiri et al., 2013). It is evident that PLWHVA require more access to sanitation facilities, as well as more water usage (20 to 80 liters/day) compared to the general population (WHO, 2014). They experience higher episodes of diarrhea, 6 times higher than the general population (WHO, 2014) and thus need more water for washing their soiled clothes, for bathing and drinking. Therefore, understanding the association between HIV status and the access to improved water and sanitation will generate much needed evidence to focus WASH interventions on this particular vulnerable group. Towards this objective, the rationale of the study is to determine the associations between HIV status and access to improved water and sanitation in Kenya. Also to determine if this association differs between urban and rural populations.

CHAPTER III

METHODS AND PROCEDURE

3.1 Data source

This study dataset was extracted from the Kenya Demographic and Health Survey (DHS) 2008-2009 (website:https://dhsprogram.com/data/dataset_admin/download-datasets.cfm). These are cross-sectional surveys designed to generate data for monitoring the health and population of Kenyans. The Kenya National Bureau of Statistics conducted the 2008-2009 Kenya Demographic and Health Survey (KDHS), with the technical assistance from Measure DHS. The most recent KDHS did not include data on HIV/AIDS and thus the choice to use the 2008 -2009 dataset.

3.2 Study population

The KDHS 2008-2009 includes a representative sample of 10,000 households across all the eight provinces of the country. The sample encompassed 8,444 women aged 15-49years and 3465 men aged 15 to 54years from 400 clusters in the country.

3.3 Sample design

The sampling frame for the KDHS 2008-2009, the fourth National Sample Survey and Evaluation Programme (NASSEP IV) involved a two-stage stratified sampling design. The frame was developed in 2002 from enumeration areas of the 1999 population and housing census. The first step sampling included listing 400 clusters (133 urban and 267 rural) from the national

sample frame. Next, the households were systematically sampled from the updated household list. For the HIV testing, male and female individuals residing in the household were invited to be tested. All protocols were followed regarding blood specimen and ethical considerations.

3.4 Analysis

The unit of analysis for this thesis was the household level. Assumptions were made regarding how to classify the households into HIV status. If any individual in the household tested positive for HIV, then that household was coded as a “HIV positive household”.

Otherwise, if there were no positive tests in the household, then the household was coded as a “HIV negative household”.

3.5 Dependent variable

3.5.1 HIV status

HIV status (HIV positive or HIV negative) formed the dependent variable of interest. The test results were obtained from testing individual members in the households for HIV. The reference group for the dependent variable of interest was HIV positive.

3.6 Independent variables

3.6.1 Drinking Water

The variable for improved drinking water was coded as improved water; according to the JMP definition of improved and unimproved drinking water sources (see Table 1). However, in this study, bottled water was categorized as improved drinking water source if the household source of non-drinking water was improved. Improved drinking water sources includes: piped

water into dwelling, piped water into the plot, public tap/standpipe, tube well or borehole, protected dug well, protected spring, bottled water and rainwater. Unimproved drinking water source includes unprotected dug well, unprotected spring, tanker truck/cart with small tank and Surface water

3.6.2 Household sanitation

The variable for improved sanitation was coded based on the JMP definition of improved sanitation (see Table 1). The households were first classified into two categories; improved toilet facility and unimproved toilet facility. Improved toilet facility includes: flush/pour flush to piped sewer system, flush/pour flush to septic tank, flush/pour flush to pit latrine, ventilated improved pit (VIP) latrine and pit latrine with slab. Unimproved toilet facility includes: bucket/hanging toilet, no facility/bush/field, pit latrine without slab/open pit, flush/pour flush not to sewer/septic tank/pit latrine.

3.6.3 Wealth index

The wealth index variable was coded as a proxy for the socioeconomic status of a household. The coding was divided into quintiles: Poorest, Poorer, Middle, Richer and Richest. The variable has an assigned weight (factor score) for each household based on the assets they possess.

3.6.4 Region

The place of residence according to this study was coded as region. It refers to the place where the respondents were interviewed, i.e. in the rural area or the urban area. The categorization was based on how the clusters were defined, i.e. urban or rural. The urban regions

included large cities (populations of over 1 million), small cities (populations over 50,000) and towns, which were considered as other urban areas. Rural regions composed all the other areas not considered urban. Table 3 below summarizes variables used for analysis in this study.

Table 3.1 Description of variables used in the study

	Variable Description	Type of data
Dependent variable	HIV status	Binary
Independent variable	Type of place of residence	Binary
	Access to improved water	Binary
	Time to get to water source	Continuous
	Access to improved sanitation	Binary
	Shared toilet with other households	Binary
	Anything done to make water safe to drink	Binary
	Wealth Index	Categorical

3.7 Statistical methods

Statistical Analysis System (SAS) software was used for analyses of the dataset (SAS, version 9.4; SAS Institute Inc., Cary, NC). Descriptive statistics were performed to obtain the frequency distribution, the mean and identify the proportion of missing values of the variables in the dataset. Weighted chi-square statistical tests were used to compute the frequencies and percentages and test for associations with the outcome. Concerning inferential statistics, weighted bivariate logistic regression was used to measure the association between HIV status and each independent variable of interest. Crude odds ratio was recorded for these variables and compared with the adjusted odds ratio in multivariable logistic model. The first multivariable

logistic regression controlled for wealth and region. The second model (full model) was adjusted for the following variables; region, wealth, improved sanitation, shared toilet facility, improved water and any treatment to water. Further stratification was done based on the region. The DHS used two sampling weights, the household and the individual weights. For purposes of this study, the household sample weight was applied when performing the statistical analyses. The level of statistical significance for this study was set a priori at p-value <0.05.

CHAPTER IV

RESULTS

This study analyzed data from the Kenya DHS 2008-2009, encompassing 9057 observations. Out of the total 9057 households sampled in this study, 3753 (90%) households were categorized as HIV negative and 422 (10%) as HIV positive households. The frequencies and percent coverage of access to improved water sources and sanitation are presented in Table 4.1

Table. 4.1. Weighted summary statistics on the water and sanitation variables			
Summary statistics for households by treatment of drinking water, improved water sources, improved sanitation facilities and region, according to Kenya Demographic and Health Survey 2008-09			
	All HH N=9057	HIV negative N=3753	HIV positive HH N=422
Improved sanitation	2180 (23.14)	777 (23.25)	79 (19.90)
Shared toilet facility	3824 (50.17)	1422 (49.92)	213 (59.28)
Improved drinking water sources	5906 (63.41)	2150 (63.77)	293 (70.26)
Treated water	3956 (45.12)	1409 (45.85)	228 (54.81)
Treat water by boiling	2444 (28.65)	862 (29.08)	122 (29.50)
Treat water by filter	92 (0.8)	25 (0.58)	3 (0.18)
Treat water by bleach/ chlorine	1569 (17.64)	584 (18.81)	117 (28.51)
Treat water by straining; cloth	107 (1.20)	3 (1.13)	10 (3.23)
Treat water by solar disinfection	14 (0.04)	3 (0.14)	2 (0.22)
Treat water by let it stand and settle	43 (0.07)	14 (0.28)	3 (0.98)
Region			
Urban	2910 (25.95)	1043 (25.84)	155 (27.19)
Rural	6147 (74.05)	2267 (74.16)	267 (72.81)
Wealth			
Poorest	1060(16.34)	662(17.00)	55(12.73)
Poorer	792(17.75)	491(16.48)	78(16.46)
Middle	896(18.98)	527(17.18)	65(15.70)
Wealthier	998(19.78)	624(21.13)	80(21.9)
Wealthiest	1579(27.11)	1006(28.21)	144(31.20)
Time to water location(round trip)			
Mean time to get to water location Mean (SD)		22.54 (2.7)	19.10 (2.7)

Log transformations were used to estimate the mean time to get to water locations

*N (%) displayed unless otherwise noted.

4.1.2 Sanitation facilities

As shown in Table 4.1, only 23% of all the households had access to an improved sanitation facility. The HIV negative households have a slightly higher percentage of access to improved sanitation (23 %) compared to HIV positive households (20%). About 50% of all the households sampled in this study reported sharing toilet facilities with other households. The sharing was mostly common for HIV positive households (59%) compared to HIV negative households (50%).

4.1.3 Improved drinking water sources

As depicted in Table 4.1, 63% of all households had access to improved drinking water sources. Among those households that had an HIV test, a higher proportion of the HIV positive households (70%) reported getting their drinking water from an improved source compared to HIV negative households (64%). In terms of water treatment options, boiling and chlorine were the most commonly used treatment option. About 29% of all the households reported boiling water, with both HIV positive (30%) and HIV negative households (29%) reporting a similar percentage.

Water treatment with chlorine was reported for 18% of all the households analyzed in this study. Households with HIV positive persons had a greater percentage of reporting treating water-using chlorine (29%) than HIV negative households (19%). Fewer households (about 1%) used straining as a method of water treatment, with more HIV positive households reporting a higher use of this method (3%) compared to the HIV negative households (1%). Other methods like solar disinfection and letting water stand and settle were least reported to be used overall for all the households (less than 1%). The average time to fetch water for a round trip was reported to be

less for HIV positive households (19minutes) compared to HIV negative households (22 minutes) and was overall not > 30 minutes on average.

4.1.5 Region

The majority in this study resided in the rural areas (74%) compared to those in the urban areas (26%).In the urban areas; there was a slightly higher percentage of HIV positive households (27%) compared to the HIV negative households (25%).

4.2 Bivariate analysis of HIV status and independent variables of interest

To examine associations between HIV positive test household and access to WASH variables, we performed logistic regression. Unadjusted associations are presented in table 4.2

Table 4.2 Weighted Unadjusted logistic regression
Association between HIV status and the independent variables among households
according to the Kenya Demographic and Health Survey,2008 - 09

Independent variables	HIV Status=positive	
	UOR	95 % C.I
Improved Water sources	1.3	(1.01 - 1.78)
Improved sanitation	0.8	(0.59 - 1.14)
Shared facility	1.5	(1.10 - 1.93)
Done anything to treat water?		
Yes	1.4	(1.12 – 1.84)
No	1.0	Reference
Region		
Urban	1.0	Reference
Rural	0.9	(0.67 - 1.31)
Wealth index		
Poorest	1.0	Reference
Poorer	1.5	(0.97 - 2.29)
Middle	1.2	(0.72- 2.06)
Wealthier	1.4	(0.82 - 2.35)
Wealthiest	1.5	(0.90 - 2.42)

UOR = Unadjusted odds ratio , C.I = confidence interval

As shown in table 4.2, statistically significant associations were found between HIV status and improved water sources, shared facility and anything done to treat water. In this unadjusted analysis, the odds of having HIV positive households among those with improved drinking water are 1.3 times the odds of having HIV negative households (95%; C. I: 1.01, 1.78). However, in terms of improved sanitation, there was a not a statistically significant association between HIV positive households and odds of reporting improved sanitation (OR= 0.8; 95% C.I: 0.59 ,1.14). The odds of having HIV positive households among those sharing toilet facility are 1.5 times the odds of having HIV negative households (95%; C.I: 1.10 ,1.93). The odds of finding HIV positive households report treating their drinking water are 1.4 times the odds of HIV negative households (95%; C. I: 1.12 ,1.84). There was no statistically significant association between HIV status and the region (urban vs. rural). The odds of having HIV positive

households in the rural region are 0.9 times the odds of finding them in the urban region (95%; C. I: 0.67 ,1.31). Similarly, there was no statistically significant association between HIV status and wealth.

4.4 Multivariable analysis of HIV status and independent variables of interest

In an attempt to address the complex nature of access to water and sanitation as well as HIV status, we performed multivariable logistic regression and the results are provided in Table 4.3. The first model (model 1) was adjusted for wealth index and region. Model 2 was adjusted for region, wealth index, improved water source, improved sanitation, shared facility and treatment of water. Model 3 was adjusted for region, wealth index, improved water source, improved sanitation and treatment of water. Among the independent variables, region (urban vs. rural) and wealth status were assessed for effect modification but we failed to find an effect.

Table 4.3 Weighted Adjusted multivariable logistic regression

Association between HIV status and the independent variables among households according to the Kenya Demographic and Household Survey 2008 - 09

HIV status=positive									
Model 1				Model 2			Model 3		
Independent variables	AOR	95 % C.I	P value	AOR	95 % C.I	P-value	AOR	95 % C.I	P-value
Improved Water sources									
Yes	1.3	(0.921 - 1.844)	0.1342	1.2	(0.85 - 1.71)	0.301	1.4	(0.96 - 1.93)	0.083
No	1.0	Reference		1.0	Reference		1.0	Reference	
Improved sanitation									
Yes	0.8	(0.55 - 1.06)	0.113	1.1	(0.71 - 1.62)	0.752	0.7	(0.52 - 1.01)	0.061
No	1.0	Reference		1.0	Reference		1.0	Reference	
Shared facility									
Yes	1.4	(1.06 - 1.93)	0.018*	1.5	(1.05 - 2.21)	0.026*			
No	1.0	Reference		1.0	Reference				
Treat water									
Yes	1.4	(1.07 - 1.78)	0.014*	1.3	(0.98 - 1.68)	0.069	1.4	(1.11 - 1.84)	0.006*
No	1.0	Reference		1.0	Reference		1.0	Reference	
Region									
Urban				1.0	Reference		1.0	Reference	
Rural				1.20	(0.79 - 1.85)	0.386	1.1	(0.74 - 1.78)	0.539
Wealth index									
Poorest				1.0	Reference		1.0	Reference	
Poorer				1.6	(0.85 - 2.85)	0.155	1.4	(0.89 - 2.12)	0.156
Middle				1.4	(0.74 - 2.73)	0.288	1.1	(0.65 - 1.93)	0.691
Wealthier				1.5	(0.76 - 3.07)	0.229	1.2	(0.68 - 2.23)	0.492
Wealthiest				1.6	(0.79 - 3.19)	0.196	1.3	(0.69 - 2.39)	0.423

AOR: Adjusted odds ratio, C. I=Confidence Interval Model 1: Adjusted for region and wealth index

Model 2: Adjusted for region, wealth index, improved water and sanitation, treatment of water and shared facility

Model 3: Adjusted for region, wealth index, improved water and sanitation and treatment of water

As shown in table 4.3, after adjusting for region and wealth index in model 1, statistically significant associations with household HIV positive status were found for the following variables: shared facility (AOR = 1.4; 95% C.I: 1.06, 1.93) and anything done to treat water (OR = 1.4; 95% C.I: 1.07, 1.78). However, after further adjustment (see Table 4.3 model 2), only shared facility was found to be statistically significant (AOR = 1.5; 95% C. I: 1.05, 2.21) in the presence of all variables considered. The odds of sharing toilet facility among HIV positive households is 1.5 times the odds of HIV negative households after controlling for the other variables in the model.

Upon further adjustment, in presence of all other variables excluding the shared facility (see Table 4.3 model 3), only the variable for anything done to treat water was considered statistically significant (AOR = 1.4; 95% C. I: 1.11, 1.84). The odds of treating water among HIV positive households is 1.4 times the odds of HIV negative households after controlling for the other variables in the model.

CHAPTER V

DISCUSSION AND CONCLUSION

5.1 Discussion

In this study, we examined the association between HIV status and the access to improved water and sanitation in Kenya, based on the Kenya Demographic and Health Survey 2008-09. We found no statistically significant associations between a household HIV status and access to improved water and sanitation. Consistent results from Schilling, K. A. (2015), found no statistical significance in access to drinking water among HIV positive vs. HIV negative households in Nyanza region of Kenya (Schilling, K. A., 2015).

The results indicate that shared facility variable has an effect on the association between HIV positive status and other independent variables. When included in model 2, there is no statistically significant results for anything done to treat water (p-value=0.069). However, when excluded in model 3, there is a statistically significant result for anything done to treat water (p-value=0.006). Similarly, there is no statistically significant results for improved sanitation in all the models (see Table 4.3). This can be explained based on how the improved sanitation variable was coded in this analysis. All households that shared facility, irrespective of whether it was an improved toilet facility, were classified to have unimproved sanitation.

We did, however, find a statistically significant association between household HIV status and reported treatment of drinking water. There was a higher odds of HIV positive household for those who reported treating their drinking water, compared to HIV negative households. Results from the Global Enteric Multi Centre Study (GEMS) in rural-western Kenya

indicated that unimproved water exacerbated diarrhea illness among PLHVA (Center for Vaccine Development/University of Maryland, 2015). The causative pathogens attributed to diarrhea illness in the region (cryptosporidium, shighella, Rotavirus and E. coli) are all associated to poor sanitation and contaminated drinking water and could possibly be eliminated with appropriate water treatment (Center for Vaccine Development/University of Maryland, 2015).

5.1.1 Improved Sanitation

In this study, about 20% of the HIV positive households had access to improved sanitation facilities compared to 23% of the HIV negative households. While we initially found a statistically significant decreased odd of access to improved sanitation among HIV positive households, this did not remain after further adjustment. However, the overall access to improved sanitation is an important area for improvement. Most recent results suggest some improvement although more than two thirds still lack access to improved sanitation. (WHO/UNICEF JMP, 2015).

5.1.2 Improved water sources

A majority of the households sampled in this study had access to improved drinking water sources (63%) and we found no significant difference between households with HIV positive individuals and those without. While earlier research has suggested some evidence of stigma or reduced access to water, we did not find this in our study. A study carried out by Yallew et al. (2012) to assess WASH practices among PLHVA home based care services in Gonder, Ethiopia reported stigma at water points from 33% of the responders (Yallew et al., 2012).

5.1.3 Treatment of water

In our study, the only association that remained statistically significant was reported treatment of drinking water and HIV positive households. This suggests that either these households were more aware of the need to improve the quality of their water (irrespective of their access to improved sources). Schilling et al., 2015, in a study based on a large case control study of moderate to severe diarrheal disease in Kenya, found that HIV positive households that were aware of their HIV status for at least 30 days prior to the survey, reported increased treatment of drinking water. The authors hypothesized that HIV and WASH services were being bundled in this country and that may have been a positive impact on WASH behaviors in PLHVA (Schilling et al., 2015). The implementation of the basic care package in 2009, as a major HIV intervention program could be largely credited for the promotion of safer drinking water practices among PLHVA (National Aids STI & control program, 2016). Under the package, HIV positive patients receive water bleach for treating water(chlorine), cotton filter cloth and a 5-gallon container for the safe storage of treated water (NASCOP, 2016). However, that may not have been in place during the time data was collected for this study.

For Kenya to achieve the WASH-related SDG targets by 2030, a stepwise approach should be adopted to increase access and improve infrastructure based on wealth index and region (rural vs. urban). For instance, most rural households (15%) still practice open defecation compared to the urban (5%) ones (WHO / UNICEF JMP (2015). Priority should be to ensure these households are open defecation free (ODF). Consequently, they will transition to unimproved facility before finally upgrading to an improved facility (WHO/UNICEF JMP, 2015). Similarly, in terms of improved drinking water, rural households should first transition

from using surface water to improved communal water source, and finally into piped water present on the dwelling.

In examining the socio-economic disparities related to WASH, lower income persons bear the greatest brunt of inadequate and lack of WASH facilities (Hutton, 2016). Given this orientation, the government and donors should allocate more funding to the lower socio-economic groups of the population, with a bias towards PLHVA. This will ultimately create a balance between increasing basic access to WASH facilities to those without and improving the existing WASH infrastructure to populations already benefiting from it.

5.2 Limitations

A key limitation of this study is that the data set used is 7 years old (DHS, 2008/09). Therefore, the results of this study may not reflect the current WASH situation in the country, obviously, because progress has been made in the access to improved water and sanitation. Secondly, like with all cross-sectional studies, recall bias and self-reported bias from participants are likely to occur. In addition, since the DHS is a cross-sectional study, causality cannot be established and as such the analysis is limited to testing relationships.

5.3 Implications

Even though the study results show that there were no statistical differences between HIV positive and HIV negative household in the access to improved drinking water and sanitation, it is evident from research studies that HIV positive patients are more vulnerable to opportunistic infections than the rest of the population. There is need for the government to tailor specific interventions that are targeting this particular group. In examining the treatment options, even though most PLHVA used chlorination, pathogens like cryptosporidium remain a risk to them, as

chlorination does not effectively eliminate it. Therefore, it is imperative for the government to scale up the access to piped water to this vulnerable group. Emphasis on appropriate water treatment methods at the point of use, should be part and parcel of HIV intervention programs (e.g. basic care package).

In an effort to achieve universal access to water and sanitation by the year 2030, an estimated Kenya shilling 1.5 Trillion (100 billion annually) is needed against the current budget of 40 billion Kenya shilling (Ministry of Water & Sanitation, 2014). Exploring financing options are therefore fundamental to addressing the country's deficit budget. Presently the Ministry of water has reached out to commercial investment and the private sector, through the public-private partnership (PPP) in an effort to address this (Ministry of Water & Sanitation, 2014). Similarly, in terms of improved drinking water, rural households should first transition from using surface water to improved communal water source, and finally into piped water present on the dwelling.

REFERENCES

- African Population and Health Research Center, *Urban Health in Kenya Key Findings (2012): The 2000 Nairobi Cross-Sectional Slum Survey*. [Online] Retrieved from <http://aphrc.org/publications/urban-health-in-kenya-key-findings-2000-nairobi-cross-sectional-slum-survey/>. [Accessed February 2016].
- Bery, R., & Rosenbaum, J. (2010). *How to integrate water, sanitation, and hygiene into HIV programmes*. Geneva, Switzerland: World Health Organization.
- Bushen, O. Y., Davenport, J. A., Lima, A. B., Piscitelli, S. C., Uzgiris, A. J., Silva, T. M. J., ... Guerrant, R. L. (2004). Diarrhea and Reduced Levels of Antiretroviral Drugs: Improvement with Glutamine or Alanyl-Glutamine in a Randomized Controlled Trial in Northeast Brazil. *Clinical Infectious Diseases*, 38(12), 1764–1770.
<http://doi.org/10.1086/421394>
- Clasen, T., Haller, L., Walker, D., Bartram, J., & Cairncross, S. (2007). Cost-effectiveness of water quality interventions for preventing diarrhoeal disease in developing countries. *Journal of Water and Health*, 5(4), 599–608. <http://doi.org/10.2166/wh.2007.010>
- Curtis, V., & Cairncross, S. (2003). Review: Effect of washing hands with soap on diarrhea risk in the community: a systematic review. *The Lancet Infectious Diseases*, 3275-281. doi: [10.1016/S1473-3099\(03\)00606-6](https://doi.org/10.1016/S1473-3099(03)00606-6)
- 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.
<http://doi.org/10.1155/2015/209505>

Hutton, G., & Mili Vrugheze (2015). Global Costs and Benefits of Drinking-Water Supply and Sanitation Interventions to Reach the MDG Target and Universal Coverage. Report No. WHO/HSE/WSH/12.01, World Health Organization, Geneva.

Hutton, G. (2016). The cost of meeting the 2030 Sustainable Development Goal Targets on Drinking Water, Sanitation and Hygiene. [Online] Retrieved from: <https://www.wsp.org/sites/wsp.org/files/publications/Summary.pdf> [Accessed February 2016].

Kimani-Murage, E. W., Holding, P. A., Fotso, J.-C., Ezeh, A. C., Madise, N. J., Kahurani, E. N., & Zulu, E. M. (2011). Food Security and Nutritional Outcomes among Urban Poor Orphans in Nairobi, Kenya. *Journal of Urban Health*, 88(S2), 282–297.
<http://doi.org/10.1007/s11524-010-9491-z>

Kimani-Murage, E. W., & Ngindu, A. M. (2007). Quality of Water the Slum Dwellers Use: The Case of a Kenyan Slum. *Journal of Urban Health*, 84(6), 829–838.
<http://doi.org/10.1007/s11524-007-9199-x>

Magadi, M. A. (2013). The disproportionate high risk of HIV infection among the urban poor in sub Saharan Africa. *AIDS and Behavior*, 17(5), 1645–1654.
<http://doi.org/10.1007/s10461-012-0217-y>

Montgomery, M. A., & Elimelech, M. (2007). Water and sanitation in developing countries: including health in the equation. *Environmental Science & Technology*, 41(1), 17–24.

Mugambe, R. K., Tumwesigye, N. M., & Larkan, F. (2013). Barriers to accessing water, sanitation and hygiene among people living with HIV/AIDS in Gomba and Mpigi

districts in Uganda: a qualitative study. *Journal of Public Health*, 21(1), 29–37.

<http://doi.org/10.1007/s10389-012-0515-x>

National AIDS and STI Control Programme (NASCO), Kenya. Kenya AIDS Indicator Survey 2012: Final Report. Nairobi, NASCO. June 2014.

Pavlinac, P. B., Naulikha, J. M., Chaba, L., Kimani, N., Sangare, L. R., Yuhas, K. ... Walson, J. L. (2014). Water Filter Provision and Home-Based Filter Reinforcement Reduce Diarrhea in Kenyan HIV-Infected Adults and Their Household Members. *American Journal of Tropical Medicine and Hygiene*, 91(2), 273–280. <http://doi.org/10.4269/ajtmh.13-0552>

Population Service Kenya. (2016). Basic care package. [Online] Retrieved from:

<http://www.psikenya.org/index.php?id=27> [Accessed February 2016].

Prüss, A., Kay, D., Fewtrell, L., & Bartram, J. (2002). Estimating the burden of disease from water, sanitation, and hygiene at a global level. *Environmental Health Perspectives*, 110(5), 537–542.

Rheingans, R., Kukla, M., Adegbola, R. A., Saha, D., Omere, R., Breiman, R. F. ... Levine, M. M. (2012). Exploring Household Economic Impacts of Childhood Diarrheal Illnesses in 3 African Settings. *Clinical Infectious Diseases*, 55(suppl 4), S317–S326.
<http://doi.org/10.1093/cid/cis763>

Shaheed, A., Orgill, J., Montgomery, M. A., Jeuland, M. A., & Brown, J. (2014). Why “improved” water sources are not always safe. *Bulletin of the World Health Organization*, 92(4), 283–289. <http://doi.org/10.2471/BLT.13.119594>

Schilling, K. A. (2015). Exploring Leading Causes of Childhood Morbidity using the Global Enterics Multicenter Study (GEMS), rural western Kenya, 2008-2012 (Unpublished doctoral thesis). Georgia States University, Atlanta, Georgia.

UNICEF. (2006). *Progress for children: a report card on water and sanitation*. New York, NY: UNICEF.

United Nations: Sustainable Development Goals (2016) [Online] Retrieved from:<http://www.un.org/sustainabledevelopment/blog/2015/12/unicef-urges-swift-action-robust-financing-to-close-water-and-sanitation-gaps-in-sub-saharan-africa/>[Accessed February 2016]

University of Maryland School of Medicine. (2016). Global Enterics Multicenter Study (GEMS); Supplemental fact sheet by country. [Online] Retrieved from:<http://medschool.umaryland.edu/gems/factsheets.asp>[Accessed February 2016]

Wanyiri, J. W., Kanyi, H., Maina, S., Wang, D. E., Ngugi, P., O'Connor, R., ... Ward, H. D. (2013). Infectious diarrhoea in antiretroviral therapy-naive HIV/AIDS patients in Kenya. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 107(10), 631–638. <http://doi.org/10.1093/trstmh/trt078>

WHO/UNICEF (2015). A Snapshot of Sanitation and Drinking Water in Africa: a regional perspective based on new data from the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation. Geneva: World Health Organization and New York: UNICEF, 2015. [Online] Retrieved from:http://www.wssinfo.org/fileadmin/user_upload/resources/JMP2015_Sub-saharan-africa.pdf [Accessed February 2016].

WHO/UNICEF Joint Water Supply and Sanitation Monitoring Programme, World Health Organization, & UNICEF. (2015). *Progress on sanitation and drinking water*. [Online] [Accessed February 2016].

WHO and UNICEF (2013). Post 2015 WASH Targets and Indicators, WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation. WHO, Geneva and UNICEF, New York. In collaboration with the Water Supply and Sanitation Collaborative Council, Geneva.

WHO and UNICEF (2014). Progress on Drinking Water and Sanitation. 2014 Update, WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation. WHO, Geneva and UNICEF, New York.

World Health Organization. (2016). WHO Media Centre Fact Sheet; Sanitation fact sheet. [Online] Retrieved from: <http://www.who.int/mediacentre/factsheets/fs392/en/> [Accessed February 2016].

World Health Organization. (2016). WHO Media Centre Fact Sheet; Drinking Water fact sheet. [Online] Retrieved from: <http://www.who.int/mediacentre/factsheets/fs392/en/> [Accessed February 2016].

World Health Organization. (2016). Water, sanitation and Health; Water Supply, Sanitation and hygiene development. [Online] Retrieved from: http://www.who.int/water_sanitation_health/hygiene/en/ [Accessed February 2016].

Yallew, W. W., Terefe, M. W., Herchline, T. E., Sharma, H. R., Bitew, B. D., Kifle, M. W., ...

Adane, M. M. (2012). Assessment of water, sanitation, and hygiene practice and associated factors among people living with HIV/AIDS home based care services in Gondar city, Ethiopia. *BMC Public Health*, *12*(1), 1057. <http://doi.org/10.1186/1471-2458-12-1057>

Yates, T., Lantagne, D., Mintz, E., & Quic k, R. (2015). The impact of water, sanitation, and hygiene interventions on the health and well-being of people living with HIV: a systematic review. *JAIDS, Journal of Acquired Immune Deficiency Syndromes*, *68*(Suppl. 3), S318-S330.

Yu, W., Bain, R. E., Mansour, S., & Wright, J. A. (2014). A cross-sectional ecological study of spatial scale and geographic inequality in access to drinking water and sanitation. *International Journal for Equity in Health*, *13*(1). <http://doi.org/10.1186/s12939-014-0113-3>