EFFECTIVENESS OF COMMUNITY-LED TOTAL SANITATION ACTIVITIES ON SELECTED HEALTH OUTCOMES AMONG CHILDREN AGED BELOW FIVE YEARS IN KINANGO SUB-COUNTY, KWALE COUNTY, KENYA

FRANCIS GWAMA MWATSAHU

DOCTOR OF PHILOSOPHY

(Public Health)

JOMO KENYATTA UNIVERSITY OF

AGRICULTURE AND TECHNOLOGY

2022

Effectiveness of Community-Led Total Sanitation Activities on Selected Health Outcomes among Children Aged Below Five Years in Kinango Sub-County, Kwale County, Kenya

Francis Gwama Mwatsahu

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in Public Health of the Jomo Kenyatta University of Agriculture and Technology

2022

DECLARATION

This thesis is my original work and has not been presented for a degree in any other university.

Signature …… Date…….

Francis Gwama Mwatsahu

This thesis has been submitted for examination with our approval as university supervisors

Signature ……Date……

Prof. Simon Karanja, PhD

JKUAT, Kenya

Signature ……Date……..……

Prof. Mohamed Karama, PhD

Umma University, Kenya

Signature…….  Date……..……

Prof. Michael Zimmermann, PhD

Swiss Federal Institute of Technology (ETH) Zurich, Switzerland

Signature ……Date……..……

Dr. Calvins Otieno, PhD

M U, Kenya

DEDICATION

This work is dedicated to my wife, children and siblings and Kwale County Government

ACKNOWLEDGMENT

My sincere appreciation goes to Jomo Kenyatta University of Agriculture and Technology management through the Vice Chancellor for granting me an opportunity to pursue my PhD in Public Health. I also owe the Pwani University institutional ethical approval committee a special acknowledgement for approving this research work.

Furthermore, I extend my gratitude to my lecturers in the School of Public Health for their tireless commitment to ensuring excellence in the field of Public Health. Additionally, without forgetting, my sincere thanks to my supervisors, who ensured this research was a success. Finally, my utmost thanks go to Kwale County Government (Department of Health Services), Public Health Unit, for helping me with resourceful information on my research study.

Last but not least, my special thanks go to my research respondents who actively participated in this study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABBREVIATIONS AND ACRONYMS

CLTS	:	Community-Led Total Sanitation
HHs	:	Households
HIF	:	Hygiene Improvement Framework
KH	:	Kinango Hospital
KDHS	:	Kenya Demographic Health Survey
KNA	:	Kenya News Agency
KHSSIP	:	Kenya Health Sector Strategic & Integrated Programme
KTA	:	Kenya Trachoma Association
MOH	:	Ministry of Health
MOPHS	:	Ministry of Public Health and Sanitation
OD	:	Open defecation
ODF	:	Open defecation free
PHAST	:	Participatory Hygiene and Sanitation Transformation
PSU	:	Primary sampling unit
RAs	;	Research Assistants
SPPS	:	Systematic probability proportional sampling
TOT	:	Trainer of trainees
UNESCO	:	United Nations Environmental Scientific and Cultural Organization
UNICEF	:	United Nations Integrated Children Education Fund

DEFINITION OF TERMS

Vijiji's	A group of settlement that is smaller than a town, usually in the countryside and the smallest county administrative unit
Triggering	Process of encouraging, empowering, igniting, and supporting people at household and community levels to take action to eliminate open defecation

ABSTRACT

A third of the population globally do not have access to water and sanitation. In Kenya, 55% of the total population does not have access to water and proper sanitation. This has contributed to sanitation related morbidity and mortality among children below the age of 5 years. In an effort to address the problem the Community-Led Total Sanitation (CLTS) approach has worked well in various set-ups. This study aimed to determine the effectiveness of CLTS on selected health outcomes (nutrition status, diarrhea and anemia) among children aged below 5 years in Kinango Sub-County, Kwale County, Kenya. This was a quasi-experimental comparative study with intervention (CLTS among 405 households in 5 villages) sites and control (non-CLTS among 402 households in 5 villages) stes. Anthropometric and haemoglobin measurements were undertaken at baseline and end-line. In addition, an entry and exit questionnaire was administered to collect data on socio-demographic characteristics, knowledge on CLTS practices and on the frequency of experiencing diarrhea among the children <5years. Qualitative data were collected through key informant interviews (KIIs) and Focus group discussions (FGDs). Data were analyzed using SPSS IBM version 22.0. Descriptive statistics were used to explore insights in data. Association between variables was assessed using both chi-square and multivariate logistic regression analysis. The mean difference of health outcomes between CLTS and non-CLTS sites was done using Chi-square test. Binary logistic regression and Poisson regression were used to identify predictors of latrine ownership and morbidity. Qualitative data was summarized using thematic analysis**.** At baseline survey, out of 402 children, 181 (40.02%; 95% C.I=40.1-50.0) were malnourished in the control group while 221 (54.98%; 95%C.I=50-60) had no malnutrition. On the other hand, out of 405 children, 173 (42.72%; 95%C.I:37.8-47.7) had malnutrition while 232 (57.28%; 95%C.I:52.3-62.2) had no malnutrition. There was no significant difference in nutrition status for children in the control and intervention group (χ^2=0.44, df =1, p=0.55) at baseline. Chi-square statistics indicated that there were significantly (χ^2=31.2, df =1, p=0.00) more children without malnutrition among the intervention group compared to the control group at end-line. Morbidity for diarrhea was assessed among children below 5 years. At baseline, 230 (57.2%; 95% CI: 52.36-62.04) out of 402 children in the control arm were reported to have experienced diarrhea in the last 2 weeks while 172 (42.8%; 95% CI: 37.96-47.63) had no reports of diarrhea. During the same period, 213 (52.6%; 95% CI: 47.74-57.66) out of 405 children in the intervention arm were reported to have experienced diarrhea in the last 2 weeks while 192 (47.4%; 95% CI: 42.54-52.26) had no reports of diarrhea. Hence, there was no significant difference (χ^2=3.083, df=1,p=.079) in the occurrence of diarrhea among children in the control arm compared to the intervention arm at baseline. At endline; 198 (49.3%; 95% CI: 45.0-54.6) out of 402 children were reported to have had diarrhea while 109 (26.9%; 95% CI: 22.83-31.37) out of 405 children in the intervention arm were reported to have had diarrhea. Consequently, there were significantly (χ^2=44.73, df=1, p<.001) fewer cases of diarrhea reported among children in the intervention arm compared to the control arm at endline. Awareness on CLTS was a predictor of diarrhea occurrence. Children from households that were aware of CLTS were 55% less likely to present with diarrhea as compared to those living in households that had never

heard of CLTS ($p<0.001$). For anaemia, 89 (22.14%; 95% CI: 18.2-26.5) out of 402 children in the control arm were anaemic while 313 (77.86%; 95%CI: 73.5-81.8) were not anaemic. For the intervention arm, 94 (23.21%; 95%CI: 19.2-27.6) out of 405 children, were anaemic while 311 (76.79%; 95% CI: 72.4-80.8) were not anaemic. There were no significant differences ($\chi^2=0.079$, df =1, $p=0.78$) in the proportion of children that were anaemic in the control arm compared to those within the intervention arm at baseline. At endline, 98 (24.38%; 95% CI: 20.3-29.9) out of 402 children in the control arm were anaemic while 304 (75.62%; 95%CI: 7 1.1-79.7) were not anaemic. Conversely, 38 (9.38%; 95% CI: 6.7-12.7) out of 405 children in the intervention group were anaemic while 367 (90.62%; 95% C.I=87.3-93.3) were not anaemic. Consequently, the proportion of children without anaemia was significantly ($\chi^2=31.3$, df =1, $p=0.00$) higher in the intervention group compared to children in the control group. Latrine ownership was associated with CLTS implementation (AOR = .29, 95% CI = 0.16- 0.53, P< 0.001). Indicators for socio-economic status successfully predicted latrine ownership, the higher the socio-economic status, the higher the probability of owning a latrine. Households that had settled in their own land were two times more likely to own a latrine compared to those without (OR=2.58, 95%, CI: 1.80-3.70, p<.001). Households in the control arm were 53% less likely to own a latrine as compared to those in the intervention arm. Implementation of CLTS, land ownership, type of housing and CLTS knowledge were significant predictors of latrine ownership. This study shows that socio-behavioral interventions can substantially increase access to sanitation facilities in a rural setting. Additionally, CLTS implementation has been shown to improve water, hygiene and sanitation (WASH) practices and subsequently reduce malnutrition, diarrhea and anemia in children aged below 5 years. It is recommended that county governments should scale up CLTS services in areas where open defecation is still a challenge.

CHAPTER ONE

INTRODUCTION

1.1 Background

Nearly 892 million people across the world still practice open defecation despite global efforts to improve sanitation (Saleem *et al*., 2019). Open defecation is an act of defecating in open fields, waterways, and open trenches and even along the roads without correct method of human excreta disposal (Saleem *et al*., 2019). Sub-Saharan Africa, Southern Asia and Central Asia account for 90% of the world's open defecators. Developing countries comprise of averagely 16% of open defecators, while under developed countries have an average proportion of 20% of open defecators in the world. Majority of these open defecators are poor people living in most rural regions of these poor countries(Mara, 2017). On the other urban areas of low-income countries also have high number of open defecators(Mara, 2017). Over 37% (2.6 billion) people worldwide live without access to operational latrine; this leads to spread of excreta related diseases which kills a child every day (Mshida *et al*., 2018). The wide-reaching effects of poor sanitation are also due to the element that nobody loves to talk about shit (Njuguna, 2016a). According to the Ministry of Health report (M. O. F. Health, 2016b) indicates that over 50% people in Africa still did not have access to improved sanitation, in the sense of safe excreta disposal. The situation is most serious in Sub-Saharan Africa (SSA). This has significant health repercussions because indiscriminate defecation near the home is associated with increased morbidity and mortality(Dreibelbis *et al*., 2013). The report further explains the glaring disparities between urban and rural settings. While the rural latrine coverage is lowest in all SSA communities, the urban poor bear the blunt of low latrine coverage. This is because the urban poor live in slums and slum-like environments which are the most densely populated settlements(Emerson *et al*., 2009). The overcrowding created by high densities and lack of latrines leads to increases in communicable diseases, such as diarrhea and trachoma(Garn *et al*., 2017).

According to (Doocy et al., 2016),unvailability of proper sanitation affects a large percent of the world population a counting up to 40 percent (2.4 billion) of the global population. This proportion likely to rise to 50 percent by 2025. Deaths from diarrhea attributed to unimproved sanitation toll to approximately 6,000 children per a day which accumulatively account up to two million deaths annually(Keusch *et al*., 2014). People suffering from water bone diseases admitted to hospital occupy 50% of hospital beds worldwide. It is estimated that 50% of people in Asia have shortage of proper sanitation and this leads to high mortality from diarrheal diseases in China, India and Indonesia which is twice the death from HIV/Aids(Velleman *et al*., 2014)**.** In 1998, about 308,000 died from war in Africa, on the other hand approximately two million people died as a result of diarrheal diseases(Walker *et al*., 2013)**.** In most low-income nations poor hygiene, contaminated water and lack of proper sanitation, these three leads to 80 percent of all infectious diseases. Parasitic infections are also attributed and encouraged by poor sanitation. Nearly 1.5 million people suffer from parasitic infections worldwide(Waddington *et al.*, 2014). Parasitic worms may not cause direct death. However, they might lead to stunted growth and general poor nutritional health status in individuals infected. Dysentery, cholera, typhus fever, typhoid, schistosomiasis and trachoma are some of the major diseases that result from improper sanitation, unsafe water and unhygienic waste disposal.

Open defecation cause water and food contamination from human excreta and these predispose children to diarrheal and other faucal related oral diseases. Open defecation is also cause transmission of geoparasites such as hookworms, trichuriasis and ascariasis ,these intestinal parasites are known to cause anemia in children under five years(Coffey *et al*., 2018b; Njuguna, 2016b). On the other hand open defecation will cause environmental enteropathy which is a sub-clinical condition associated with poor nutritional absorption in the gastrointestinal tract leading to stunted growth in children (Njuguna, 2016a). Intestinal parasite cause anemia through blood loss in stool, loss of appetite to food and competition for nutrients from intestinal parasites. The intestinal parasite also cause damage to intestinal wall leading to impairment in absorption of nutrients (Coffey *et al*., 2018a).

Community-Led Total Sanitation (CLTS) is an integrated approach to the attainment of improved sanitation by eliminating the practice of open defecation (OD) to solve health problems related to human excreta. CLTS entails the facilitation of the communities' analysis of their sanitation profile, their practices of defecation and the consequences leading to collective action to become open defecation free (ODF). CLTS is a community-based approach that is used to solve the problem of open defecation and improve general community sanitation practices, which will tackle health and health-related problems associated with poor sanitation including reduction infections from geoparasites to children under five years of age (Mwatsahu *et al*., 2021). In many cases CLTS initiates a series of few collective local development actions by the ODF communities(Augsburg *et al*., 2016). Community-Led Total Sanitation represents a radical alternative to conventional top-down approaches to sanitation and offers hope of achieving the Sustainable Development Goals. CLTS is a concept that promotes household sanitation within the context of basic human dignity.

1.2 Statement of the problem

More than 40% (2.5 billion) of the world's population have no access to improved sanitation(Velleman *et al*., 2014**).** In Africa, 65% of the population lack sanitary means of proper excreta disposal(Mara *et a*l., 2010); access to sanitation in rural parts of Kenya continues to be a major challenge. In Kenya, approximately 19,500 individuals, including 17,100 children below the age of 5 years die each year from diarrhea. 90% of which is attributed to poor water, sanitation and hygiene(Echazú *et al*., 2015). 2009 census puts the overall access levels at 65% with rural coverage (56%) and urban (79%). 2015 update puts the overall coverage at 31% with rural coverage (36%) and urban (18%). These figures indicate that over 8 million Kenyans still defecate in the open which result in prevalence of diseases such as diarrhea and anemia. National OD rate is 16%, which masks massive regional disparities in some counties that OD remains the norm e.g., Turkana (82.2%), Wajir (76.7%), Samburu (73.4% and Kwale (31.7%) (MOH 2016/17-2019/20). In Kwale County, diarrhea accounts for 8.2% of OPD cases. In Kinango sub-county, diarrhea accounts for 11.2% of OPD cases. Kwale County is blamed on the cultural practice of the people

of Kwale. According to the MOH, Kenya most families in the remote villages of the county are yet to build toilets because of the beliefs that sharing a toilet with in-laws or respectable members of the family it is a taboo and it is likened with witchcraft (Omar, 2021). These past studies documented the effect of OD. Literature, indicate a research gap to determine the effectiveness of Community-Led Total Sanitation activities on selected health outcomes of children below the age of 5 years in Kinango sub-county, Kwale County, Kenya; with specific reference to determine nutritional status of children, proportions of children with diarrhea, and anemia diseases.

1.3 Justification of the study

"Health for all by the year 2000 and beyond" was the overall goal of World Health Organization(Grantham-McGregor *et al.*, 2007). This goal has never been achieved, though the Government and NGO's have played a big role in educating the community in both rural and urban areas on Primary Healthcare and safe sanitation. One element of Primary Healthcare is to ensure safe and proper disposal of human excreta, but despite all these efforts, excreta related diseases are among the top ten diseases in most counties in Kenya (Njuguna, 2016a). The MOH, recommended the need to undertake a study on factors hindering utilization of CLTS approach leading to low levels of sanitation within counties(M. O. F. Health, 2016a). Before looking at the factors hindering the CLTS uptake, this study sets a center stage to establish the health effects of improved sanitation through CLTS approach among the already established ODF villages in Kwale County. The **s**tudy findings will inform county policy-makers, on the effectiveness of community-led total sanitation activities on health outcomes of children below the age of 5 years in Kinango Sub-County, Kwale County, Kenya. The study will also build on the body of knowledge over the efficacy of CLTS approach aimed at strengthening the linkages and partnerships among CLTS stakeholders (MOH, County Governments and healthcare service delivery, private partners) to further improve CLTS approach implementation in Kwale County.

1.4. Research Questions

1. What are the effects of Community-Led Total Sanitation on nutritional status among children aged below 5 years in Kinango Sub- County, Kwale County, Kenya?
2. What are the episodes of diarrhea occurrence among children aged below 5 years in Community-Led Total Sanitation implementing site and non-Community-Led Total Sanitation implementing site on occurrence in Kinango Sub- County, Kwale County, Kenya?
3. What is the effect of Community-Led Total Sanitation on anemia among children aged below 5 years in Kinango Sub- County, Kwale County, Kenya?
4. What is the effect of CLTS on ownership of latrine and practice of open defection among household members in Community-Led Total Sanitation implementing site and non-Community-Led Total Sanitation implementing site in Kinango Sub- County, Kwale County, Kenya?
5. What are the socio-cultural barriers influencing Community-Led Total Sanitation in Kinango Sub- County, Kwale County, Kenya?

1.5 Objectives

1.5.1 Broad objective

To determine the effects of Community-Led Total Sanitation activities on selected health outcomes of children aged below 5 years in Kinango Sub- County, Kwale County, Kenya.

1.5.2 Specific objectives.

1. To determine the effects of Community-Led Total Sanitation on nutritional status of children aged below 5 years in Kinango Sub- County, Kwale County, Kenya.
2. To determine the episodes of diarrhea occurrences among children aged below years in Community-Led Total Sanitation implementing site and non-Community-Led Total Sanitation implementing site in Kinango Sub- County, Kwale County, Kenya.
3. To determine the effect of Community-Led Total Sanitation on anemia among children aged below 5 years in Kinango Sub- County, Kwale County, Kenya.
4. To determine the ownership of latrine and practice of open defection among household members in Community-Led Total Sanitation implementing site and non-Community-Led Total Sanitation implementing site in Kinango Sub-County, Kwale County, Kenya.
5. To determine the socio-cultural barriers influencing Community-Led Total Sanitation in Kinango Sub- County, Kwale County, Kenya.

1.6 Theoretical and Conceptual Framework

1.6.1 Theoretical Framework

Hygiene Improvement Framework (HIF); as applied to Comprehensive Approach for Preventing Childhood Diarrhea - will be adopted as the theoretical framework of this study topic. This theory explains how to prevent diarrheal and other diseases using the three key elements to fight disease: access to the necessary hardware or technologies, promoting healthy behaviors, and support for long-term sustainability; as applied in the HIF theory(HIF-net at WHO, 2004). Improved hygiene will reduce diarrheal and other diseases among the communities, involving players(Ramesh *et al.*, 2015). Mindful of the need to combat diarrhea and sanitation related diseases on its multiple fronts and using lessons learned from past studies, EHP developed the Hygiene Improvement Framework (HIF). The Framework has three core components: Improving Access to Water and Sanitation "Hardware", Promoting Hygiene and Strengthening the Enabling Environment. These components are designed to encourage key household behaviors that reduce the incidence of childhood diarrhea, namely: safe disposal of feces, washing hands correctly at the right times, and storing and using safe water for drinking and cooking(Joshi & Amadi, 2013).

(Cavill *et al.*, 2015)encourage a comprehensive approach to Community-Led Total Sanitation improvement for maximum impact, selective or sequential approaches (e.g., starting with hygiene promotion) can be effective entry points in child, maternal, and other health programs. Hygiene improvement plays an important role in reducing opportunistic infections and improving child (and maternal) nutritional status(Black *et al.*, 2013). Safe water, improved sanitation, and improved hygiene practices, such as hand-washing, will be especially important in communities with high diarrheal and trachoma disease prevalence to reduce the risk of opportunistic infections(Plan International Ethiopia *et al.*, 2014). Furthermore, investments in preventing diarrheal diseases are compromised unless safe water is available for infant feeding, and household hygiene practices such as hand-washing are practiced(Alula *et al.*, 2018). Recognizing the critical role of hygiene improvement in diarrhea, UNICEF has identified "Community-Led Total Sanitation" as one of the priorities in Kwale

County's Strategic Plan 2013–2017(UNICEF, 2015). HIF three components will address both the issue of water quality and water quantity, which reduce the risk of contamination of food and drink. Several studies have shown that providing more water to a household or a community apparently leads to greater health benefits than simply providing safe water (Pickering *et al.*, 2019). More water supports better personal and domestic hygiene, e.g., hand-washing, bathing, food washing, and household cleaning. And it also makes water available for income generating activities (e.g., local industries) and gardening, both of which can improve a family's diet, hence their resistance to disease(Doocy *et al*., 2016). Girls who spend less time fetching water have more time for school. Similarly, ensuring access to water supply systems can greatly reduce the time women spend collecting water, allowing more time to care for young children and more time for income generating activities. However, the health effects of water quality may be underestimated because most studies looked at water systems rather than water quality at the point-of-use, namely the household(Doocy *et al*., 2016).

The second element of the hardware component, sanitation facilities, involves providing facilities to dispose of human excreta in ways that safeguard the environment and public health, typically in the form of various kinds of latrines, septic tanks, and water-borne toilets*(Garn et al.*, 2017). Sanitation coverage is important because fecal contamination can spread from one household to another, especially in densely populated areas. Access to sanitation facilities can open school doors for girls and reduce drop-out rates, since girls often stay away from schools because of the indignity of having no privacy(Dreibelbis *et al*., 2013). The third element, household technologies and materials, refers to the increased availability of such hygiene supplies as soap (or local substitutes), chlorine, filters, water storage containers that have narrow necks and are covered, and potties for small children. Point-of-use chlorination in the home is gaining attention as a key way to address the problem of contaminated household drinking water(Waddington *et al.*, 2014). It is particularly effective in areas where water and sanitation service provision is low (such as urban slums), at health care facilities where water quality is especially important, or where there is a threat of diarrhea or a similar epidemic. Point-of-use

chlorination should be considered as part of a hygiene improvement package that also includes the other components of the Framework(Agency *et al*., 2018)

According to (Mondal & Kar, 2013) CLTS is a planned approach to preventing diarrheal and trachoma diseases through the widespread adoption of safe hygiene practices. It begins with and is built on what local people know, do and want. In the Hygiene Improvement Framework, promoting hygiene refers to advocating for, teaching, and supporting behaviors that are known to reduce diarrheal disease, namely: proper hand-washing, proper disposal of feces, and storing and using safe water, at least for drinking and preparing food(ALBashtawy, 2015).

The second part of the Framework consists of five basic strategies that can be applied alone or in combination depending on the nature of the program. The primary target audiences are caretakers of young children and children themselves: These include communication, social mobilization, social marketing, community participation and advocacy. Integrating a hygiene promotion component into an existing child, maternal, or other health program is usually quite feasible, since many of those programs already address behavior change(Bos *et al.*, 2018). Hygiene promotion is based on a good understanding of how behaviors within households and communities contribute to diarrhea and trachoma morbidity in children. (Dreibelbis *et al*., 2013)identifies knowledge and beliefs about the causes of diarrhea, trachoma, current high-risk behaviors, and any barriers or enabling factors to overcoming these behaviors. This information makes it possible to identify CLTS changes that are feasible in order to promote concrete actions that people are both willing and able to take.

According to(Burton, 2007) comprehensive communication strategy raises awareness about CLTS facilities and practices, shares information, and promotes behavior change by highlighting benefits that are important to the target audience. A variety of communication channels may be used, such as traditional media, music, song and dance, community drama, literacy materials, leaflets, posters, pamphlets, videos, and home visits(Foley, 2010). Typical venues for CLTS activities are community gatherings, health centers, schools, daycare and nutrition centers, and the household.

In some settings, training health workers, teachers, and community agents in CLTS skills may also be an important strategy(Wilbur & Jones, 2014).

Social mobilization is a process to obtain and maintain the involvement of various groups and sectors of the community in the control of disease. For example, a community group might design and implement a campaign to increase the use of soap for hand-washing or to promote the proper use and maintenance of CLTS facilities(Radin *et al*., 2020).

Social marketing makes use of marketing principles and strategies to achieve social goals such as better CLTS. A social marketing approach may involve a partnership between the public sector and manufacturers of soap or water purification products to both expand the product market and promote improved CLTS and hygiene. Social marketing can create a demand for CLTS facilities and services from the agencies that are supposed to provide both the sanitation hardware and software components(Echazú *et al*., 2015).

Community participation, an essential component of the CLTS process, typically involves such activities as collective examination of barriers to practicing CLTS in the community, designing measures to use CLTS facilities and improve practices, or community-based monitoring of progress in achieving behavior change. Participation means that community members from all socio-economic, ethnic, and religious groups have a voice, including women, men and children.

Advocacy is an integral part of all aspects of CLTS. Donors, program managers, and community representatives can advocate for improved CLTS behaviors and for interventions that support these behaviors to governmental and non-governmental stakeholders. Schools and school children are good entry points for CLTS improvement through additions to the curriculum and providing safe drinking water, sanitation and hand-washing facilities for boys and girls (Lake, 2017.).

Strengthening the Enabling Environment for diarrhea and prevention puzzle creates an environment- whether at the community, Sub-County, regional, or national level that supports the technology and CLTS interventions envisioned in this framework.

With implementation of these interventions and especially if they are to be sustained, must be built on a strong foundation. Supporting the enabling environment typically takes the form of: Policy improvement, Institutional strengthening, Community involvement, Financing and cost-recovery activities and Cross-sector and public-private partnerships(Samie *et al.*, 2009).

Policies that encourage and promote sustainable CLTS improvement and prevent diarrheal and trachoma diseases create the environment in which development priorities are ultimately allocated the necessary human, financial, and social resources(Jones *et al*., 2016).

According to(Augsburg *et al*., 2016), good policy does not simply happen; it grows out of heightened awareness, which in turn depends on getting good information into the hands of policymakers. On the other hand, policy improvement includes assessing the adequacy of national policies for CLTS improvement, determining where the gaps are, facilitating a process to reach consensus on a policy agenda, and developing more effective policies (White, 2011). According to(Crocker *et al*., 2021), there should be explicit policies for both water supply and CLTS, of course the existence of good policies is not sufficient unless the political will, resources, and capacity exist to implement them.

The third feature of the enabling component, promoting community involvement, means developing local structures to take the responsibility for operating and maintaining local systems. When community members have done the work and when they have committed their own time, effort, and resources to establishing improved water and CLTS systems, they are more committed to following up on and safeguarding their investments(UNICEF, 2015). The fourth element of the enabling component, financing and cost-recovery, addresses the fact that for many communities, the up-front infrastructure and technology costs of CLTS improvement are a serious challenge, as are the on-going operating and maintenance expenses. But if these interventions can be shown to be financially viable as they have in the case of privately owned and operated public sanitary facilities and profit-making water and CLTS utilities run by the urban poor; then financing is easier to obtain. The goal is for

user fees to cover the recurrent costs of water supply and CLTS services. If users are consulted in the design process, then prospects for full cost recovery of recurrent costs are more likely(Waddington *et al.*, 2014).

The final element of the enabling component, cross-sector and public-private partnerships, involves bringing together a number of government entities or some type of public-private collaboration. Water supply and CLTS agencies may have to work together with other ministries such as health, environment, rural development, agriculture, and planning. The government sector may join forces with elements in the private sector or non-governmental sector to accomplish jointly what neither has sufficient resources to accomplish on its own.

Establishing coordinating mechanisms such as interagency committees, steering committees, and task forces is key to effective partnerships, and successfully coordinating the activities of all the partners is likewise a key element of creating an effective enabling environment. No single CLTS improvement effort will look exactly like another; different players in different settings will put together their own package of activities. But while the specifics will vary from place to place, the overall strategy should be a comprehensive approach that addresses the three key components-increasing access to hardware, promoting hygiene, and strengthening the enabling environment (Allegranzi & Pittet, 2009).

In application to the study topic; outcomes standards meant to evaluate the health impacts of CLTS interventions by assessing desirable changes in the lives of the children under the age of five years and their physical environment. Figure 1.1 shows the research conceptual framework.

1.6.2 Conceptual Framework

The independent variables included characteristics of household members e.g. gender, age, education level, awareness, socio-economic wealth and behavioral factors e.g. socio-cultural practices, open defecation, sanitation coverage, triggers for action will influence sanitation improvement, resulting to disease reduction in HHs. The strategy focuses on increasing the coverage and use of improved sanitation facilities, increasing the coverage and use of hand wash facilities, improving solid and liquid waste management through establishing proper disposal sites and increasing households' knowledge on proper sanitation practices. Improvement of these indicators would momentarily reduce diarrhea, nutrition and anemia prevalence amongst children below 5 years in Kinango sub-county, Kwale County.

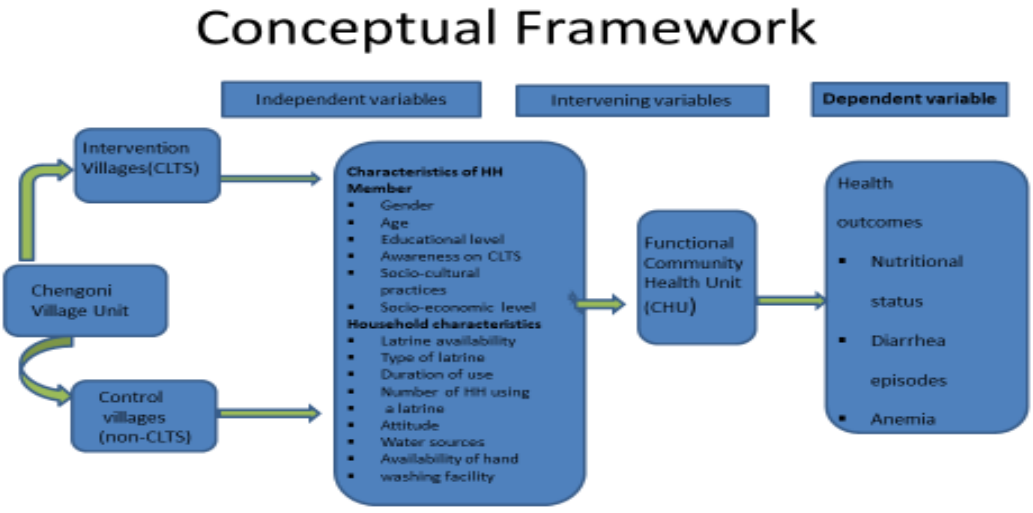

Figure 1.1: Conceptual framework

CHAPTER TWO

LITERATURE REVIEW

2.1 Background of Community-Led Total Sanitation (CLTS)

Community-Led Total Sanitation (CLTS) is an innovative methodology for mobilizing communities to completely eliminate open defecation (OD). Communities are facilitated to conduct their own appraisal and analysis of open defecation (OD) and take their own action to become ODF (open defecation free) (Lawrence *et al.,* 2016). CLTS entails the facilitation of the communities' analysis of their sanitation profile, their practices of defecation and the consequences leading to collective action to become open defecation free (ODF). CLTS processes can precede and lead on to, or occur simultaneously with improvement of latrine design; the adoption and improvement of hygienic practices; solid waste management; waste water disposal care; protection and maintenance of drinking water sources; and other environmental measures (Radin *et al*., 2019). CLTS focuses on the behavioral change needed to ensure real and sustainable improvements investing in community mobilization instead of hardware, and shifting the focus from toilet construction for individual households to the creation of open defecation-free villages, raising awareness that even if a minority of people continues to defecate in the open everyone is at risk of disease. CLTS uses participatory methodologies and processes, including community mapping and transect walks, to facilitate communities to analyze their own sanitation practices and fecal-oral pathways. During this process (called triggering) communities come to the realization they are eating each other's shit resulting in communities into taking action to become open defecation free (ODF). CLTS triggers the community's desire for collective change, propels people into action and encourages innovation, mutual support and appropriate local solutions, thus leading to greater ownership and sustainability (Mwatsahu *et al*., 2021). CLTS was pioneered by Kamal Kar (a development consultant from India) together with VERC (Village Education Resource Centre), a partner of WaterAid Bangladesh, in the late 1999 and 2000 in Mosmoil, a village in the Rajshahi district of Bangladesh, whilst evaluating a traditionally subsidized sanitation programme.

CLTS was founded on two pillars of Total and Community-Led sanitation(UNICEF, 2015). The approach aimed at eradicating open defecation in the villages in India and Bangladesh. Kar, who had years of experience in participatory approaches in a range of development projects, succeeded in persuading the local NGO to stop top-down toilet construction through subsidy. He advocated change in institutional attitude and the need to draw on intense local mobilization and facilitation to enable villagers to analyze their sanitation and waste situation and bring about collective decision-making to stop open defecation.

CLTS spread fast within Bangladesh where informal institutions and NGOs are key. Both Bangladeshi and international NGOs adopted the approach. The Water and Sanitation Programme (WSP) of the World Bank played an important role in enabling spread to neighboring India and then subsequently to Indonesia and parts of Africa. Over time, many other organizations have become important disseminators and champions of CLTS, amongst them Plan International, UNICEF, WaterAid, SNV, WSSCC, Tearfund, Care, WSP, World Vision and others. Today CLTS is in more than 60 countries in Asia, Africa, Latin America, the Pacific and the Middle East, and governments are increasingly taking the lead in scaling up CLTS. Many governments have also adopted CLTS as national policy(Augsburg *et al*., 2016). CLTS is participatory in nature and facilitates communities to take a decisive role in ensuring that each and every member internalizes the implication of poor sanitation (e.g. open defecation). The CLTS methodology unites the community to commit to using sanitary latrines and hygienic behavior. The community understands that the process is a shift towards a zero subsidy approach rather than providing them with money to construct latrines (Venkataramanan *et al.*, 2018). Once “triggered”, adults and children become passionately involved in the management of their own sanitary well-being. CLTS uses communication for social change and in the process community members are able to declare their villages as Open Defecation Free (ODF) as families gradually climb steps in the ladder of total sanitation. CLTS was found to address the health problems associated with human fecal matter.

2.2 Effects of CLTS on nutritional status of children aged under five years.

Under nutrition status is a concern and a serious public health challenge in developing countries, it account up to one-third of deaths among children under five years of age across the globe (Mshida *et al*., 2018).Malnutrition impact negatively physical and mental development of children, it increases their susceptibility to communicable diseases and also increase disease severity and lengthen the recovery period from illness. During early stage of child development poor nutrition can lead multiple chronic comorbidities in kids and physical disabilities such as to stunted growth in children, which is attributed to complications such as poor academic performance in school. In severe case it can lead to medical conditions such as Marasmus, Kwashiorkor and it can even cause death when not treated (Mshida *et al*., 2018)

One in every five children under five years in the world are stunted. Despite the rate of stunting decreasing in Asia, the prevalence is still high in Sub-Saharan Africa (Gimaiyo *et al*., 2019; Mshida *et al*., 2018).Averagely 40% of children experiencing stunted growth in the world they live in Africa (Gimaiyo et al., 2019). In Tanzania according to Tanzanian Demographic Health Survey, it was reported that children under five year have stunted rate of 34.7%, underweight rate of 13.7% while the wasted rate was reported to be 4.4% (Mshida *et al*., 2018)

In Kenya according to Kenya Health Demographic Survey the wasting and stunting rate among children under five year is 4% and 26% respectively(KDHS, 2014). Additionally, there is disparities in malnutrional status among children of different counties in Kenya. In Kwale county the malnutrition status is alarming and raising concern with 29% stunting rate, 21% underweight rate and wasted rate is at 9% (KDHS, 2014).

Poor sanitation is one of the main reason behind malnutrition in the low-income and middle-income countries in the world (Gimaiyo *et al.*, 2019).Studies have shown that malnutrition is associated with poor hygiene and sanitation due to diarrhea, intestinal parasites and environmental enteropathy(Velleman *et al*., 2014). It is evident that open defecation will cause environmental enteropathy which is a sub-

clinical condition associated with poor nutritional absorption in the gastrointestinal tract leading to stunted growth in children (Gimaiyo *et al*., 2019; Njuguna, 2016a). Currently several community-based interventions have been implemented aimed at improving sanitation in the rural areas in the country. Community-Led Total Sanitation (CLTS) is an integrated approach to the attainment of improved sanitation by eliminating the practice of open defecation (OD) to solve health problems related to human excreta, the approach mobilizes communities to end open defecation through construction of latrines and behavior change (Gimaiyo *et al.*, 2019).

Study have revealed that CLTS triggers Open Defecation Free community (ODF),this in turn reduces diarrheal and oral fecal related disease and promotes good nutritional status among children under five years (Mwatsahu *et al*., 2021).Water, hygiene and sanitation makes part of the fundamental human rights which plays a very big role in nutritional status of children under five years of age (Mshida *et al*., 2018).Despite the advantages accorded to improved sanitation most communities still practice open defecation and few people who own latrine they are not improved and they pose risks of fecal contamination (Mshida *et al.*, 2018).The holistic and effective approach to prevention of wasting and stunting is through proper environmental sanitation (Gizaw & Worku, 2019).

The government of Kenya initiated national community led total sanitation intervention programme aimed at improved sanitation. Kenya managed to reduce the proportion of individual not accessing improved sanitation by 63% in 2015.Still in the long term the government is devoted to achieve universal improved sanitation coverage by the year 2030 as highlighted in Kenya's vision 2030 (MoH, 2016b).

2.3 Effects of CLTS on diarrheal diseases of children aged under five years.

Diarrhea is the passing of three or more loose or watery school within 24 hours for up to two weeks this is according to WHO definition. There are over 1.7 billion cases of diarrheal disease globally every year. The diarrheal is the leading cause of death globally (Jung *et al.*, 2016) but the second leading cause of death among children under five years across the globe majorly in the low-income countries (P. Health,

2018). Diarrhea is a curable and preventable disease countable of averagely 11% of child mortality worldwide (Jung et al., 2016). Poor sanitation it is the contributing factor for diarrheal disease in low-income countries across the world (Jung *et al.*, 2016).

Approximately 4.4 million children under five years of age will die yearly from communicable disease by the year 2030 out of which 60% of this deaths will occur in Sub-Saharan Africa (Thiam *et al*., 2017). 3.6% global disease burden is attributed to diarrhea this is according to disability-adjusted life years (Thiam *et al.*, 2017). Even though mortality from diarrhea has decreased over the past 25 years across the globe, morbidity and mortality from diarrhea in Sub-Saharan Africa and in Asia has not, and this is attributed to inadequate water, hygiene and sanitation and also malnutrition (Alebel *et al*., 2018; Melese et al., 2019; Thiam *et al.*, 2017).

In Ethiopia mortality of children under five years is greatly contributed by diarrhea, according to 2016 Ethiopian Demographic Health Survey about 12% of children under five years experienced diarrhea for two weeks prior to the survey (Alebel *et al*., 2018). While in Senegal diarrhea is the third leading cause of death among children under five years that is as per the Senegal Ministry of Health (MOH) (Thiam *et al.*, 2017). Studies across the world have identified use of unsafe drinking water and use of unimproved sanitation as the main risk factors for diarrhea among children aged under five years (Mutuku & Ochieng, 2020). The prevalence of diarrhea is alarming in middle and low-come countries and this has been attributed to inadequate safe drinking water and unimproved hygiene and sanitation (Hussein, 2017; Melese *et al*., 2019; Mutuku & Ochieng, 2020).

In Kenya over 1.4 million cases of diarrhea among children under five years were reported in 2018 alone (Mutuku & Ochieng, 2020). Approximately 17,100 deaths from diarrhea are reported in Kenya yearly and of which about 90% of these deaths are attributed to poor water, hygiene and sanitation. The Kenya Demographic and Health Survey revealed that the prevalence of diarrhea has not changed since 2007, with surveys showing 16% of children <5 years of age experiencing diarrhea within the previous 2 weeks(KDHS, 2014).

Contaminated water sources and food with human fecal matter, poor personal hygiene, and bacterial infections together with general poor living conditions are the major cause of diarrhea among children under five of years (Sanyaolu *et al*., 2020).

The major entry point for gastrointestinal pathogen is the mouth especially when children are in contact with fecal matter that contaminate their food and water (Sanyaolu *et a*l., 2020).

Unimproved sanitation is the major risk factor for diarrhea. Additionally, lack of proper basic sanitation facilities are the reason why people practice Open Defecation (OD) which is the leading risk factor for diarrhea (Melese *et al*., 2019). CLTS is one of the leading strategy the WHO has adapted toward eradication of Open Defecation and consequently reducing human excreta related health problems such as diarrheal diseases (Gimaiyo *et al.*, 2019; Gizaw & Worku, 2019; Sanyaolu *et al.*, 2020). In Kenya Community Led Total Sanitation is one of the strategy the government is using to improve sanitation and eliminate open defecation from its communities (Mwatsahu *et al.*, 2021).

CLTS is aimed at achieving Open Defecation Free (ODF) communities which to a great extend will reduce diarrheal diseases and improve nutritional status of children under five years(Mara, 2017). In Kwale county in Kenya the prevalence of diarrhea is alarming this therefore necessitate the assessment of CLTS to meet its objective to reduce diarrheal diseases among children under five years of age(KDHS, 2014).

2.4 Effects of CLTS on anemia in children aged under five years.

Anemia is a serious public health problem across the globe and it affects about 2 million people with great number comprising of women and children (Mougenot *et al*., 2020).Globally the prevalence of anemia is 42.6% according to World Health Organization, with Africa and Asia having the higher prevalence of 62.3% and 58.3% respectively (Li *et al.*, 2020). WHO reports that the high global prevalence of anemia is among children under five years and women(WHO, 2015). In china the prevalence of anemia in children under five years was at 12.6% with regional

disparities, in the rural region the prevalence was high at 13.3% and in the urban region was at 10.3% (Li *et al*., 2020) **.**

In Kenya the overall anemia prevalence in children is estimated to be 28.8% nationwide (KDHS, 2014) According to the recent nested cohort study carried out in the coastal region of Kenya, 244 children were evaluate out of which 185 (76%) were found to have suffered anemia at one point since birth (Kao *et al*., 2019).

Anemia is defined by low red blood cell count or low levels of haemoglobin which leads to reduced oxygen carrying capacity of blood(Joshi & Amadi, 2013) . Anemia damages physical and cognitive development in children (Coffey *et al.,* 2018a). Anemia is caused by multiple factors including inadequacy of nutrients essential for hematopoietic function such as iron, folic acid, vitamin A and B12, it can also be as a result of communicable diseases such as malaria while other studies has also shown genetic factors and unimproved hygiene and sanitation are the reason behind the development of anemia in children (Coffey *et al.*, 2018b; Venkataramanan *et al.*, 2018)

Unimproved sanitation cause anemia through two know pathways, first it is through intestinal fecal related parasites and the second one is through the condition called environmental enteropathy (Coffey *et al*., 2018a)**.** Open defecation cause transmission of geo-parasites such as hookworms, trichuriasis and ascariasis, these intestinal parasites are known to cause anemia in children under five years (Coffey *et al.*, 2018a, 2018a; Njuguna, 2016a). On the other hand open defecation will cause environmental enteropathy which is a sub-clinical condition associated with poor nutritional absorption in the gastrointestinal tract leading to stunted growth in children (Njuguna, 2016a). Intestinal parasite cause anemia through blood loss in stool, loss of appetite to food and competition for nutrients from intestinal parasites. The intestinal parasite also cause damage to intestinal wall leading to impairment in absorption of nutrients (Coffey *et al.*, 2018a). Other studies have shown that some parasites such as Giardia lamblia and *Ascaris lumbricoides* leads to loss of appetite, malnutrition and consequently reducing absorption of nutrients such as iron (Mougenot *et al*., 2020). Households without access to improved sanitation are

vulnerable to malnutrition and inflammation that may lead to other type of anemia (Mougenot *et al.,* 2020)

Anemia has adverse effects on children, it causes impairment in physical and cognitive development in children, it also affect performance of children in school and also leads to stunted growth(Mougenot *et al.,* 2020) .

Published studies have linked poor sanitation to the development of anemia (Coffey *et al*., 2018a; Li *et al.,* 2020; Mougenot *et al.,* 2020; Mshida *et al*., 2018). Community Led Total Sanitation is a community-based approach aimed at improving sanitation and ending open defecation which in turn will solve health problems related to unimproved sanitation such as transmission of intestinal parasite which cause anemia in children.

Kenya demofraphic health survey conducted in the coastal region of Kenya, Kwale County included has shown that the prevalence of anemia in the region is very high at 76%(KDHS, 2014)**.** In Kwale County the rate of open defecation is at 31.7%. The county government of Kwale is commited to transform ther villages and communities to Open Defecation Free (ODF) as well as attaining 85% by 2022; improved sanitation among its people. Currently, Kwale County latrine coverage is at 60.4%(KDHS, 2014).Studies have indicated that though CLTS is not a nutritional intervention it potentially reduce parasitic infection among children and improve nutrient absorption thus reducing prevelence of anemia among children.

2.5 Latrine ownership and practice of open defecation among household members

Despite the world's collective effort through global action plans such as Millennium Development Goals (MDGs) to attain improved sanitation across the globe the target was not attained after 15 years of implementation, still more than 2.6 million people have no access to improved sanitation. And nearly 892million people of the world population still practice open defecation (Saleem *et al.,* 2019). After the failure to

achieve improved sanitation as per MDGs the issue was again highlighted in the Sustainable Development Goals (SDGs) number 6.2 (Saleem *et al.*, 2019).

Approximately 215 million people in Sub-Saharan Africa practice open defecation (Njuguna, 2016a). Sub-Saharan Africa and Southern Asia have been noted to be the regions with high prevalence of open defecation and with the least sanitation coverage (WHO, 2015; Ματινα, 2019).

In Kenya 50% of the rural regions have no access to basic sanitation (M. O. F. Health, 2016b). About 5.6 million Kenyans still practice open defecation (M. O. F. Health, 2016b; Njuguna, 2016a). The national defecation rate stands at 16% in Kenya with substantial regional inconsistencies. Open defecation in some counties it is a norm with Turkana the leading with 82.2% of the population practicing open defecation, Wajir and Samburu counties at 76.7% and 73.4% respectively (MoH, 2016b).

In Kwale county only 18.4% of the county population have access to improved sanitation, 14.8% have unimproved sanitation while 15.6% have shared sanitation and 31.7% (291,387); out of 866,820 county population, practice open defecation. Kwale county is ranked 23 out of 47 counties according to ministry of health sanitation benchmarking (Legge *et al*., 2021; Ministry of Health and Water & Sanitation Program, 2014). The county loses 677million shillings due to poor sanitation yearly (Ministry of Health and Water & Sanitation Program, 2014).In a recent report by the ministry of health, poor latrine coverage in Kwale county is majorly blamed on the cultural beliefs and practices of the people of Kwale county(Omar, 2021).Old cultural practices in Kwale county consider it a taboo sharing latrine with in-laws and other respectable members of the family together with other relatives, according to the community that is taken to be witchcraft. In Kwale County according to the report some members of the society completely oppose the issue of having toilets in their houses and they are determined to uphold this belief. Despite this the families has been forced to build toilets ,just to satisfy the public health officers, but they do not use the constructed toilets and instead they have resorted to keep using the bushes (Omar, 2021).

Poor sanitation is the cause of many diseases ranging from oral fecal related diseases, diarrheal disease, intestinal parasites and other geo-parasites (Coffey *et al.*, 2018a; Legge *et al*., 2021; Mara, 2017; Ministry of Health and Water & Sanitation Program, 2014; Njuguna, 2016a). Open defecation predisposes water and food to fecal contamination which will lead to fecal related infection (Njuguna, 2016a).

2.6 Socio-cultural barriers, level of awareness and practices towards CLTS.

Socio-cultural means common traditions, habits, patterns and beliefs present in a population and it is also include attitude and behavior (Chambers & Myers, 2016). Successful CLTS depends on socio-norms and behavior change (Chambers & Myers, 2016). In some communities it is a social norm to practice open defecation. Habitually, some communities in both Sub-Saharan Africa and in Asia they see nothing wrong in open defecation (OD) (Ματινα, 2019). A study conducted in North India showed that OD was hardly seen as socially unacceptable(Coffey *et al*., 2018b). Another study conducted in Tanzania indicated that 40% of the overall respondents strongly agreed that it is normal to defecate in the open in their communities(O'Connell, 2014). Other studies have shown that it is a taboo sharing latrine with in-laws and other respectable members of a family with other relatives. For instant in Kenya a recent report by the ministry of health blamed cultural practices of members in Kwale county over the issue of open defecation (Omar, 2021). According to the old culture of the people of the county it is a taboo or sinful to share toilets with relatives they respect the most, in some families this is taken to be witchcraft. Most families in rural areas of Kwale County have yet to build toilets because of these beliefs. According to the ministry report most families have been forced to construct latrines to satisfy the public health officers but they do not use them instead they have resorted to continue using the bushes (Omar, 2021). People living in poverty are less likely to commit their small resources on sanitation. People living in poverty are more likely to live in unsanitary environment and this will predispose them to sanitation related diseases resulting in decreased productivity and increased expenditure on health care (Njuguna & Muruka, 2020). Normally, open defecation is associated to poverty. More than 60% of the poorest wealth quintile practice open defecation as compared to less than 1% in the richest quintiles (MoH,

2016b). In Kenya Nationally, 45.2% of people live below the poverty line (Njuguna & Muruka, 2020). In Kenya it is projected that the poorest group of people are 270 times more likely to practice open defecation than the wealthiest individuals (Njuguna & Muruka, 2020). In Kwale County, about 70% of its people live below the poverty level (Brief, 2017). This is also a strong barrier to be addressed in order to achieve effective CLTS and completely eliminate OD. CLTS does not provide subsidies for pit-latrine structures and hand washing facilities. Instead; the community-led total sanitation program provides financial support for the hardware. This is usually achieved through community triggering creates disgust, fear and shame to its member to participate. Communities can have access to latrines, clean water sources and other hygiene services but still people will be practicing open defecation in these communities especially those in poor areas. Poor communities has been associated with continued use of open defecation (Bokea, 2020; Musembi, 2016). Other studies have shown that providing incentives to people such as pit-latrine papers, household pit-latrines and other sanitary inputs to entice them to avoid the practice of open defecation and hence reducing mortality and morbidity due to poor sanitation (Bokea, 2020). When people are given incentives they tend to work extra hard as individuals to attain the promised goal for the a ward of incentives and these in general will increase the positive outcomes from the village levels and heightens the level of knowledge among the interacts (Bokea, 2020; UNICEF, 2009). On the other hand, CLTS is an effective tool in improving Knowledge levels of communities on sanitation and hygiene and consequently reducing incidences of open defecation. A study conducted in Zambia which indicated that acquaintance of communities to CLTS triggering processes heightened knowledge on hygiene and sanitation (Lawrence *et al.*, 2016). This awareness and knowledge on hygiene and sanitation triggered individuals, families and the communities at large to construct and make use of toilets (Lawrence *et al*., 2016). This finding can also be explained by the idea that improving knowledge on hygiene and sanitation might had also changed the attitude of individual on hygiene and sanitation. A comparative cross-sectional study conducted in Uganda also indicated statistical significant difference in the level of knowledge and awareness on hygiene and sanitation between the CLTS intervention sub-counties and non-CLTS control sub-counties. People were

more knowledgeable on hygiene and sanitation in the intervention site than the non-intervention site (Okolimong, 2018). Cultural beliefs and practices are among the major challenges and barriers to effective latrine coverage and utilization (Chambers & Myers, 2016).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study area

The study was conducted in a rural setting in Chengoni Village Unit, Samburu-Chengoni Ward of Kinango Sub County. The study involved all the 10 villages in the study area (Chengoni Village Unit) with 5 intervention villages [Bofu, Makamini, Chanzou I, Chanzou II and Dambale and 5 control villages [Chengoni A, Chengoni B, Mtulu, Mwakunde and Mwanzungi). The total number of households (HHs) in the intervention and control sites were 2457 and 2198, respectively. At the beginning of the study, all these villages were not implementing CLTS and they were also not certified as open defection free (ODF).

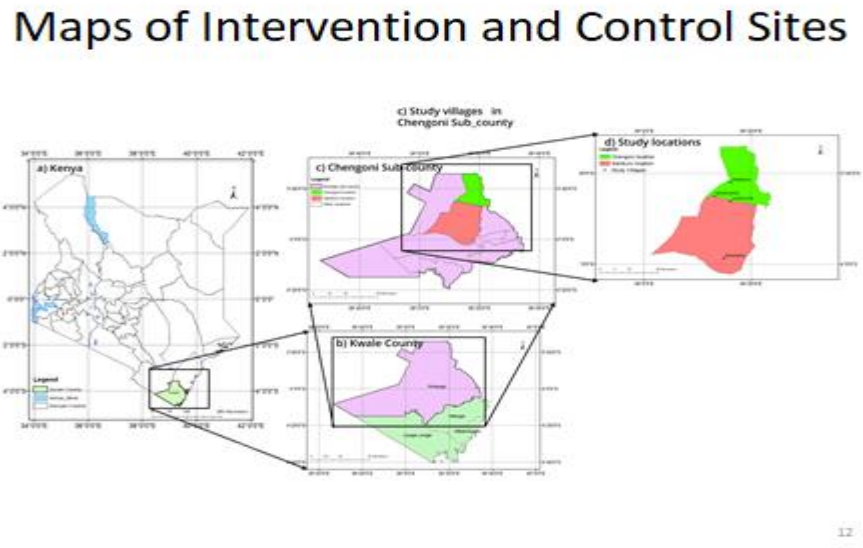

Figure 3.1: Maps of Intervention and Control Sites

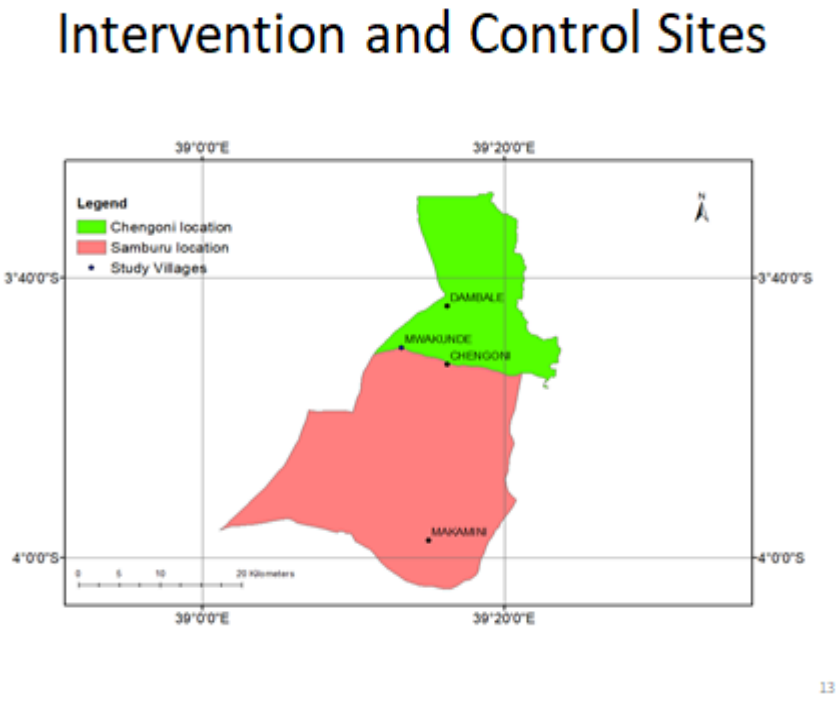

Figure 3.2: Map of Chengoni Village Unit showing Intervention and Control Sites

3.2 Study design

The study used a quasi-experimental design, with intervention and control sites. The study adopted a pretest-post-test approach. There were 5 villages in in the intervention arm (Bofu, Makamini, Chanzou I, Chanzou II and Dambale), and 5 villages in the control arm (Chengoni A, Chengoni B, Mtulu, Mwakunde and Mwanzungi). To minimize contamination, a 5 km buffer between the two arms was maintained.

3.3 Study population

The study population included children aged below the age of 5 years residing in Chengoni Village Unit and their respective guardians. The intervention site received the Community-Led Total Sanitation (CLTS) intervention while the control site received no sanitation related intervention at all.

3.3.1 Sample size determination

The study aimed at comparing the primary outcomes in the study site at baseline and end line. In this given scenario, sample size formula for differences in two proportions of the target population is convenient. Sample size formula according to Fleiss method was used (Wang, 2007), thus;

$n = (Z_{\alpha/2}+Z_{\beta})^2 * (p_1(1-p_1)+p_2(1-p_2)) / (p_1-p_2)^2$,

Where:

n = Sample size in each group (assumes equal sized groups)

$Z_{\alpha/2}$ = the desired level of statistical significance (typically 1.96 for 5% level of significance)

Z_{β} = the desired power (typically 0.84 for 80% power).

p1-p2 = effect size i.e. reduction in diarrhea due to CLTS, set at 10%.

$n = (1.96+0.84)^2*(0.55(1-0.55) +0.45(1-0.45))/(0.1)^2$

n = 388.08 (approximately = 388 HHs per arm) Plus 10% for non-response (39)

n=427 per arm (Intervention and Control sites), sum of 854

Actual data was collected on 402 and 405 respondents in control and intervention sites, respectively.

3.3.2 Inclusion criteria

1. All villages in Chengoni Village Unit were included
2. Children aged below 5 years from households in Chengoni Village Unit
3. Guardians of children aged below 5 years from households in Chengoni Village Unit willing to participate

3.3.3 Exclusion criteria

The study excluded:

1. Children aged below 5 years and their guardians who had not resided in the area for at least 3 years
2. Children who met the inclusion criteria but their caregivers did not consent to participate in the study.

3.4 Sampling procedure

3.4.1 Probability sampling procedure

All the 10 villages in Chengoni Village Unit were selected since they had not gone through CLTS and OD persisted. The CHVs performed household listing to identify households with children aged below 5 years. The number of HHs selected per village were sampled using probability proportional to size method. The households were then picked using systematic sampling method. Every alternate household were sampled until the sample size was attained.

Table 3.1: Sample size distribution by village

Control villages			Intervention villages		
Village name	**No. of HHs**	**HHs sampled**	**Village name**	**No. of HHs**	**HHs sampled**
Bofu/Makamini	124	99	Chengoni A	168	116
Chanzou I	108	91	Chengoni B	195	111
Chanzou II	102	86	Mtulu	107	61
Dambale	156	127	Mwakunde,	101	52
			Mwanzungi	112	65
Total	**490**	**402**	**Total**	**683**	***405***

A total of 402 households were sampled in control group and 405 were also sampled in the intervention group

3.4.2 Sampling procedure for the Focused Group Discussions (FGDs) participants

The participants of the focused group discussions were purposively selected taking into account their knowledge and exposure on community health services. Discussants were chosen from among those who had participated in the questionnaire survey. The FGDs consisted of 6-12 discussants representing peer leaders, the youth, and persons with disability were used where applicable. The FGDs groups for male and female participants were made separate that are the genders were not mixed together. The grounded theory were used to determine the number of FGDs to be held which was determined to be 3 FGDs. Consequently, the FGDs were conducted until saturation was achieved.

3.4.3 Key Informant Interviews (KIIs).

Key informants were purposively selected and they included: a community leader, the chairperson of a Community Health Unit, Area Public Health Officer and Health Facility In-charges.

3.5 Study variables

The dependent variables were 1) Nutriton status of children (malnourised or not malnourised), 2) Proportion of children with diarrhea, 3) Proportion of children with anemia, 4) Proportion of latrine ownership Whereas the independent variables include 1) socio-demographic characteristics of household heads (gender, age, education level, socio-cultural practices and awareness) and 2) Household characteristics (possession / number of latrine in HH, type of latrine, duration of use, practices that triggers for action in latrine e.g availability of water) perceived factors in the effectiveness of Community-Led Total Sanitation activities on health outcomes of children aged below 5 years.

3.6 Data collection tools

3.6.1 Pre-Testing

Pre-testing of the developed questionnaire was done in Maji ya Chumvi village unit; Samburu-Chengoni ward; Kinango Sub-County; Kwale county for a period of two (2) weeks. The principal investigator made corrections to the questionnaire to meet the research objectives and answer the research questions of the study before actual data collection was conducted.

3.6.2 Collection Techniques

A structured questionnaire was used to conduct a household survey. The questionnaire captured data on the CLTS approach activities, socio-demographic characteristics of HHs members and household characteristics - latrine possession; sanitation coverage; open defecation; availability of water; as well as measures taken by the households members to determine the effectiveness of community-led total sanitation activities on health outcomes of children aged below 5 years (nutritional status, status of diarrheal diseases, anemia and latrine ownership in the study site).

3.6.3 Desk review

Morbidity data from the integrated hospital registers in all the surrounding four health facilities (Chanzou dispensary, Maji ya Chumvi dispensary, Silaloni dispensary and Samburu HC) was reviewed retrospectively. This provided useful data for comparison with data from questionairres.

3.6.4 Questionnaire survey

The questionnaires were administered to all respondents by the by the principal investigator with the help of research sssistants.. Key Informatic Interviews (KIIs) were conducted by the principal investigator. The KIIs lasted between 30-45 minutes. In addition, Focused Groups Discussions were conducted by the principal investigator wth the help of a research assistant who acted as a secretarat. Further to taking notes, the discussion was recorded by use of a tape recorder. The information was later transcribed and the tapes destroyed.

3.7 Data management and analysis

3.7.1 Quantitative data.

Collected data was entered into excel spreadsheet and was cleaned then the data was exported to SPSS version 22.0 (IBM Corporation, New York USA) for coding and analysis. Continuous data was tested for normality using Kolmogorvor-Smirnor Test, if the data was normally distributed, we analyzed and presented it as mean$\pm$standard

deviation (SD), median and mode were also reported. Frequencies for all variables were recorded and cross-tabulated using percentages. Nominal data that is categorical was analyzed using Chi-square test or Fisher's exact test was used to analyze the difference between control and intervention groups. To test for the mean difference of the outcomes between control and intervention group, independent sample t test was used and the mean difference was deemed statistically significant at 95% confidence interval (95%,CI) with the p value $p<.05$.

Binary logistic regression model was used to determine the association between dependent and independent variables, and the model was used to adjust for confounders. The test for association was done using odds ratio (OR) carried at 95% CI and p value of less .05 was deemed statistically significant.

3.7.2 Qualitative data

The interviews were transcribed then processed using thematic analysis (Braun and Clerk 2006). The emerging themes were put together using grouping procedure based on similarities and differences. Qualitative & quantitative data were then be triangulated.

3.7.3 Data security and confidentiality.

Data extracted from hospital records did not carry any identifiers such as no reference were made to the patient names, serial numbers or address/ immediate neighborhoods. Hard copy forms were stored in lockable secure cabinets. Upon entry, all data were password protected hence only authorized persons had no access rights.

3.7.4 Data sharing / dissemination

Parties who were involved in the study were taken through a feedback forum with all the other stakeholders. They have received the complete report for future considerations on the relevant areas of study. All the study findings are yet to be publicly available through publication of the work in a peer reviewed open access journal.

3.8 Ethical considerations

The study was approved by accredited Ethics Review Committee of Pwani University, which is a National Commission for Science, Technology & Innovation (NACOSTI) accredited. Kwale County Government (Department of Health Services) was informed about the study prior to execution and feedback provided throughout

the research process. Oral informed consent was obtained from all respondents participated in the interviews as well as the household survey. Before interviews, the respondents were informed about the aim of the study, their discretion to participate and confidentiality of the information that they were to provide. The anticipated benefits or risks to the participants or the community was clearly explained and all the participants were given an opportunity to express whether they had understood the objectives of the study and what was expected of them as respondents. The participant were informed that to participate in the study was voluntary that they could leave or drop out of the study at will and no consequences or harm accorded to that, it was also explained to them that there was no direct material or monetary benefit by participating in the study survey. Confidentiality and originality of the work was observed by proper citation and cross-referencing and listing all scientific sources at the end of the report. APA referencing style was used throughout this study report.

3.9 Research limitations & gap

1. Given the retrospective nature of data on diarrhea cases registered at the health facilities, this study does not seek to establish a causal pathway therefore further research especially follow up study is required to establish causal relationships.
2. We relied on respondent self-reporting to measure defecation behaviors, & illness symptoms; these outcomes are thus subjected to reporting bias.
3. Household diarrhea incidence is based on a two-week recall period and this may introduce recall bias. The study is not a trend or follow-up type of research, thus does not consider seasonal differences in the occurrence of diarrhea.

CHAPTER FOUR

RESULTS

4.1 Demographic characteristics of study participants in the control- and intervention sites

In the baseline survey, majority of the respondents [273 (67.9%)] in the control group were aged between 26-35 years while in the intervention group, majority [262 (64.7%)] were aged between 31-40 years. At baseline, out of 402 respondents in the control site, 228 (56.7%) had attained secondary level of education while 144 (35.6%) out of 405 respondents in the intervention site had attained secondary level of education. At baseline survey data most of the respondents in the control group and intervention group most were peasant farmers 57%, 49.9%,56.2% and 55.1 respectively. About 345 (85.8%) and 298 (73.6%) of the respondent in the control and intervention group were married in that order. Most participants in the baseline data in the control group and in the intervention, group had monthly income of Ksh. (0-5,000) that is 221(54.9%) and 232(57.3%) respectively. In general, only few participants earned monthly income of more than 15,000 Kenyan shillings both in the control and intervention site in the baseline and endline survey (Table 4.1)

Table 4.1: Demographic characteristics of the respondents

Variables	Categories	Baseline survey				End term survey			
		Control		Intervention		Control		Intervention	
		F	%	F	%	F	%	F	%
Age (years)	16-25	75	18.7	32	7.9	78	19.4	81	20
	26-35	273	67.9	255	63	205	63.4	244	60.3
	36-45	54	13.4	118	29.1	69	17.2	80	19.8
Number of children	1-3	103	25.6	88	21.7	92	22.9	92	22.7
	4 -6	285	70.8	261	64.5	277	68.9	286	70.5
	>6	14	3.5	56	13.8	33	8.2	27	6.7
Level of education	primary	89	22.1	171	42.2	114	28.4	119	29.4
	Secondary	228	56.7	144	35.6	167	41.5	206	50.9
	Tertiary	85	21.1	90	22.2	121	30.1	80	19.8
Primary occupation	Supported	10	2.5	7	1.7	1	.2	25	6.2
	Farmer	229	57.0	202	49.9	226	56.2	223	55.1
	Business	112	27.9	102	25.2	108	26.9	99	24.4
	Employment	51	12.7	94	23.2	67	16.7	58	14.3
Marital status	Single	57	14.2	107	26.4	65	16.2	95	23.5
	Married	345	85.8	298	73.6	337	83.8	310	76.5
Monthly income	0-5,000	221	54.9	232	57.3	241	59.9	235	58.0
	5001-10,000	119	29.6	105	25.9	101	25.1	109	26.9
	10,001-15,000	45	11.2	38	9.3	53	13.2	57	14.1
	>15,000	17	4.2	30	7.4	13	3.2	4	0.99

4.1.1 To determine the effects of CLTS on nutritional status among children aged below 5 years.

At baseline, 181 (40.02%; 95% C.I=30.4-49.6) out of 402 children in the control were malnourished while 221 (54.98%; 95%C.I=45.3-64.8) had no malnutrition. For the intervention group, out of 405 children, 173 (42.72%; 95%C.I:33.3-52.7) had malnutrition while 232 (57.28%; 95%C.I:47.3-66.7) had no malnutrition. Chi-square statistics indicated no significant difference ($\chi 2=0.44$, df=1, p=0.55) in nutrition status for children in the control group compared to the intervention group for MUAC at baseline survey. Out of 402 children in the control group at endline, 195 (48.51%; 95%C.I=39.2-58.8) had malnutrition while 207 (51.49%; 95%C.I=42.3-

61.7) had no malnutrition. On the other hand out of 405 children, 119 (29.38%; 95%C.I=19.3-38.7) had malnutrition while 286 (70.62%; 95%C.I=61.3-80.7) had no malnutrition at the intervention site. Chi-square statistics indicated that there were significantly (χ2=30.2, df=1, p=0.00) more children without malnutrition among the intervention group compared to the control group at endline survey (see **Table 4.2)**.

Table 4.2: Nutrition status of children aged below 5 years in the control and intervention sites at baseline and end-line survey.

Group	Baseline survey					End line survey				
	With mltrn	No mltrn	Chi^2	df	p-value	With mltrn	No Mltrn	Chi^2	df	p-value
	Freq (%)	Freq %				Freq (%)	Freq (%)			
Control	181 (40.02)	221 (54.98)	0.35	1	0.55	195 (48.51)	207 (51.49)	30.2	1	0.00
Intervention	173 (42.72)	232 (57.28)				119 (29.38)	286 (70.62)			

Key. Mltrn -Malnutrition

There is no statistical significance difference in the proportion of malnourished children < 5 years between the control and intervetion groups at baseline survey (χ^2=0.44, df=1, p=0.55) **(**see **Figure 4.1)**

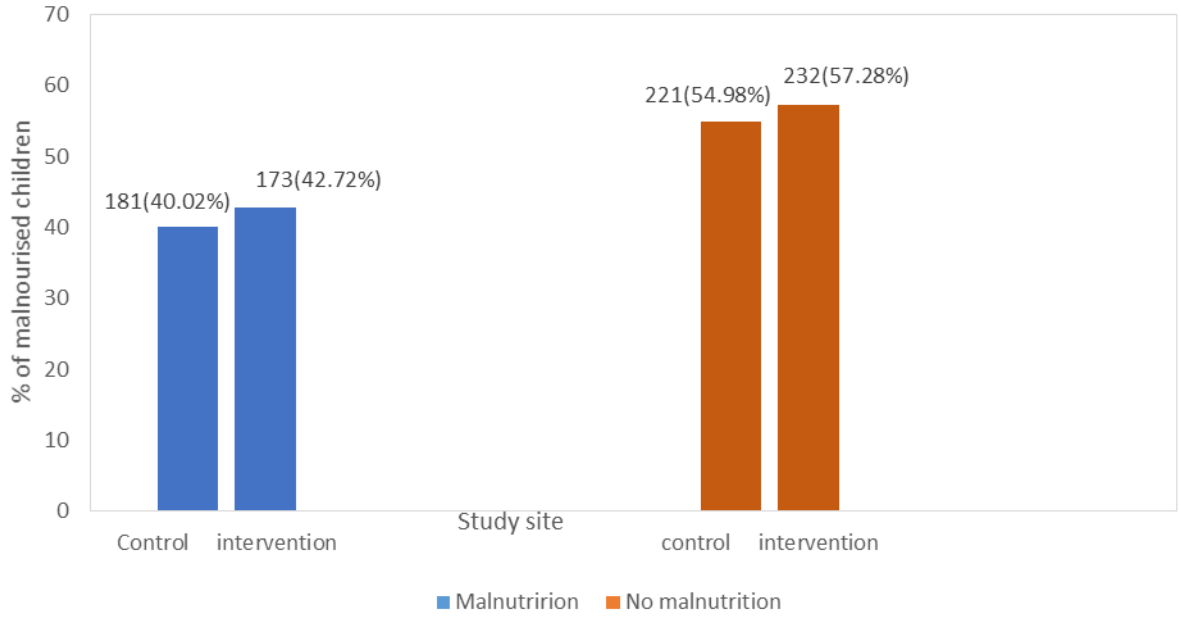

Figure 4.1: Nutritional status among children aged below 5 years in the study sites in baseline survey.

However, after 6 months; **Figure 4.2** shows that, there were significantly (χ^2=30.2, df=1, p=0.00) more children without malnutrition among the intervention group compared to the control group at end-line survey.

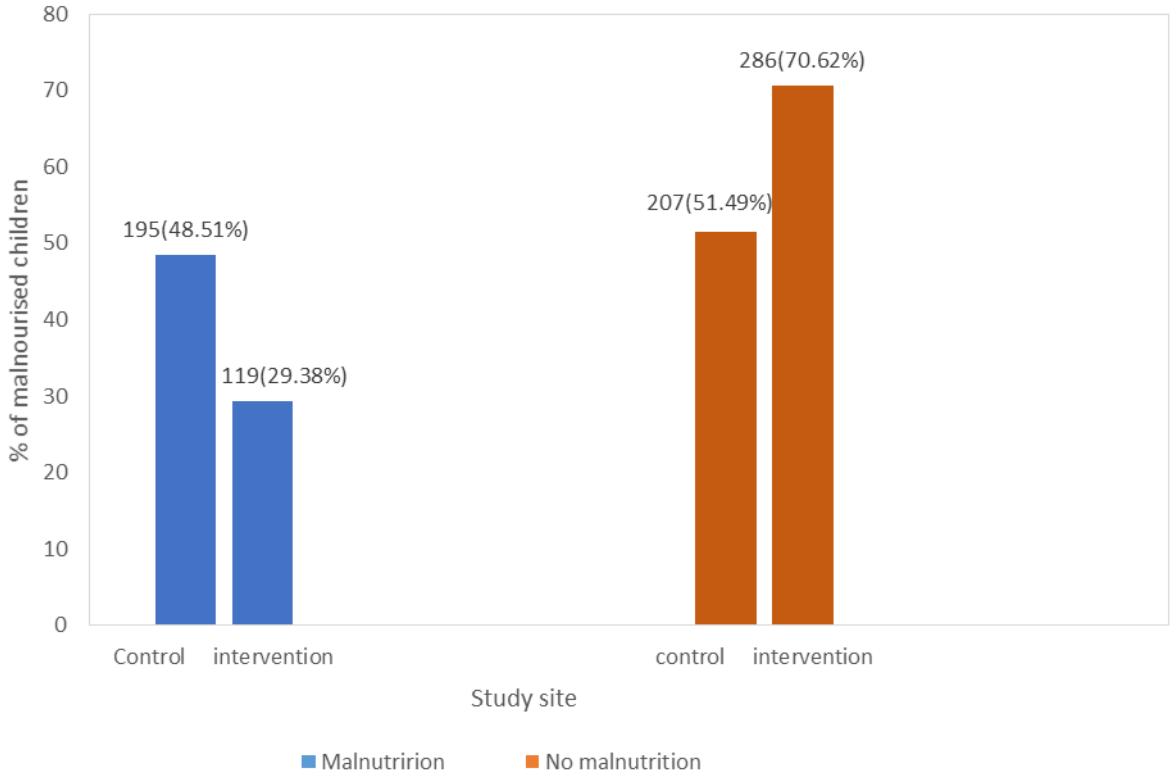

Figure 4.2: Nutritional status among children aged below 5 years at the study sites in end-line survey.

4.1.1.1 Factors associated with malnutrition among children aged below 5 years in the study sites.

A multivariate logistic regression analysis was conducted after adjustments indicated that age of respondents, number of children and marital status had no statistical association with nutritional status of children aged below 5 years in the study. However, the level of education of parents/guardians of the children aged below 5 years, occupation of parents/guardians and their monthly incomes were significantly associated with under-nutrition. Children of guardians with primary level of education were 1.32 times more likely to be malnourished as compared to those with

secondary and tertiary level of education (AOR=1.32; 95% CI: 1.006-1.733, p<.05). Having no primary occupation (being supported) was significantly associated (AOR=3.274: 95% CI 2.461-4.354) with malnutrition among children aged below 5 years (see Table 4.3).

Table 4.3: Factors associated with nutritional status of children aged below 5 years in the study at baseline

Variables in the Equation								
							95% CI.for EXP(B)	
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1[a]	Study Arm	.393	.181	4.687	1	.030	1.481	1.038	2.114
	Age of respondent	-.166	.169	.970	1	.325	.847	.608	1.179
	Number of children of respondent	-.044	.120	.134	1	.715	.957	.756	1.212
	Level of education of respondent	.278	.139	4.002	1	.045	1.320	1.006	1.733
	Marital status	.248	.161	2.361	1	.124	1.281	.934	1.758
	Primary Occupation of respondent (supported)	1.186	.146	66.387	1	.000	3.274	2.461	4.354
	Constant	-2.414	.553	19.068	1	.000	.089		

a. Variable(s) entered on step 1: Study Arm, Age of respondent, Number of children of respondent, Level of education of respondent, Marital status, Primary Occupation of respondent, Average Monthly Income.

4.1.2 To determine the episodes of diarrhea of children aged below 5 years in the control and intervention sites at baseline and end-line of the survey.

Out of 402 children in the control arm at baseline, 230 (57.2%; 95% CI: 52.36-62.04) were reported to have experienced diarrhea within the last 2 weeks while 172 (42.8%; 95% CI: 37.96-47.63) had no reports of diarrhea. For the intervention group, 213 (52.6%; 95% CI: 47.74-57.66) out of 405 children, were reported to have

experienced diarrhea within the preceding 2 weeks while 192 (47.4%; 95% CI: 42.54-52.26) had no reports of diarrhea. At end-line, out of 402 children in the control group, 198 (49.2%; 95% CI: 45.0-54.6) were reported to have experienced diarrhea within the last 2 weeks whereas in the intervention arm, 109 (26.9%; 95% CI: 22.83-31.37) out of 405 children were reported to have experienced diarrhea in the last 2 weeks. Consequently, significantly (χ^2 = 42.73, df =1; P<.001) fewer children in the intervention group were reported to have experienced diarrhea compared to children in the control group (see **Table 4.4**).

Table 4.4: Diarrhea of children aged below 5 years in the control and intervention sites at baseline and end-line of the survey

Group	Baseline survey					End-line survey				
	Diarrhea Freq (%)	No diarrhea Freq (%)	χ^2	df	P-value	Diarrhea Freq (%)	No Diarrhea Freq (%)	χ^2	df	P-value
Control	230 (57.2)	172 (42.8)	1.73	1	0.079	198 (49.2)	204 (50.3)	42.73	1	0.001
Intervention	213 (52.6)	192 (47.4)				109(26.9)	296 (73.1)			

The proportion of children who reported to have had diarrhea for the last two weeks in the control and the intervention groups were not significantly different (χ^2 = 1.73, df =1; P=0.079) at baseline survey as illustrated in **Figure 4.3.**

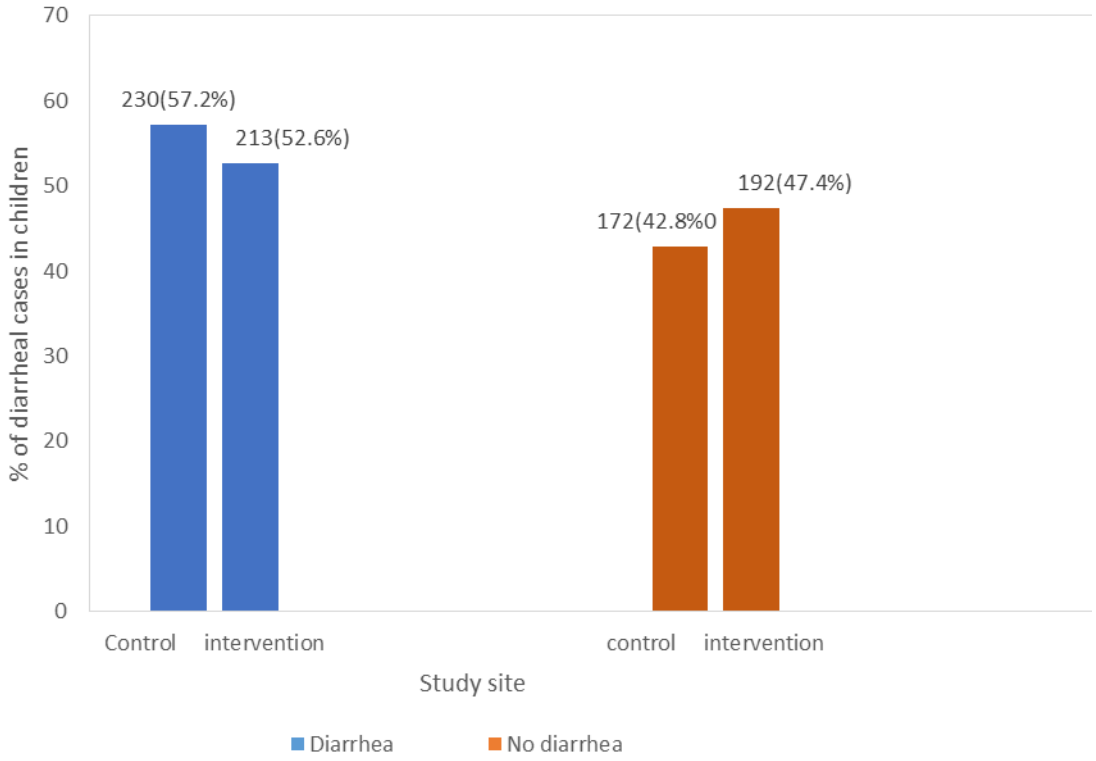

Figure 4.3: Episodes of diarrhea ocurrence among children aged below years between control and intervention site at baseline survey.

At end-line survey (see **Figure 4.4**); in the intervention site, significantly fewer (χ^2 = 42.73, df =1; P=0.001) children were reported to have experienced diarrhea compared to children in the control group in the last two weeks**.**

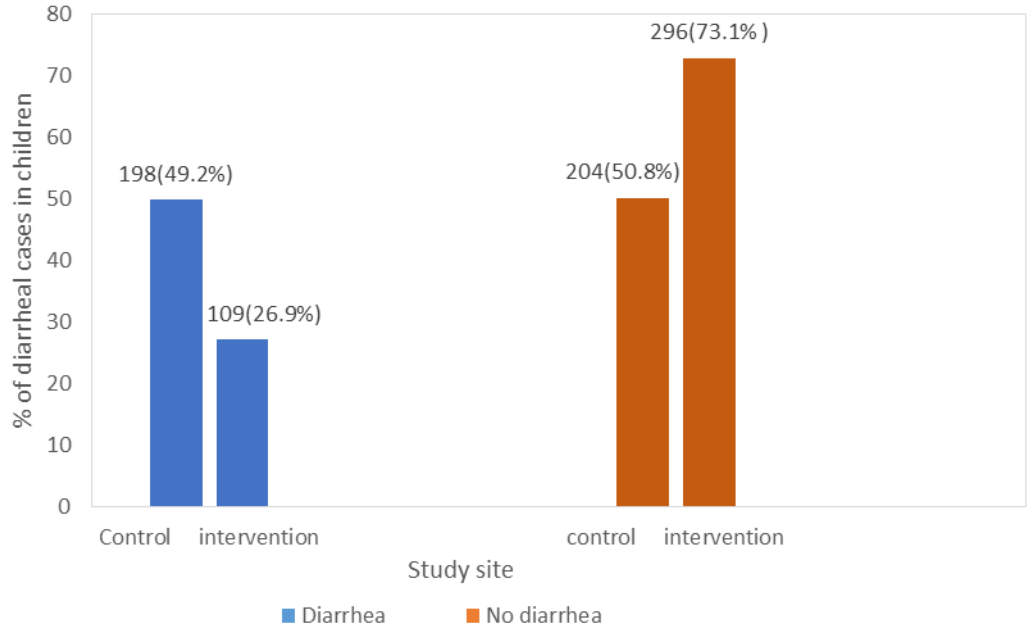

Figure 4.4:. Episodes of diarrhea ocurrence among children aged below 5 years between control and intervention site at endline survey.

4.1.3.1 To determine the effect of CLTS on anemia among children aged below 5 years in the control and intervention sites at baseline and end-line of the survey.

Results indicated that out of 402 children in the control group, 171(51.2%; 95% C.I=41.3-60.7) were anemic while 231 (48.8%: 95% CI = 39.1-58.5) were not anemic. For the intervention group, out of 405 children, 163 (48.8%:95% CI: 39.1-58.5) were anemic while 242 (51.2%: 95% C.I=41.3-60.7) were not anemic. Chi-square statistics indicated that there was no significant differences (χ^2=0.079, df=1, P>0.05) in the proportion of children that were anemic in the control and intervention sites at baseline survey. At end-line 164 (61.4%; 95%C.I=51.7-71.11) out of 402 children in the control site were anemic while 238 (44.1%; 95%C.I=34.4-53.8) were not anemic. In the intervention group 103 (38.6%; 95%C.I=28.9-48.3) out of 405 children were anemic while 302 (55.9%; 95%C.I=46.2-65.6) were not anemic.

Consequently, the proportion of children without anemia was significantly (χ^2=21.5, df=1, P<0.05) higher in the intervention site compared to the control site (**Table 4.5)**

Table 4.5: Cases of anemia among children aged below 5 years in the control and intervention sites at baseline and end-line of the survey

Group	Baseline survey					End line survey				
	Anemic Freq (%)	Not anemic Freq %	Chi^2	df	P-value	Anemic Freq (%)	Not anemic Freq (%)	Chi^2	df	P-value
Control	171 (51.2)	231 (48.8)	0.079	1	0.30	164 (61.4)	238 (44.1)	21.5	1	0.00
Intervention	163 (48.8)	242 (51.2)				103 (38.6)	302 (55.9)			

The proportion of anemic children between control and intervention group at baseline survey were not significantly different (χ^2=0.079, df=1, P>0.05) as illustrated in **Figure 4.5** below.

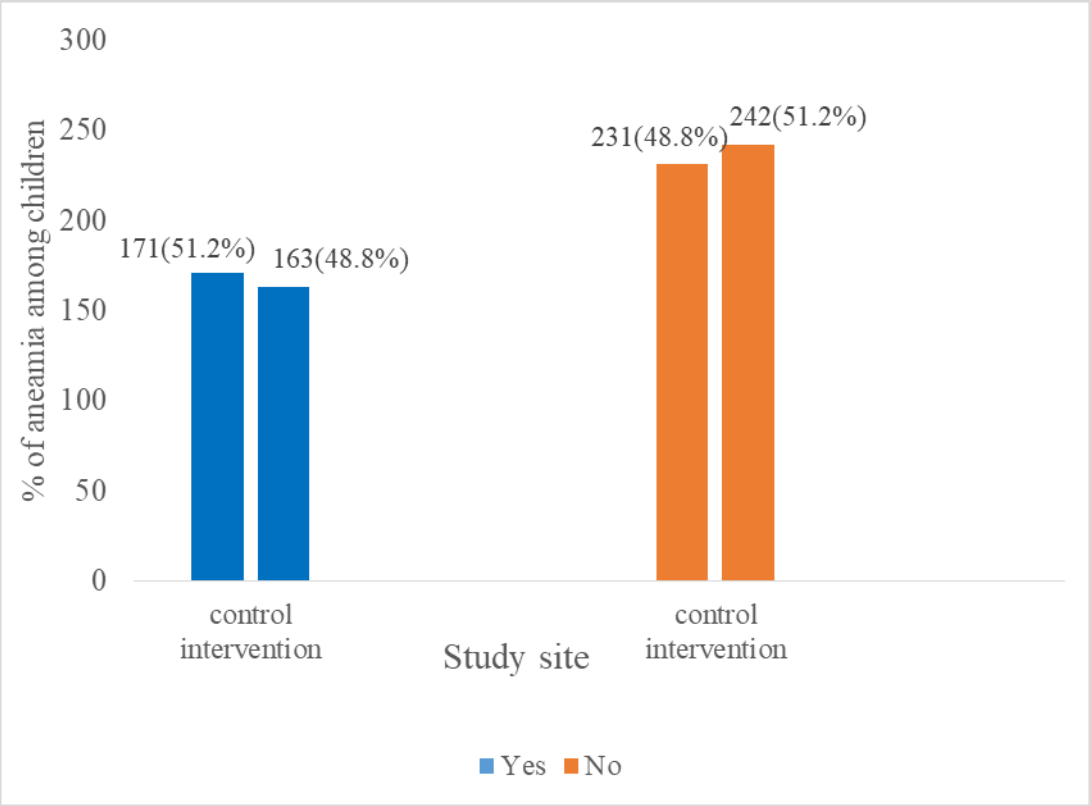

Figure 4.5: Proportion of anemic children aged below 5 years at the control and the intervention group at baseline survey.

The proportion of children without anemia was significantly ($\chi 2=21.5$, df=1, $P<0.05$) higher in the intervention site compared to the control site. (see **Figure 4.6**).

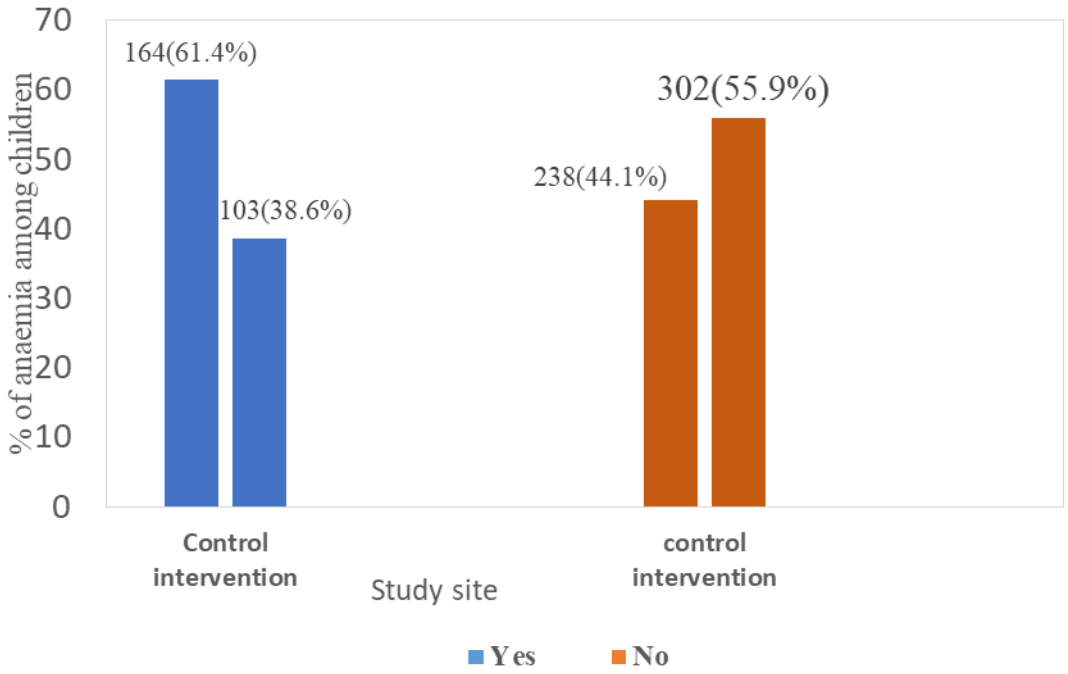

Figure 4.6: Proportion of anemic children aged below 5 years at control and intervention group at endline survey

4.1.3.2 Predictors of anemia among children aged below 5 years at baseline

After adjustment and controlling for confounding factors, there was no significant difference in anemia status among children in the control and intervention arms at baseline [(AOR = 0.938, 95% CI = 0.652- 1.349, P> 0.05)]. In a multivariate logistic regression analysis, all the variables analyzed were not significantly associated with anemia status at baseline. Thus; age of respondents [(AOR = .878, 95% CI = .630- 1.225, P> 0.05)], number of children [(AOR = 1.008, 95% CI = .796- 1.276, P> 0.05)], level of education of respondents [(AOR = .962, 95% CI = .721- 1.282, P> 0.05)], primary occupation of respondents [(AOR = 1.115, 95% CI = .843- 1.474, P> 0.05)], marital status[(AOR = 1.124, 95% CI = .814- 1.550, P> 0.05)], and average monthly income of correspondents [(AOR = 1.000, 95% CI = 1.000- 1.000, P> 0.05)]. **Table 4.6** shows below.

Table 4.6: Predictors of anemia among children aged below 5 years at baseline

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Study Arm	-.064	.185	.120	1	.729	.938	.652	1.349
	Age of respondent	-.130	.170	.586	1	.444	.878	.630	1.225
	Number of children of respondent	.008	.120	.005	1	.946	1.008	.796	1.276
	Level of education of respondent	-.039	.147	.072	1	.789	.962	.721	1.282
	Primary Occupation of respondent	.109	.142	.585	1	.444	1.115	.843	1.474
	Marital status	.117	.164	.504	1	.478	1.124	.814	1.550
	Average Monthly Income	.000	.000	1.146	1	.284	1.000	1.000	1.000
	Constant	1.260	.556	5.142	1	.023	3.525		

a. Variable(s) entered on step 1: Study Arm, Age of respondent, Number of children of respondent, Level of education of respondent, Primary Occupation of respondent, Marital status, Average Monthly Income.

4.1.3.3 Predictors of anaemia among children aged below 5 years at end-line

The adjusted odds ratios indicated that there was significance association between introduction of CLTS activities and anemia [(OR = 3.064, 95% CI = 2.026- 4.634, P< 0.05)]. Children in the control site (non-CLTS site) were 3 times more likely to develop anemia as compared to children in the intervention site (CLTS site); as illustrated in **Table 4.7** below.

Table 4.7: Predictors of anemia among children aged below 5 years at end line

Variables in the Equation								
							95% C.I.for EXP(B)	
		B	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**	Lower	Upper
Step 1[a]	Study Arm	1.120	.211	28.128	1	.000	3.064	2.026	4.634
	Age of respondent	.332	.206	2.604	1	.107	1.394	.931	2.088
	Number of children of respondent	-.208	.157	1.755	1	.185	.812	.597	1.105
	Level of education of respondent	-.181	.172	1.119	1	.290	.834	.596	1.167
	Primary Occupation of respondent	.155	.158	.959	1	.327	1.167	.857	1.590
	Marital status	-.200	.179	1.251	1	.263	.819	.577	1.162
	Average Monthly Income	.000	.000	2.504	1	.114	1.000	1.000	1.000
	Constant	1.259	.674	3.492	1	.062	3.523		

a. Variable(s) entered on step 1: Study Arm, Age of respondent, Number of children of respondent, Level of education of respondent, Primary Occupation of respondent, Marital status, Average Monthly Income .

4.1.3.4 Association between nutritional status and anemia among children aged <5 years at baseline and end-line survey.

Analysis indicated that malnutrition was significantly associated with anaemia among children below 5 years at baseline and at end-line. See below **Table 4.8**.

Table 4.8: Cross tabulation (Chi^2 Test) between nutritional status and anemia of children aged below 5 years at baseline and end-line survey.

Group	Baseline survey					End line survey				
	With mltrn Freq (%)	No mltrn Freq %	Chi^2	df	p-value	With mltrn Freq (%)	No mltrn Freq (%)	Chi^2	df	p-value
Anemic	185 (52.3)	149 (32.9)	30.7	1	.000	162 (51.6)	105 (21.3)	79.5	1	.000
Not anemic	169 (47.7)	304 (67.1)				152 (48.4)	388 (78.7)			

4.1.4 To determine the ownership of latrine and practice of open defection among household members.

Bivariate logistic regression analysis showed that CLTS implementation, having a male household head, land ownership and having permanent house structures were all significantly associated with latrine ownership ($p<0.05$).

Households in the Non CLTS arm were 53% less likely to own a latrine as compared to those in the CLTS arm, households that reported to have heard about CLTS as well as received CLTS reference materials were twice as likely to own a latrine than those who had no knowledge of CLTS. Male headed households were 82% likely to own a latrine as compared to female headed households (OR=1.82, 95% CI: 1.35-2.45, P<.001). On the other hand, using land ownership (OR=2.58, 95%, CI: 1.80-3.70, p<.001), source of lighting and type of household structure as proxy indicators for socio-economic status, the higher the socio-economic status, the higher the probability of owning a latrine.

Further, those that participated in CLTS were three times more likely to own a latrine as compared to non-participants (OR=2.88,95% CI:2.15-3.87, p<.001), and also those who received materials were about 2 times more likely to own a latrine than their counterparts (OR=1.75,95% CI:1.30-2.34, p<.001). Additionally those who heard about CLTS and had primary and secondary level of education were 1.7,1.7 and 4.6 more likely to own latrine as compared to those who had not heard and had no any basic education (OR=1.71,95%, CI:1.21-2.42, p<.0010),(OR=1.74,95% CI:1.28-2.36,p<.0010) and(OR=4.57,95%,CI:2.51-8.33,P<.001) respectively as shown in **Table 4.9**.

Table 4.9: Latrine ownership and practice of open defecation among household members

Characteristics	UOR (95% CI)	p value
Arm		
Non CLTS	1 (Reference)	
CLTS	2.13 (1.61 – 2.86)	0.00*
Sex of HH head		
Female	1 (Reference)	
Male	1.82 (1.35-2.45)	0.00*
Marital status		
Married	1 (Reference)	
Separated	0.93 (0.44 -1.98)	0.85
Single	0.86 (0.40-1.86)	0.71
Widowed	1.01 (0.57-1.79)	0.98
Level of education		
None	1 (Reference)	
Other	1.47 (0.09-23.72)	0.79
Primary	1.74 (1.28-2.36)	0.00*
Secondary	4.57 (2.51-8.33)	0.00*
Tertiary	2.94 (0.26-32.8)	0.38
Occupation		
Daily labor	1 (Reference)	
Employed	1.42 (0.67-3.00)	0.37
Farmer	0.63 (0.41-0.97)	0.04*
Other	0.00 (0.00-.)	1.00
Small business	2.34 (0.92-5.94)	0.07
Income		
< 5000	1 (Reference)	
> 15000	-	1.00
10001-15000	1.88 (0.91-3.89)	0.09
5001-10000	1.32 (0.88-2.00)	0.18
Land ownership		
No	1 (Reference)	
Yes	2.58 (1.80-3.70)	0.00*
Type of housing		
Permanent	1 (Reference)	
Semi-permanent	0.24 (0.13-0.43)	0.00*
Temporary	1.71 (0.08-0.35)	0.00*
Source of lighting		
Electricity	1 (Reference)	
Kerosene	0.11 (0.03-0.36)	0.00*
Other	0.06 (0.01-0.34)	0.00*
Solar panels	0.18 (0.05-0.60)	0.01*
Cooking fuel		
Gas	1 (Reference)	
Charcoal	-	1.00
Firewood	-	1.00
Water source		
Shallow well	1 (Reference)	
Piped water	0.89 (0.42-1.92)	0.77
Other	0.32 (0.15-0.70)	0.00*
Distance to water source		
< 30min	1 (Reference)	
>1hr	2.75 (0.88-8.63)	0.08
30min-1hr	0.84 (0.60-1.17)	0.30
Heard of CLTS		
No	1 (Reference)	
Yes	1.71 (1.21-2.42)	0.00*
Participated in CLTS		
No	1 (Reference)	
Yes	2.88 (2.15-3.87)	0.00*
Received CLTS material		
No	1 (Reference)	
Yes	1.75 (1.30-2.34)	0.00*

4.1.4.1 To determine the ownership of latrine and practice of open defection among household members - Multivariate analysis (Logistic regression).

We performed multivariate logistic regression analysis, all variables were included in a stepwise backward logistic regression that is; CLTS implementation, land ownership, type of housing and CLTS knowledge remained significant predictors of latrine ownership. Households in non-CLTS implementation site were 71% less likely to own a latrine as compared to those in the CLTS site (AOR=.29,95% CI: .16-.53, P<.001). On the other hand respondents who reported that their occupation was farming were 64% less likely to have their own pit latrine as compared to those employed, had small business and those engaging in daily labor (AOR=.36,95%,CI:.21-.62,P<.001). As reported households with their own land were two times more likely to own their own latrine as compared to those without their own land (AOR=1.99,95%, CI: 1.27-3.10,P<.001). Proxy indicators for socio-economic status significantly associated with latrine ownership, the higher the socio-economic status, the higher the probability of owning a latrine, shows T**able 4.10**.

Table 4.10: Latrine ownership- Multivariate analysis (Logistic regression)

Characteristics	AOR (95% CI)	p value
Arm		
CLTS	1 (Reference)	
Non CLTS	0.29 (0.16-0.53)	0.00*
Occupation		
Daily labor	1 (Reference)	
Farmer	0.87 (0.33-2.39)	0.78
Employed	0.36 (0.21-0.62)	0.00*
Small business	2.06 (0.70-6.04)	0.19
Income		
< 5000	1 (Reference)	
> 15000	-	1.00
10001-15000	0.39 (0.14-1.09)	0.07
5001-10000	0.56 (0.31-1.00)	0.05
Land ownership		
No	1 (Reference)	
Yes	1.99 (1.27-3.10)	0.00*
Type of housing		
Permanent	1 (Reference)	
Semi-permanent	0.41 (0.20-0.83)	0.01*
Temporary	0.36 (0.15-0.88)	0.02*
Source of lighting		
Electricity	1 (Reference)	
Kerosene	0.19 (0.05-0.82)	0.03*
Solar panels	0.28 (0.07-1.16)	0.08
Water source		
Shallow well	1 (Reference)	
Piped water	0.82 (0.34-1.98)	0.66
Other	0.24 (0.09-0.6)	0.00*
Distance to water source		
< 30min	1 (Reference)	
>1hr	2.98 (0.80-11.08)	0.10
30min-1hr	1.92 (1.21-3.05)	0.01*
Heard of CLTS		0.00*
No	1 (Reference)	
Yes	2.24 (1.31-3.82)	
Participated in CLTS		0.00*
No	1 (Reference)	
Yes	5.49 (3.22-9.35)	
Received CLTS material		0.00*
No	1 (Reference)	
Yes	0.16 (0.07-0.34)	

4.1.5 To determine the socio-cultural barriers influencing CLTS among household members

The proportion of participants who reported to have heard about CLTS in the intervention and the control site were not significantly different (χ^2 = 0.246, df =1; P=0.344). On the other hand, the proportion of participants who reported to have participated in CLTS in the intervention site was significantly higher (χ^2 = 164.810, df =1; P<.001) as compared to the control group. Additionally, the proportion of those who had reported receiving CLTS materials in the intervention group was significantly higher (χ^2 = 418.708, df =1; P<.001) than those in the control group, shows Table 4.11.

Table 4.11: Awareness of CLTS among respondents.

Characteristic	**n(%)**		**Chi-square values**	**P value**
	CLTS	**Non-CLTS**		
Heard of CLTS			0.246	0.344
No	87 (21.9)	81 (19.9)		
Yes	309 (78.1)	325 (80.1)		
Participated in CLTS			164.810	0.000*
No	146 (36.8)	330 (81.3)		
Yes	250 (63.1)	76 (18.7)		
Received CLTS material			418.708	0.000*
No	116 (29.3)	400 (98.5)		
Yes	280 (70.7)	6 (1.5)		

Community health volunteers (CHVs) were the main source of information on CLTS both in the CLTS and Non-CLTS villages accounting up 74% and 73% respectively. On the other hand, 69% of the information in the CLTS intervention site was given by health workers while in the non-CLTS control site the health workers provided only 38% of the information on CLTS. CHVs seemed to spread the information more than health workers, covering even non CLTS villages whereas social media provided the least information on CLTS **(Figure 4.7).**

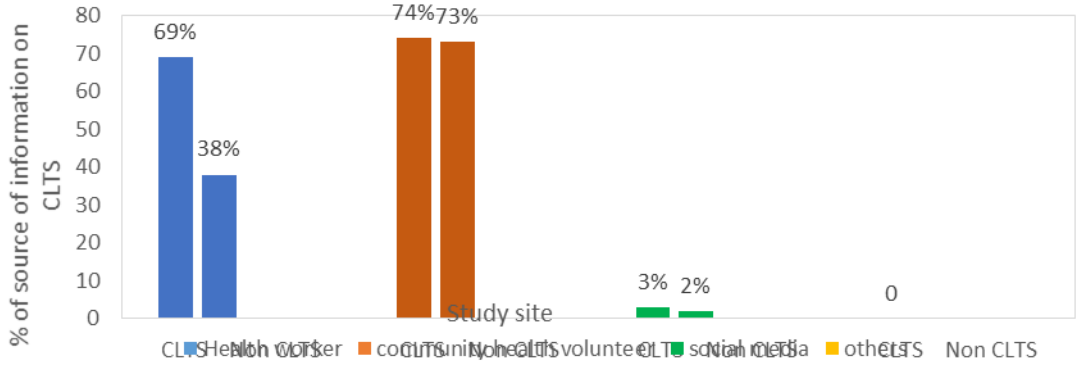

Figure 4.7: Source of information on CLTS for the community members in the CLTS and Non CLTS sites

4.1.5.1 Health seeking behavior by parents/guardians in the study sites

In the intervention and control groups, respondent reported that the major barriers to seeking health care services were distance and lack of medicines. In the intervention group, 69% of participants reported distance as the main barrier to seeking healthcare services while 24% of participants reported lack of medicines in the facilities as another barrier to seeking healthcare service. On the other hand, in the control group 66% of the participants reported distance as a barrier to seeking healthcare services while 22% reported lack of medicines as a barrier to seeking healthcare services (**Figure 4.8)**

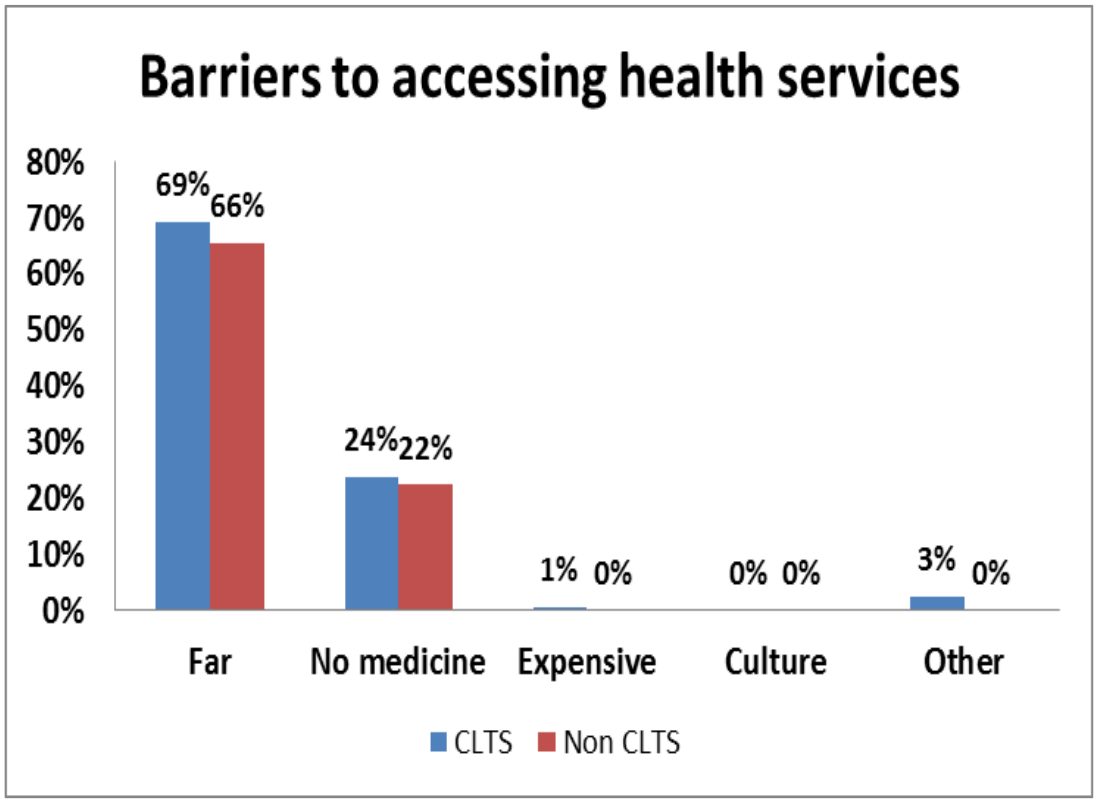

Figure 4.8:. Barriers to accessing health services by caregivers of children aged below 5 years in the study sites.

In the intervention group, 80% of respondent reported to walk for more than 30 minutes to the health facilities while on the other hand 98% of respondents in the control group reported walk for more than 30 minutes to the health facility. Additionally, 21% of the respondents in the intervention group walked for more than half a day to reach a medical facility while in the control group only 15% of respondents who reported walking for more than an hour to the health facility **(Figure4.9)**.

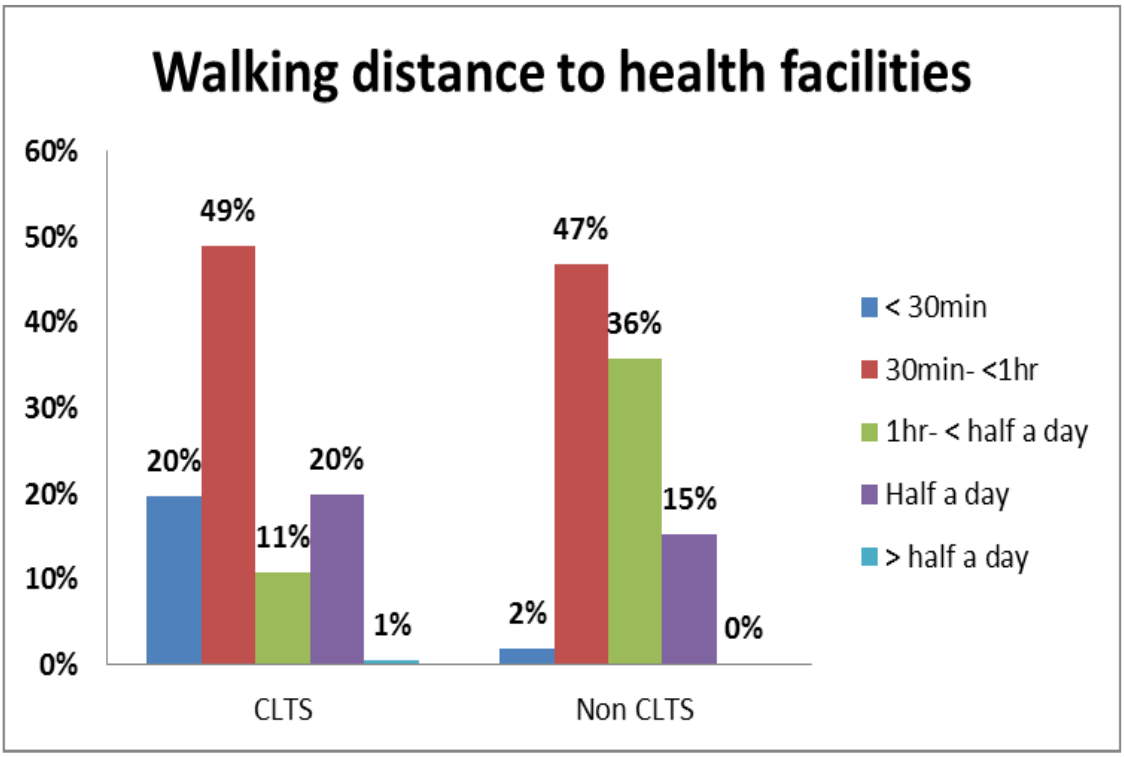

Figure 4.9:. Barriers to accessing health services by caregivers of children aged below 5 years in the study sites

4.1.5.2 Water sanitation and hygiene (WASH) Knowledge and Practices among respondents.

In the intervention group 19, out of 405 respondents reported to treat water while 386 reported not to treat water. On the other hand, 32 out of 402respondents in the control group reported to treat water while 370 reported not to treat water. Chi-square statistics revealed that there was no significant difference (χ^2 = 3.197, df =1; P=0.074) in the proportion of respondents who treated water between the intervention and control groups. On the other in the intervention group 101 out of 395 respondents reported to have hand washing facility while 294 had no hand washing facility. On the contrary, in the control group only 47 out of 406 respondents reported to have hand washing facility **(Table 4.12).** Chi-square statistics indicated the proportion of respond with hand washing facility was significantly higher (χ^2 = 26.033, df =1; P<.001) in the intervention group than the control group.

A total of 154 out of 396 participants in the intervention group reported using bush as a type of toilet while 242 reported to use toilet which could be flash toilet, traditional pit latrine of ventilated pit latrine. In the control 234 out of 406 respondents reported using bushes as an alternative toilet while 172 out of 406 reported to be using functional toilets which could be flash toilet, traditional pit latrine or ventilated pit latrine. Chi-square statistics indicated that the proportion of respondents who reported using bushes was significantly higher (χ^2 = 29.073, df =1; P<.001) in the control group compared to the intervention group. Additionally, 98 out of 396 respondents reported to be sharing toilet in the intervention group while 70 out of 406 respondents reported to share toilets in the control group. Chi-square test revealed there were no significant different (χ^2 = 6.814, df =1; P=0.077) in the proportion of those sharing the toilets in the intervention and control.

On self-proclaimed ODF 248 out of 396 respondents in the intervention group proclaimed to be ODF while in the control group only 159 out of 406 proclaimed to be ODF. Chi-square analysis indicated the proportion of self-proclaimed ODF in the intervention group was significantly higher (χ^2 = 91.701, df =1; P<.001) compared to the control group **(Table 4.12).**

Table 4.111: Knowledge and Practices of WASH.

Characteristic	n(%)		Chi-square values	P value
	CLTS	Non-CLTS		
Water treatment				
No	377 (95.2)	374 (92.1)	3.197	0.074
Yes	19 (4.8)	32 (7.9)		
Available hand washing facility				
No	294 (74.2)	359 (88.4)	26.033	0.000
Yes	101 (25.5)	47 (11.6)		
Toilet type				
Bushes	154 (38.9)	234 (57.6)		
Flash latrine	9 (2.3)	9 (2.2)	29.073	0.000
Traditional pit latrine	198 (50.0)	135 (33.3)		
Ventilated pit latrine	35 (8.8)	28 (6.9)		
Toilet sharing				
No	298 (59.5)	336 (59.3)	6.814	0.077
Yes	98 (40.5)	70 (40.7)		
Self-proclaimed ODF				
Don't know				
No	51 (12.9)	16 (3.9)	91.701	0.000
Yes	97 (24.5)	230 (56.7)		
	248 (62.6)	159 (39.2)		

In the CLTS intervention site, 63.6% used piped water while 36.6% of the respondent used unprotected sources of water. Similarly in the Non-CLTS villages 56.1% of the respondents used piped water while 43.9% used unprotected sources of water **(Figure 4.10).**

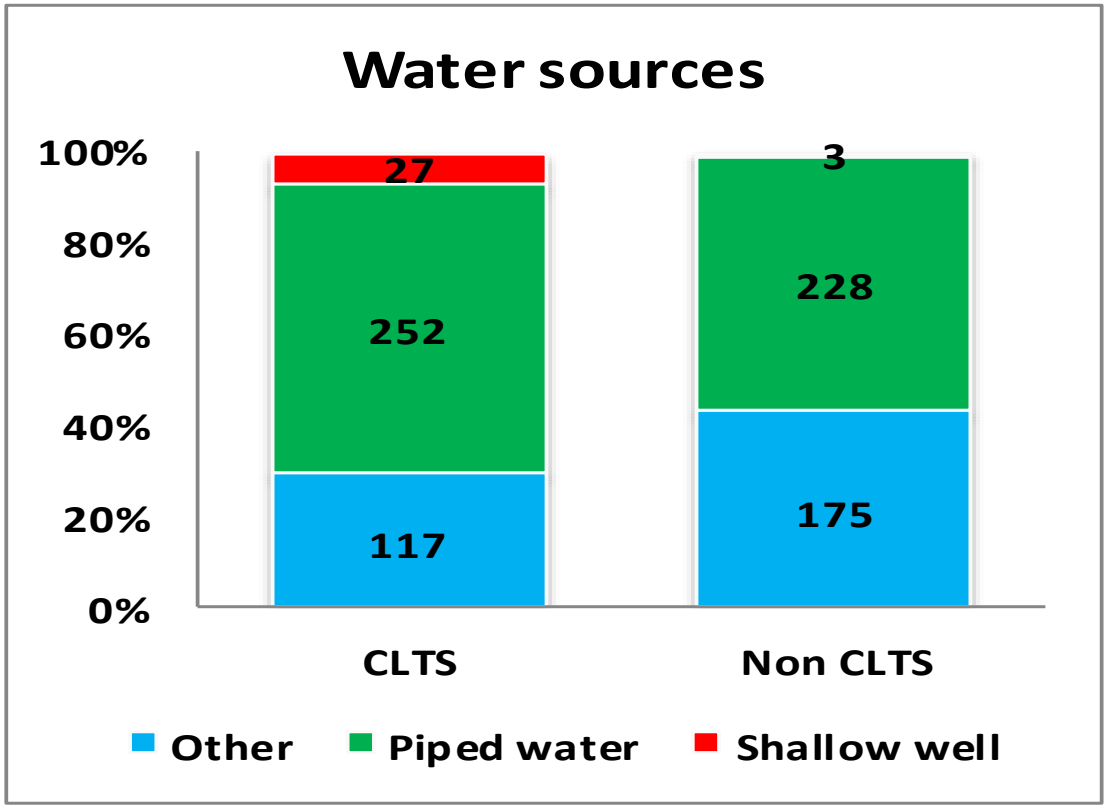

Figure 4.10:. Sources of water for the respondents in the study

Hand washing practices differed between the respondents in the CLTS intervention sites compared to the control sites. However, in the Non-CLTS sites the practice of hand washing was also relatively improved despite being lower than in the CLTS implementation villages (**Figure 4.11).**

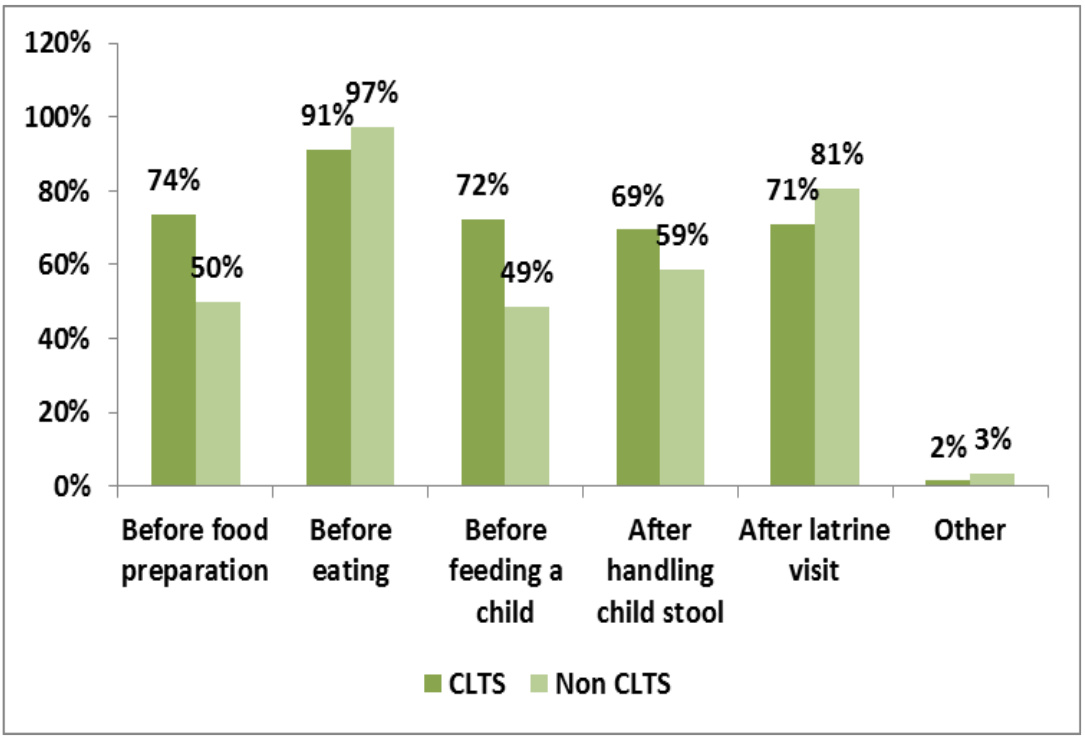

Figure 4.11: Knowledge and Practices of WASH among respondents in the study.

4.1.5.3 Triangulation of quantitative and qualitative data collection

We conducted qualitative analysis to identify effects of open defecation on nutritional status, Episodes of diarrhea and anemia among children <5 years of age in the community setting. The study sought also to determine factors associated with latrine ownership and identify socio-cultural barriers to CLTS implementation. Key-informants interviewed included the Area Public Health Officer (1); Health facility In-charge (1); Chairperson of Community Health Unit (1); Community leader (1) and 12 participants of a community focus group discussion (n=12). To explore a range of experiences and perceptions. We followed Denzin's 5 multiple triangulation approach, which encourages several methods to collect data and multiple investigators with varied expertise.

Phase I of the study focused on understanding the context of the study and included interviews with public health officers and facilities in-charge. The second phase involved observation of community leaders, chairperson of community health unit.

Focus Group Discussions (FGDs) with Key Informants Interviews (KIIs), followed by FGDs with community health discussants chosen from those who participated in the community survey at household level were conducted in order to share personal experiences on hygiene and sanitation practices. The final phase included workshops to feedback findings.

Data were coded and thematically analyzed. The result from Key informants identified the malnutrition, diarrheal and anemia diseases among under five years as one of the main challenges of poor sanitation in the region. The observations were supported by the KIIs and FGDs, they were also supported by the evidence of hand quantitative analysis result.

Malnutrition was viewed by respondents to be as a result of poverty and inadequate agricultural produce. The respondents expressed their feelings that Kwale is semi-arid and they usually receive inadequate rainfall and the poverty index of its people is high hence most families doesn't afford not only three course meals thrice a day but they hardly get three meals and a day and even if they take, they can cannot afford to take balanced diet hence put children below 5 years at risk of being malnourished. However, some other few respondents suggest that poor sanitation has also contributed to malnutrition. As the following responses suggest, there was a strong feeling amongst the groups that poverty and inadequate agricultural produce are the main contributors of malnutrition, and also poor sanitation.

i. A 52 years old woman said, "*We don't produce a variety of crops. It rains once in a while. Our income from small business is too small to buys they necessary food for our family so sometimes we can take porridge in the morning and sometimes repeat the same porridge in the evening".*
ii. A middle-aged man also said, "*You know our life style we don't usually do farming. Our land is poor in producing crops because we rarely receive adequate water in most seasons of the year. We land variety of food sources".*

iii. A community leader suggested, *"We admit that our income and agricultural produce is low. But we also don't take care of our children as required, we leave them to take dirty things and water making them sick. Recent the child of my brother was admitted to hospital for because of worms the child was very weak*".

The respondent felt that poverty, inadequate water supply and poor sanitation behavior are the main cause of malnutrition among children aged below 5 years in the community. The issue of poor sanitation was consistency with the survey findings which associated CLTS with nutritional status of children < 5 years. The findings indicated children from CLTS implementation arm were less likely to develop malnutrition as compared to those from the no-CLTS site. Also, the survey result had identified children from poor family which had not primary occupation and depended to be support their children were more likely to be malnourished this is in agreement with FGD results. Although the survey did not identify inadequate agricultural produce as the cause of malnutrition the suggestion of the FGD was valid. Poverty and inadequate agricultural produce are known barriers to adequate food supply.

Diarrheal diseases were suggested by the respondents as one of the main challenges of poor sanitation in the community. For instant the following respondents strongly believed that poor hygiene and sanitation and poor care of children are root course of diarrheal diseases among children.

i) A 35 years old mother whose identity is concealed said, *"Parents most of time we leave children unattended and they end up eating dirt things. We belief child stool has no effect and we just leave it in the field without disposing and children eat anything they find in the field"*.

ii) Another middle-aged mother added, *"I have been feeding my child without washing had and even been handling child stood and won't mind washing hands. My two kinds started diarrheal and they were*

admitted for two weeks in the hospital. I was advised by nurses to wash hands, cook food well and boil water for my kids".

iii) A middle-aged teacher said, *"My nephew died recently from diarrhea. My sister has no constructed latrine".*

The respond had strong feeling that diarrheal disease has become a challenge in their community and the reason behind this is poor hygiene and sanitation. This FGD result is consistency with the survey result which indicated that implementation of CLTS reduced the proportion diarrhea in children from 52.6% to 26.9% and thus reducing the proportion of diarrhea in children significantly by 48.8%.

The respondents suggested that latrine ownership and proper fecal matter management is good and healthy.

i) A 32-year-old breastfeeding mother said, *"It is good to own a told. When my husband built a pit latrine, we started avoiding a lot of houseflies and other insects in the compound".*

ii) A middle-aged man said, *"From the time I constructed a VIP latrine my compound is clean. I used to step on kids stools most of the time in the compound. Houseflies were all over".*

Most respondents advocated for latrine ownership and proper sanitation. However, they still didn't practice proper sanitation by nor own latrine this is because despite the good knowledge still barriers such as cultural beliefs and tradition, low level of education, inadequate information, lack of land ownership was stronger.

i) A man whose identity not disclosed said, *"It is good to have a latrine: But as a man my stool cannot mix with that of my daughters and my in-laws it is culturally wrong".*

ii) One FGD member said, *"Our people believe that when you share a toilet you are witchcrafts. It is also shame to be seen going to the toilet. People have not received proper information on the importance of latrine".*

iii) A middle-aged married man said, *"I have a family but I don't own land. I cannot build a latrine in the land that is not mine. No need for a latrine and washing hands my wife can handle my kids stool with bare hands because children stool is nothing because children don't eat bad things so their stool is harmless. I earn little that I use to feed my family no extra money to use to construct a toilet".*

Majority of the respondents strongly agreed that latrine ownership and proper sanitation are very important. However, the barriers are too strong to let them own latrine and practice proper sanitation. Cultural beliefs are one of the strong barriers that need to be addressed by providing proper information to the community. This FGDs result is consistent with the household survey result indicated that most information on CLTS was given by CHVs and not professionally trained health workers. This is a clear indication that there are inadequate health workers and more need to be recruited to provide the community with this information. Some respondent indicated that due to poor income they cannot afford to build a toilet a young man said "the little I get is for feeding my family no extra to use in building a toilet". The FGDs result is in agreement with quantitative result which indicated the level of income was directly associated with latrine ownership. The household survey did not identify culture and beliefs as the barriers to latrine ownership, however, through observation it was there and this was supported by FGDs results. The FGDs result indicated that most people who had information about CLTS owned latrines. The result is consistent with the house hold survey result which indicated household which had information about CLTS were more likely to own a latrine.

The key informants also identified that people were not practicing hand washing. This was also confirmed through FGDs and was revealed by quantitative analysis result. The key informants observed that cultural beliefs and traditions contributed to open defecation practice. This was packed with the result from FGD where majority declared that it is a taboo and when seen going to the toilet and owning a toilet people labeled them as witchcrafts. However, this was not supported with the quantitative analysis result because respondents never mentioned of cultural beliefs.

In regard to health seeking behavior respondents suggested that distance, inadequate medicine, inadequate health workers are some of the reasons why they don't visit the health facilities for healthcare services.

i) A middle-aged woman from Kinango said, *"This hospital has no drugs. You can walk for long and still not get drugs and sometime long queue because only one health worker serving many people"*.

ii) A middle-aged respondent said, *"When we go for treatment, we are only given painkillers. Most facilities are far you can walk for more than one hour. Others walk for even two hours to the health centers"*.

The participants pointed out that lack of adequate medicine, inadequate healthcare workers and long distances contribution to their reluctance to seek medication. All these barriers are evident from the household survey also where the analysis indicated that inadequate medicine, lack of enough health workers and long distances were the barriers to healthcare service seeking behavior. The findings indicated that more health workers need to be deployed to serve the community, more primary care health facilities such as health centers, dispensaries and community health centers should be established to bring services near to the community and also the government should ensure adequate supply of medicine to the established primary health care units.

The FGDs identified long distance, high cost, lack of medicine and culture as barriers to health seeking behavior. The result was supported by key informants interview result and got concrete support from quantitative analysis result. Triggering and follow ups including provision for incentives was identified by FGDs to be the way to engage latrine ownership, the FGDs also suggested county government to come up with project to ensure the community assess clean and safe drinking water to solve the problem of water inadequacy.

CHAPTER FIVE

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Discussion

A Quasi Experimental study design was used in this work of research to compare the effects of CLTS health outcomes among children under five years at baseline and end term survey between control and intervention sites. Comparing the outcomes is very crucial because it helps to determine the effects of CLTs using proportion difference between the controls and intervention site at baseline and end term survey. The study critically focused on the effects of implementation of CLTS on the primary outcome that is latrine ownership and practice of open defecation secondary outcomes such as nutritional status, anemia status and status of diarrheal disease among children under five years. The study also focused on the social-cultural barriers, level of awareness and practice towards CLTS among household members in CLTS implementing sites and non-CLTS implementing sites.

5.1.1 Effects of CLTs on nutritional status among children aged below 5 years.

In the baseline survey majority of the children in the control group had between mild to severe malnutrition 214 (53.3%) while in the intervention group most children were free from malnutrition 232 (57.3%). On the other hand, in the end term survey data showed that most children in both control and intervention group were free from malnutrition that is 207 (51.5%) and 286 (70.6%) respectively. Nutritional status between the control and intervention groups at baseline and at end term survey were statistically different between the two study sites with $p=0.003$ and ($p < 0.001$) correspondingly. This result implied that CLTs implementation had effects of improving nutritional status of children in the intervention site compared to the control site, without the intervention there was high preference of malnutrition but after the intervention more than half of the respondents had children free from malnutrition as compared to the high malnutrition in the control sites.

The logistic regression analysis conducted further quantified the significance showing that children in the control site had three more folds of developing malnutrition than children in the intervention site. This is in agreement with our prior study where the prevalence of malnutrition declined with implementation of CLTS (Mwatsahu *et al.*, 2021). This finding could be as a result of CLTS improving human fecal waste disposal that reduced helminthic parasitic infection in children. Several studies has shown that helminthes usually compete with nutrients in the gut of children leading to malnutrition in children under five years of age (Gizaw & Worku, 2019; Mara, 2017; Mshida *et al*., 2018).

On the other hand studies have indicated that diarrhea related illness in children under five years is one of the known cause of malnutrition in children (Gimaiyo *et al.*, 2019; Gizaw & Worku, 2019; Mutuku & Ochieng, 2020). This explain why there is low prevalence of malnutrition in the intervention site compared to the control site this is because CLTS leads to improved sanitation, CLTS has been proven to reduce diarrheal diseases among children below five years of age (Alebel *et al*., 2018; Melese *et al.*, 2019; Mwatsahu *et al*., 2021; Thiam *et al.*, 2017).

Additionally other studies have correlated CLTS with environmental enteropathy in children under five years, and the condition reduces intestinal functionality of absorbing essential nutrients that help to prevent anemia in children and promote growth in children (Coffey *et al.,* 2018a; Mshida *et al.*, 2018; Njuguna, 2016a).Studies have shown that interventions of CLTS and those of components of CLTS such as water sanitation and hygiene reduces stunted growth in children and also reduce prevalence of malnutrition among children under five years (Gimaiyo *et al.*, 2019; Gizaw & Worku, 2019). Essentially this indicates proper fecal waste to prevent children from fecal contamination will improve the nutrition status of children below five years.

Further studies have also shown that combined intervention give more better outcomes of improved nutritional status compared to single intervention (Gizaw & Worku, 2019). Therefore, integrating different intervention will improve the nutritional health status of children under five years.

5.1.2 Effects of CLTS on episodes of diarrhea occurrence among children aged below 5 years.

Diarrheal diseases remain the major cause of morbidity and mortality among children under five years in low income countries such as Kenya (MoH, 2016b; Ministry of Health and Water & Sanitation Program, 2014; Njuguna, 2016a). In Ethiopia diarrheal disease kills about a half a million children under years every year and most of these diarrheal diseases are attributed to lack of proper sanitation (Megersa *et al.*, 2019). Many studies have shown that open defecation predisposes water and food to human fecal contamination which leads to diarrhea diseases and other fecal-oral diseases (P. Health, 2018; Njuguna, 2016a; Radin *et al.*, 2019; Saleem *et al.*, 2019). Another study conducted in Kenya using secondary data from the Kenya Demographic Health Survey (DHS) 2014 revealed that unsafe disposal of children's feaces is one of the most risk factor for diarrheal disease among children in Kenya (Mutuku & Ochieng, 2020).

In the present study the prevalence of diarrheal disease in the intervention site both at the baseline was significantly low as compared to the control site where more children were reported to have experienced more diarrhea. The decline in diarrhea in the intervention site may be attributed to implementation of CLTS program, the program improved hygiene and sanitation through its awareness and also prevented children from exposure to human fecal contamination of food and water and hence preventing diarrheal disease and other oral fecal related diseases.

The result from present study is in line with the previous literature on CLTS in Kenya which revealed that there was significance difference in the prevalence of diarrheal diseases between open defecation (OD) and open defecation free (ODF) sub-counties under study (Njuguna, 2016a). The open defecation free sub-counties had low prevalence of diarrheal diseases as compared to those still practicing open defecation. A randomized control trial conducted in Mali on the effectiveness of CLTS (Pickering *et al.*, 2015). The study found no significant difference in diarrheal prevalence among children in CLTS and control villages. However, there was a significant difference in reduction in the bloody diarrhea. The study indicated that the

risk of watery stool was reduced approximately by 24% among children who were not exclusively breastfed. Mortality due to diarrheal diseases among children under five years was reported to be significantly lower in the CLTS villages (Pickering *et al.,* 2015). The author who conducted the study drew a conclusion that CLTS is a good strategy for preventing diarrhea and reducing environmental enteropathy by ensuring proper fecal waste management to avoid human fecal contamination of food and water. According to Mali study, 97% of villages were declared ODF but after a follow up it was found some villages had reverted to open defecation since human fecal waste was seen in latrine floors and in the compound in 10 that is 5.4% of CLTS households (Pickering *et al.*, 2015).This again poses a risk of diarrheal diseases after CLTS implementation.

5.1.3 Effects of CLTs on anemia among children aged below 5 years

Several studies have shown that children under five years of age who lack access to proper sanitation are at a higher risk of developing anemia compared to those living in a sanitary environment(Coffey *et al.*, 2018b; Mwatsahu *et al.*, 2021; O'Connell, 2014). This is very common because these children are at risk of being infected by geo-parasites such as helminthes transmitted through soil which is contaminated with human fecal waste (Coffey *et al.,* 2018a; Kothari *et al*., 2019). Intestinal parasite cause anemia through blood loss in stool, loss of appetite to food and competition for nutrients from intestinal parasites. The intestinal parasite also cause damage to intestinal wall leading to impairment in absorption of nutrients (Coffey *et al.*, 2018a). Other studies have shown that some parasites such as Giardia lamblia and Ascaris lumbricoides leads to loss of appetite, malnutrition and consequently reducing absorption of nutrients such as iron (Mougenot *et al.*, 2020). *Ancylostoma duodenale* and *Necator americanus* are the two species of hookworms studies have shown that cause in average 0.2 mL and 0.15mL of blood loss daily correspondently (Mwatsahu, *et al.*,2021). In the present study the analysis result shows that there is a significant difference in the risk of developing anemia among children under five years in the control site compared to the intervention site. During a logistic regression analysis the adjusted odds ratio (OR) shows that children in the control site have three more folds of developing anemia as compared to children in the intervention site

(Adj.OR=3.064,95%CI of OR=2.026-4.634,p<0.05). This finding implies that CLTS intervention reduced open defecation in the intervention site and consequently leading possible reduction in the intestinal parasitic infection and thus reducing the risk of developing anemia among children under five years in this study site. This is evident because the data from baseline survey shows no different in the odds of developing anemia in the control side compared with the intervention site (OR=0.938, 95% CI of OR=0.652-1.349, P>0.05).

This study is in agreement with several studies. A study conducted in Nepal showed that reduced open defecation (OD) correlate with improvement in hemoglobin levels of children. This indicates that children exposed to proper sanitation had relatively higher hemoglobin levels compared to those raised in poor community sanitation (Coffey *et al*., 2018a). Based on statistical checks there is increased confidence that this associations are not just mere correlation but rather causal associations. According to another study by (Freeman *et al.*, 2017) shows that another straight pathway between poor sanitation and bad nutritional status results is due to geoparasite helminthes infection, such as *Trichuris trichiura*, hookworms and *Ascaris Lumbricoides.* These infections cause poor absorption of nutrients and stunted growth. Poor nutritional absorption can cause anemia in children under five years. Across-sectional study conducted across 47 countries indicates that more 60% of countries, children with poor sanitation had significantly increased odds of anemia. In over 65% of countries children exposed to open (OD) were more likely to be anemic. Therefore there is substantial evidence of an association between elements of CLTS that is water and sanitation (WASH) and anemia (Kothari *et al.*, 2019). However other studies have indicated that there is no significance between CLTS and anemia in children under five years of age. For instant a study done in Philippians reported high rates of anemia in CLTS villages than the national rates (Belizario *et al*., 2015). The difference in findings may be due to uncontrolled confounding factors such as deworming and proper nutrition. The contradicting findings may also be due to program design, context and implementation efficacy (Mwatsahu, *et al.*,2021).

5.1.4 Latrine ownership and practice of open defecation among household members in both the intervention site and the control sites.

In the present study the prevalence of latrine ownership was high in the intervention site both in the baseline and end term survey. The high prevalence of toilet coverage and ownership in the CLTS site maybe due to implementation of CLTS, which improved toilet ownership thus most families had their own toilets as opposite to non-CLTS site where the prevalence of toilet coverage and ownership was very low. This may be attributed to the idea that CLTS program increased awareness on hygiene and sanitation hence encouraged people to construct toilets. The present study is consistent with another previous study done in Ethiopia which found the prevalence of latrine coverage was 79.4% in CLTS villages compared to 59.1% in non-CLTS villages (Megersa & Benti, 2020). A study done in rural Mozambique in the northern region of Nampula indicated that the proportion of people owning latrine was increasing directly with increase in information related to CLTS and this was highest in the CLTS intervention group at (79%) (Harter *et al*., 2018).Additionally a cluster-randomized control trial in 246 communities in Nigeria conducted between 2014 and 2018 indicated that CLTS intervention has strong and lasting effects on open defecation (OD) habits in poorer communities in poor communities, OD rates reduced by 9 percentage points (pp) from a baseline level of 75% (Pablo, 2018). The reduction in OD was achieved mostly through better toilet ownership (+8pp from a baseline level of 24%) (Pablo, 2018). This is clear evidence that latrine coverage and hence ownership improves with implementation of CLTS program. Thus, implementation of CLTS programs coupled with regular follow ups will effectively reduce open defecation and consequently reduce health problems related to poor hygiene and sanitation.

The present study also indicates that households with responded who were employed they were likely to own latrine. This implies that the employed their monthly income was relatively higher than those not work. This result is similar to the result of a cross-sectional study conducted in Ethiopia (Debesay, 2015) which indicated that family monthly income was associated with latrine ownership with AOR=10.85.

Additionally, the present study identify that the rate of latrine ownership increased with increase with the level of education. The results are consistence with the result of a study conducted in Samburu sub-county which revealed that the high levels of education of male meant higher rates of latrine ownership and vice versa. At the odds ratio of 0.686 (95% C.I 0.575-0.816, the higher the education level of female was also associated with increase in latrine ownership(County & Kuria, 2019). On the other hand, the present study found that household with high social economic status were more likely to own a latrine. The result are consistent with other studies done elsewhere which indicated that individuals with high social-economic status are likely to own and use a latrine(County & Kuria, 2019; Debesay, 2015).

5.1.5 Socio-cultural barriers, level of awareness and practices towards CLTS household members in both the intervention site and the control site.

In the current study respondents in CLTS intervention site were more knowledgeable on hygiene and Sanitation than those living in the control sites. This implies that CLTS is effective tool in improving knowledge levels of communities on sanitation and hygiene and consequently reducing incidences of open defecation. This findings are in line with a study conducted in Zambia which proved that acquaintance of communities to CLTS triggering processes heightened knowledge on hygiene and sanitation (Lawrence *et al*., 2016). This awareness and knowledge on hygiene and sanitation triggered individuals, families and the communities at large to construct and make use of toilets (Lawrence *et al.,* 2016). This finding can also be explained by the idea that improving knowledge on hygiene and sanitation might had also changed the attitude of individual on hygiene and sanitation. A comparative cross-sectional study conducted in Uganda also indicated statistically significant difference in the level of knowledge and awareness on hygiene and sanitation between the CLTS intervention sub-counties and non-CLTS control sub-counties. People were more knowledgeable on hygiene and sanitation in the intervention site than the non-intervention site (Okolimong, 2018). Therefore, this implies that community's exposure to CLTS practices such as pre and post-triggering sessions and follow up visits is every important in CLTS implementation because it will escalates the knowledge intensities of communities on hygiene and sanitation. People with enough

knowledge on hygiene and sanitation have high chances of resorting to adopt improved hygiene and sanitation practices since one's knowledge dictates one's attitude to adopt positive behavior change. Thus, achieving the main goals of CLTS.

5.2 Conclusion

5.2.1 Community-Led Total Sanitation outcomes.

Community-Led Total Sanitation (CLTS) intervention sites recorded improved sanitation and hygiene likened to the control sites as defined below:

- **Nutritional status:** CLTS reduced the proportion of malnourished children from 42.72% to 29.4% consequently the proportion of malnourished children reduced significantly by 31%.
- **Episodes of diarrhea**: Implementation of CLTS reduced the proportion diarrhea in children from 52.6% to 26.9% and thus reducing the proportion of diarrhea in children significantly by 48.8%.
- **Anemia status:**
    i) CLTS reduced the proportion of anemic children from 48.8% to 38.6% therefore reducing the proportion of anemic children significantly by 36.8%.
    ii) Malnourished children < 5 years old are more likely to be anemic than those who are well nourished.

➢ **Latrine ownership and practice of open defecation:** CLTS implementation, having a male household head, owning a land and having a permanent house structure significantly predicted latrine ownership.

➢ **Socio-cultural barriers, level of awareness and practices towards CLTS**:
    i) Distance, inadequate medicine, financial constraints, cultural myths and inadequate water sources were barriers to CLTS.
    ii) Community health volunteers and community health workers spread more information on CLTS both in the control and intervention groups.

iii) Community health volunteers and community health workers spread more information on CLTS both in the control and intervention groups.

5.3 Recommendations

i) Large scale studies designed to measure the impact of CLTS intervention on nutritional outcomes in children are needed.

ii) To help reduce diarrheal among children aged <5 years, CLTS needs to be continuously strengthened and up-scaled for communities and the nation to continuously enjoy its benefits.

iii) To help reduce anemia among children <5 years, there is need to scale up implementation of CLTS in other parts of Kwale County and Kenya at large.

iv) There is poor latrine coverage in Kwale County, therefore there is need for further research studies to be done to determine proper strategy to be used to achieve significant latrine coverage and latrine ownership preceded by their utilization.

v) The Public Health Unit should strengthen and intensify strategies that are meant to increase community's knowledge on sanitation and hygiene and CLTS triggering through community dialogue meetings. After implementation the MOH, through the Public Health unit; should intensify Follow up Mandona (FUM) to check on villages that have reverted to open defecation again.

REFERENCES

Agency, U. S., Development, I., & Tech, T. (2018). *Toward a Hygienic Environment for Infants A Review of the Literature*. *February*, *32*.

ALBashtawy, M. (2015). Personal hygiene in school children aged 6–12 years in Jordan. *British Journal of School Nursing*, *10*(8), 395–398.

Alebel, A., Tesema, C., Temesgen, B., Gebrie, A., Petrucka, P., & Kibret, G. D. (2018). *Prevalence and determinants of diarrhea among under-five children in Ethiopia : A systematic review and meta-analysis*. 1–20.

Allegranzi, B., & Pittet, D. (2009). Role of hand hygiene in healthcare-associated infection prevention. *The Journal of Hospital Infection*, *73*(4), 305–315.

Alula, S. B., Dejene, E. M., Terefe, M. L., Abinet, A. S., & Bazie, M. (2018). Knowledge, attitude and practice on hand washing and associated factors among public primary schools children in Hosanna town, Southern Ethiopia. *Journal of Public Health and Epidemiology*, *10*(6), 205–214.

Augsburg, B., Abramovsky, L., Flynn, E., & Oteiza, F. (2016). *Improving CLTS targeting: evidence from Nigeria*.

Belizario, V. Y. J., Liwanag, H. J. C., Naig, J. R. A., Chua, P. L. C., Madamba, M. I., & Dahildahil, R. O. (2015). Parasitological and nutritional status of school-age and preschool-age children in four villages in Southern Leyte, Philippines: Lessons for monitoring the outcome of Community-Led Total Sanitation. *Acta Tropica*, *141*(Pt A), 16–24.

Black, R. E., Victora, C. G., Walker, S. P., Bhutta, Z. A., Christian, P., de Onis, M., Ezzati, M., Grantham-McGregor, S., Katz, J., Martorell, R., & Uauy, R. (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. *Lancet (London, England)*, *382*(9890), 427–451.

Bokea. (2020). *No Title*.

Bos, M. G. N., Peters, S., Kamp, F. C. Van De, Crone, E. A., & Tamnes, C. K. (2018). *Emerging depression in adolescence coincides with accelerated frontal cortical thinning*. *9*, 994–1002.

Brief, P. (2017). *Poverty Transitions in Kwale County*. *February*, 1–2.

Burton, S. (2007). *An Evaluation of the WaterAid's CLTS Programme in Nigeria*. *August*, 23.

Cavill, S., Chambers, R., & Vernon, N. (2015). Frontiers of CLTS : Innovations and Insights. *Institute of Development Studies CLTS Knowledge Hub.*, *4*, 19 pp.

Chambers, R., & Myers, J. (2016). Norms, Knowledge and Usage. *Frontiers of CLTS: Innovations and Insights*, *07*, 15 pp. Retrieved from http://www.communityledtotal sanitation.org

Coffey, D., Geruso, M., & Spears, D. (2018a). Sanitation, Disease Externalities and Anaemia: Evidence From Nepal. *Economic Journal*, *128*(611), 1395–1432.

Coffey, D., Geruso, M., & Spears, D. (2018b). Sanitation, Disease Externalities and Anaemia: Evidence From Nepal. *The Economic Journal*, *128*(611), 1395–1432.

County, S., & Kuria, W. D. (2019). *Relationship Between Level Of Formal Education And Use And Ownership Of Hygiene And Sanitation Facilities In Samburu*. *9*(2), 68–75.

Crocker, J., Fuente, D., & Bartram, J. (2021). Cost effectiveness of community led total sanitation in Ethiopia and Ghana. *International Journal of Hygiene and Environmental Health*, *232*, 113682.

Debesay, N. (2015). Latrine Utilization and Associated Factors in the Rural Communities of Gulomekada District, Tigray Region, North Ethiopia, 2013: A Community Based Cross-Sectional Study. *Journal of Community Medicine & Health Education*, *05*(02).

Doocy, S., Lyles, E., Hanquart, B., & Woodman, M. (2016). Prevalence, care-seeking, and health service utilization for non-communicable diseases among Syrian refugees and host communities in Lebanon Bayard Roberts, Kiran Jobunputra, Preeti Patel and Pablo Perel. *Conflict and Health*, *10*(1).

Dreibelbis, R., Winch, P. J., Leontsini, E., Hulland, K. R. S., Ram, P. K., Unicomb, L., & Luby, S. P. (2013). The Integrated Behavioural Model for Water, Sanitation, and Hygiene: a systematic review of behavioural models and a framework for designing and evaluating behaviour change interventions in infrastructure-restricted settings. *BMC Public Health*, *13*, 1015.

Echazú, A., Bonanno, D., Juarez, M., Cajal, S. P., Heredia, V., Caropresi, S., ….& Krolewiecki, A. J. (2015). Effect of Poor Access to Water and Sanitation As Risk Factors for Soil-Transmitted Helminth Infection: Selectiveness by the Infective Route. *PLoS Neglected Tropical Diseases*, *9*(9), 1–14.

Emerson, K. J., Bradshaw, W. E., & Holzapfel, C. M. (2009). Complications of complexity: integrating environmental, genetic and hormonal control of insect diapause. *Trends in Genetics : TIG*, *25*(5), 217–225.

Foley, A. J. (2010). Book Review: Humphries, D. (Ed.). (2009). Women, Violence, and the Media: Readings in Feminist Criminology. Boston: Northeastern University Press. \$24.95. 296 pp. *Violence Against Women*, *16*(6), 715–721.

Freeman, M. C., Garn, J. V, Sclar, G. D., Boisson, S., Medlicott, K., Alexander, K. T., ….& Clasen, T. F. (2017). The impact of sanitation on infectious disease and nutritional status: A systematic review and meta-analysis. *International Journal of Hygiene and Environmental Health*, *220*(6), 928–949.

Garn, J. V, Sclar, G. D., Freeman, M. C., Penakalapati, G., Alexander, K. T., Brooks, P., … & Clasen, T. F. (2017). The impact of sanitation interventions on latrine coverage and latrine use: A systematic review and meta-analysis. *International Journal of Hygiene and Environmental Health*, *220*(2 Pt B), 329–340.

Gimaiyo, G., Mcmanus, J., Yarri, M., Singh, S., Trevett, A., Moloney, G., Robins, A., & Lehmann, L. (2019). *Can child-focused sanitation and nutrition programming improve health practices and outcomes ? Evidence from a randomised controlled trial in Kitui*. 1–12.

Gizaw, Z., & Worku, A. (2019). *Effects of single and combined water , sanitation and hygiene (WASH) interventions on nutritional status of children : a systematic review and*. *2*, 1–14.

Grantham-McGregor, S., Cheung, Y. B., Cueto, S., Glewwe, P., Richter, L., & Strupp, B. (2007). Developmental potential in the first 5 years for children in developing countries. *Lancet (London, England)*, *369*(9555), 60–70. https://doi.org/10.1016/S0140-6736(07)60032-4

Harter, M., Mosch, S., & Mosler, H. (2018). *How does Community-Led Total Sanitation (CLTS) affect latrine ownership ? A quantitative case study from Mozambique*. 1–10.

Health, M. O. F. (2016a). *Kenya Environmental Sanitation and Hygiene Strategic Framework (Kessf) 2016 - 2020*. 2016–2020.

Health, M. O. F. (2016b). *National ODF Kenya 2020 Campaign Framework*.

Health, P. (2018). *Diarrheal status and associated factors in under five years old children in relation to implemented and unimplemented community-led total sanitation and hygiene in Yaya Gulele in 2017*. 109–121.

HIF-net at WHO. (2004). *International Network for the Availability of Scientific Publications*. https://www.inasp.org.uk/health/hif-net/cdroms.html

Hussein, H. (2017). *Prevalence of Diarrhea and Associated Risk Factors in Children Under Five Years of Age in Northern Nigeria : A Secondary Data Analysis of Nigeria Demographic and Health Survey 2013 . May*.

Jones, H. E., Singini, W., Holm, R. H., & White, S. (2016). CLTS plus: making CLTS ever more inclusive. *39th WEDC International Conference, Iied 2010*, 7 pp.Retrieved from http://wedc.lboro.ac.uk/resources/conference/39/Jones-2533.pdf

Joshi, A., & Amadi, C. (2013). Impact of Water, Sanitation, and Hygiene Interventions on Improving Health Outcomes among School Children. *Journal of Environmental and Public Health, 2013*, 984626.

Jung, S., Doh, Y., Bizuneh, D. B., Beyene, H., Seong, J., Kwon, H., …, & Cha, S. (2016). The effects of improved sanitation on diarrheal prevalence , incidence , and duration in children under five in the SNNPR State , Ethiopia : study protocol for a randomized controlled trial. *Trials*, 1–10.

Kao, J., Mutuku, F., Martin, S., Lee, J., Mwandi, J., Mukoko, D., …& LaBeaud, A. D. (2019). Early childhood anemia in a birth cohort in coastal Kenya: Links to infection and nutrition. *American Journal of Tropical Medicine and Hygiene*, *101*(1), 242–252.

KDHS. (2014). Kenya. *Youth and Employment in Sub-Saharan Africa: Working but Poor*, 303–355.

Keusch, G. T., Denno, D. M., Black, R. E., Duggan, C., Guerrant, R. L., Lavery, J. V, …, & Brewer, T. (2014). Environmental Enteric Dysfunction: Pathogenesis, Diagnosis, and Clinical Consequences. *Clinical Infectious Diseases*, *59*(suppl_4), S207–S212.

Kothari, M. T., Coile, A., Huestis, A., Engmann, C., Pullum, T., & Garrett, D. (2019). *Exploring associations between water , sanitation , and anemia through 47 nationally representative demographic and health surveys*. *1450*, 249–267.

Lake, S. (n.d.). *Beyond Just Toilet*.

Lawrence, J. J., Yeboah-Antwi, K., Biemba, G., Ram, P. K., Osbert, N., Sabin, L. L., & Hamer, D. H. (2016). Beliefs, behaviors, and perceptions of community-led total sanitation and their relation to improved Sanitation in Rural Zambia. *American Journal of Tropical Medicine and Hygiene*, *94*(3), 553–562.

Legge, H., Halliday, K. E., Kepha, S., Mcharo, C., Witek-McManus, S. S., El-Busaidy, H., …, & Oswald, W. E. (2021). Patterns and Drivers of Household Sanitation Access and Sustainability in Kwale County, Kenya. *Environmental Science & Technology*.

Li, H., Xiao, J., Liao, M., Huang, G., Zheng, J., Wang, H., Huang, Q., & Wang, A. (2020). *Anemia prevalence , severity and associated factors among children aged 6 – 71 months in rural Hunan Province , China : a community-based cross-sectional study*. 1–13.

Mara, D. (2017). The elimination of open defecation and its adverse health effects: A moral imperative for governments and development professionals. *Journal of Water Sanitation and Hygiene for Development*, *7*(1), 1–12. https://doi.org/10.2166/washdev.2017.027

Mara, D., Lane, J., Scott, B., & Trouba, D. (2010). Sanitation and health. *PLoS Medicine*, *7*(11), e1000363–e1000363. https://doi.org/10.1371/journal.pmed.1000363

Megersa, S., & Benti, T. (2020). *The Association Between Diarrheal Morbidity and ODF Status Among Under Five Children in*.

Megersa, S., Benti, T., & Sahiledengle, B. (2019). *Clinics in Mother and Child Health Prevalence of Diarrhea and Its Associated Factors among Under-Five Children in Open Defecation Free and Non-Open Defecation Free Households in Goba District Southeast Ethiopia : A Comparative Cross-Sectional Study*. *June*.

Melese, B., Paulos, W., Astawesegn, F. H., & Gelgelu, T. B. (2019). *Prevalence of diarrheal diseases and associated factors among under-five children in Dale District , Sidama zone , Southern Ethiopia : a cross-sectional study*. 1–10.

Ministry of Health and Water & Sanitation Program. (2014). *State of Sanitation in Migori County*. 2. Retrieved from https://devolutionhub.or.ke/file/91fd6d25380e773cedf5ba688179252b.pdf

Mondal, P. K., & Kar, T. (2013). Global Dynamics of a Water-Borne Disease Model with Multiple Transmission Pathways. *Application and Applied Mathematics*, *8*(1), 75–98.

Mougenot, B., Amaya, E., & Herrera-Añazco, P. (2020). Water, sanitation, and hygiene (Wash) conditions and prevalence of office visits due to anemia: A regional-level analysis from Peru. *Journal of Water Sanitation and Hygiene for Development*, *10*(4), 951–958.

Mshida, H. A., Kassim, N., Mpolya, E., & Kimanya, M. (2018). *Water , Sanitation , and Hygiene Practices Associated with Nutritional Status of Under-Five Children in Semi-Pastoral Communities Tanzania*. *98*(5), 1242–1249.

Musembi, C. N. (2016). *Frontiers of CLTS : Innovations and Insights CLTS and the Right to Sanitation*. *08*.

Mutuku, D., & Ochieng, C. (2020). International Journal of Infectious Diseases Disease burden and risk factors of diarrhoea in children under fi ve years : Evidence from Kenya ' s demographic health survey 2014. *International Journal of Infectious Diseases*, *93*, 359–366.

Mwatsahu, F. G. (2021). *Effect of community-Led Total Sanitation on Development of Anemia among children Aged Below five years in Kinango sub-county, Kwale County*. 68–70.

Mwatsahu, F. G., Karanja, S., Karama, M., & Zimmermann, M. B. (2021). *Effects of Community-Led Total Sanitation on Malnutrition Status of Children Under 5 Years in Kwale County*. *33*(6), 107–117.

Njuguna, J. (2016a). Effect of eliminating open defecation on diarrhoeal morbidity: An ecological study of Nyando and Nambale sub-counties, Kenya. *BMC Public Health*, *16*(1), 2–7. https://doi.org/10.1186/s12889-016-3421-2

Njuguna, J. (2016b). Effect of eliminating open defecation on diarrhoeal morbidity: An ecological study of Nyando and Nambale sub-counties, Kenya. *BMC Public Health*, *16*(1), 1–7.

Njuguna, J., & Muruka, C. (2020). *Open Defecation in Newly Created Kenyan Counties : A Situational Analysis Open Defecation in Newly Created Kenyan Counties : A Situational Analysis*. *May*.

O'Connell, K. (2014). *What Influences Open Defecation and Latrine Ownership in Rural Households?: Findings from a Global Review*. *August*, 38.

Okolimong. (2018). *No Title*. *July*.

Omar, S. (2021, June 24). *Open defaecation blamed on Kwale cultural practices*. https://www.the-star.co.ke/counties/coast/2021-06-23-open-defaecation-blamed-on-kwale-cultural-practices/

Pablo, J. (2018). *www.econstor.eu*.

Pickering, A. J., Djebbari, H., Lopez, C., Coulibaly, M., & Alzua, M. L. (2015). Effect of a community-led sanitation intervention on child diarrhoea and child growth in rural Mali: A cluster-randomised controlled trial. *The Lancet Global Health*, *3*(11), e701–e711.

Pickering, A. J., Null, C., Winch, P. J., Mangwadu, G., Arnold, B. F., Prendergast, A. J., … & Humphrey, J. H. (2019). The WASH Benefits and SHINE trials: interpretation of WASH intervention effects on linear growth and diarrhoea. *The*

Lancet Global Health, *7*(8), e1139–e1146.

Plan International Ethiopia, Region, P., Town, A., Seka, I., District, C., & Daka, G. (2014). *Community-Led Total Sanitation & Sanitation Marketing Project*. *February*, 2 pp.

Radin, M., Jeuland, M., Wang, H., & Whittington, D. (2019). *Benefit - Cost Analysis of Community - Led Total Sanitation : Incorporating Results from Recent Evaluations*. *13*.

Radin, M., Jeuland, M., Wang, H., & Whittington, D. (2020). Benefit–Cost Analysis of Community-Led Total Sanitation: Incorporating Results from Recent Evaluations. *Journal of Benefit-Cost Analysis*, *11*(3), 380–417.

Ramesh, A., Blanchet, K., Ensink, J. H. J., & Roberts, B. (2015). Evidence on the effectiveness of water, sanitation, and hygiene (WASH) Interventions on Health Outcomes in Humanitarian Crises: A Systematic Review. *PLoS ONE*, *10*(9).

Saleem, M., Burdett, T., & Heaslip, V. (2019). Health and social impacts of open defecation on women: A systematic review. *BMC Public Health*, *19*(1).

Samie, A., Obi, C. L., Igumbor, J. O., & Momba, M. N. B. (2009). Focus on 14 sewage treatment plants in the Mpumalanga Province, South Africa in order to gauge the efficiency of wastewater treatment. *African Journal of Biotechnology*, *8*(14), 3276–3285.

Sanyaolu, A., Okorie, C., & Marinkovic, A. (2020). *Global Epidemiology and Management of Acute Diarrhea in Children from Developing Countries*. 1–5.

Thiam, S., Diène, A. N., Fuhrimann, S., Winkler, M. S., Sy, I., Ndione, J. A., …& Cissé, G. (2017). *Prevalence of diarrhoea and risk factors among children under five years old in Mbour , Senegal : a cross-sectional study*. 1–12.

UNICEF. (2009). Life on streets:Millions of children remainn homeless. In *Celebrating 20 Years of the Convention on the Rights of the Child*.

UNICEF. (2015). *o d l e Sustainability of ODF Practices in Kenya introduction*. *2010*.

Velleman, Y., Mason, E., Graham, W., Benova, L., Chopra, M., Campbell, O. M. R., G…..& Cumming, O. (2014). From joint thinking to joint action: a call to action on improving water, sanitation, and hygiene for maternal and newborn health. *PLoS Medicine*, *11*(12), e1001771.

Venkataramanan, V., Crocker, J., Karon, A., & Bartram, J. (2018). Community-Led Total Sanitation: A Mixed-Methods Systematic Review of Evidence and Its Quality. *Environmental Health Perspectives*, *126*(2), 26001.

Waddington, C. S., Darton, T. C., Jones, C., Haworth, K., Peters, A., John, T., …. & Pollard, A. J. (2014). An outpatient, ambulant-design, controlled human infection model using escalating doses of Salmonella Typhi challenge delivered in sodium bicarbonate solution. *Clinical Infectious Diseases : An Official Publication of the Infectious Diseases Society of America*, *58*(9), 1230–1240.

Walker, S. J., Fortunato, J., Gonzalez, L. G., & Krigsman, A. (2013). Identification of Unique Gene Expression Profile in Children with Regressive Autism Spectrum Disorder (ASD) and Ileocolitis. *PLoS ONE*, *8*(3).

WHO, practical solutions. (2015). *Improving nutrition outcomes with better water, sanitation and hygiene.*

Wilbur, J., & Jones, H. (2014). Disability: Making CLTS Fully Inclusive Frontiers of CLTS: Innovations and Insights. *Frontiers of CLTS: Innovations and Insights*, *03*.

Ματινα. (2019). No TitleΕΛΕΝΗ. *Αγαη*, *8*(5), 55.

APPENDICES

Appendix I: Study questionnaire

HOUSEHOLD QUESTIONNAIRE

EFFECTIVENESS OF COMMUNITY-LED TOTAL SANITATION ACTIVITIES ON SELECTED HEALTH OUTCOMES OF CHILDREN AGED BELOW 5 YEARS IN KINANGO SUB-COUNTY, KWALE COUNTY

Village Name: …….……
Household Questionnaire Number: |_|_|_| Date: |_|_| / |_|_| / |_|_|_|_|
day
month year
Data Collector Names: ……..

This questionnaire is to be administered to consenting heads of the households or other consenting members in the absence of the household head. Please ensure that you introduce yourself and the purpose of the assessment.

Introduction/Consent: My name is _____ and I am working for the principle investigator to undertake a data collection exercise in this village. We wish to collect data on sanitation status as well as related diseases. We would like to ask you some questions about your family and their health, nutrition and WASH status. Any information that you provide will be strictly confidential and will not be shown to other people. Your participation is voluntary and you can choose not to answer any or all of the questions if you want. However, we hope that you will participate since your views are important. Do you have any questions? May we begin now?

☐ Yes ☐ No. (***If no, Thank the respondent and move to the next household).***

1. Household Structure *(Tick the response in the check box provided)*

1.1	Are you the head of the household? ***(If "yes" skip to Q1.3)*** ☐No ☐Yes	1.2	If not the head of household, what is your relationship with the head of the household? ☐Spouse ☐Child ☐Grandchild ☐Other relatives
1.3	What is the sex of the household head? ☐Male ☐Female	1.4	Age of the head of the household (……in years)?
1.5	What is the marital status of the	1.6	What is the highest level of formal

	head of household? ☐Married ☐Widowed ☐Separated/Divorced ☐Single (Never married)		educational status of the household head? ☐None ☐Primary Level ☐Secondary Level ☐Tertiary ☐ Other (Specify)……
1.7	What is the main occupation of the household head?(***Choose only one answer***) ☐Farmer ☐Employed (salaried) ☐Daily labor/Wage labor ☐Small business/Petty trade ☐ Other (Specify) ……	1.8	What is your household's monthly income in Kenya shillings? ☐< 5000 ☐5001- 10000 ☐10001- 15000 ☐> 15000 ☐ No response
1.9	How many of the following items do you own? **ItemNumber owned** Cattle …… Sheep …… Goats …… Chicken …… Bicycle …… Radio …… TV ……	1.10	Do you own the land you live on? ☐No ☐Yes
1.11	Type of house ***(Observe)*** ☐Permanent ☐Semi-permanent ☐Temporary	1.12	What is your source of fuel for lighting? ☐Electricity ☐Solar panels ☐Kerosene Other (Specify)……..
1.13	What is your main source of fuel for cooking? ☐Firewood ☐Gas		

	☐Charcoal ☐Kerosene ☐Other (Specify)…….				
1.14	List the ages of all the household members and tick the appropriate sex box.	**Member**	**Age in years (indicate if months)**	**Male**	**Female**
		1		☐	☐
		2		☐	☐
		3		☐	☐
		4		☐	☐
		5		☐	☐
		6		☐	☐
		7		☐	☐
		8		☐	☐
		9		☐	☐
		10		☐	☐
		11		☐	☐
		12		☐	☐
		13		☐	☐
		14		☐	☐
		15		☐	☐
2. Health Indicators for WASH					
2.1	Where do you usually go if a household member is sick? ***(check all that apply, do not read out the responses)*** ☐Health facility ☐Community pharmacy ☐Traditional healer ☐ Other (specify)…… …….	2.2	Are there any challenges you face to accessing formal health facilities? **(*Do not read out the responses. Check all that the respondent will mention)*** ☐The facility is too far away ☐ There is no medicine or treatment available in the facility ☐ We can't afford to use the facility ☐Our culture does not allow ☐ Other (specify)…… …….		
2.3	How long does it take you to walk to the nearest health facility?(***Only select ONE answer)*** ☐Under 30 minutes ☐30 minutes to less than 1 hour ☐One hour to less than half a day	2.4	How much does it cost to get to the health facility by public means? Ksh…….		

	☐Half a day ☐More than half a day ☐No response					
2.5	Has any child below the age of 5 years in your household experienced any of the following issues in the last month? *(Tick all that apply)*	**Child No.**	**Cough /Flu**	**Stomach pain**	**Diarrhea**	**Bloody Stool**
		1	☐	☐	☐	☐
		2	☐	☐	☐	☐
		3	☐	☐	☐	☐
		4	☐	☐	☐	☐
		5	☐	☐	☐	☐
		6	☐	☐	☐	☐
2.6	Have any of your children ever died due to the following conditions?	**Condition**		**Yes**	**No**	**No. of deaths**
		Diarrhea		☐	☐	…… …
		Bloody stool		☐	☐	…… …
		Upper respiratory tract infection		☐	☐	…… …
2.7	Has any child below 5 years taken any drug for intestinal worms within the last six months? ☐No ☐Yes ☐Don't know					
2.8	For all the children aged below 5 years, measure and/or record the age, sex, weight, height, mid upper arm circumference (MUAC) and Hb. ***(Record in the separate sheet provided).***					
3. Water, Sanitation and Hygiene (WASH)						
3.1	What is your main source of drinking water? ☐Hand Pump ☐Piped Water ☐River ☐Water Trucking ☐Shallow well ☐ Other (specify)…… ……..	3.2	How long does it take to walk to the main source of water (one way in minutes)? ☐Less than 30 minutes ☐Between 30 and 1 hour ☐More than one hour			
3.3	About how many Jerry cans (20- liter ones) of water are availed in your household per day?	3.4	Do you have to pay for this water?***(If "No" skip to Q3.6)*** ☐No			

	……..		☐Yes
3.5	What is the total cost of water per day in your household (in Kshs)? ……	3.6	Do you treat your water before drinking? ***(If "No", skip to Q3.8)*** ☐No ☐Yes
3.7	If "yes" in Q3.6, what method do you use to treat water before drinking? ***(Check all that apply. Do not read out the responses)*** ☐Boiling ☐ Chemical treatment (Alum stone, Chlorination) ☐Traditional treatment ☐Decantation (sitting to settle) ☐ Filtration (Passing through cloth) ☐Other (Specify) ……	3.8	In what kind of container do you store your water at home? ☐Open jar ☐Closed jar ☐Open bucket ☐Closed bucket ☐Other (specify)……
3.9	Is there a hand washing facility with running water in the household? (**Observe)** ☐No ☐Yes	3.10	When do you wash your hands? **(*Check all that apply. Do not read out the responses*)** ☐Before preparing food ☐Before eating ☐Before feeding the children ☐After handling a child's stool ☐After using latrine/after defecation ☐Others (specify)……..
3.11	Where do household members **MAINLY**go to use a toilet? (***Only 1 response)*** ☐Traditional pit latrine ☐ Ventilated improved pit latrine ☐Flush latrine/toilet with water ☐Ablution block ☐ Mobile toilets (waste collected and disposed elsewhere) ☐Flying toilets ☐ In the bushes, open defecation ☐ Other (Specify) …….....	3.12	Is the facility in Q3.11 shared with other households? ☐No ☐Yes, with 2-3 households ☐Yes, with 4-5 households ☐Yes, with more than 5 households ☐Not applicable
3.13	What material do you use for cleaning yourself after defecation?	3.14	How do you dispose faeces of your child/children under 5 years? ☐ Leave it in the yard/do nothing

	☐Toilet paper ☐Other forms of paper ☐Water ☐Plant leaves ☐Nothing ☐Other (Specify)…….		about it ☐Put in the latrine ☐Bury it ☐Don't know ☐Other specify…….
4. Community Led Total Sanitation (CLTS)			
4.1	Have you ever heard of community led total sanitation (CLTS)? (***If "No", end the interview at this point)*** ☐No ☐Yes	4.2	If yes, what is the source of your information? ☐Health workers ☐Community health volunteers ☐Social media ☐ Other (specify)…….
4.3	If "yes" in Q4.1, did your household participate in any CLTS activities? ☐No ☐Yes ☐Don't know	4.4	If "yes" in Q4.1, have you ever received any CLTS-related information? ☐No ☐Yes ☐Don't know
4.5	Do you consider your household as being open defecation free? (***If "Yes" or "Don't know", end the interview at this point)*** ☐No ☐Yes ☐Don't know	4.6	If No, why not? ☐I do not see the importance ☐Cultural beliefs ☐The cost to build a toilet is too high ☐ Other (Specify)……

Appendix II: Anthropometric and Hemoglobin Concentration Measures for Children Below 5 Years

Village……

Household number…….

S/No.	Age in months	Sex (M/F)	Weight (Kgs)	Height (Inches)	MUAC (cm)	Hb (g/dL)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Appendix III: Focus Group Discussion Guide

FOCUS GROUP DISCUSSION INTERVIEW GUIDE

(FGD TOOL #001)

DATE |__|__|\|__|__|\|__|__|__|

Enumerator _____\
_____\

Name of the Village:

_____

Composition of the Group: **a) Men |__|__| b) Women |__|__|**

1) What are the main issues that should be looked at with reference to community sanitation?
2) What are the challenges faced due to lack of latrines in the community among the children under the age of five years?
3) What are your views with reference to open defecation in your community?
4) How does open defecation affect our environment or the health status of the community?
5) What are your experiences in relation to water handling practices?
6) What are the current beliefs and traditions concerning excreta disposal especially regarding women's habits and attitude towards child excreta?
7) What can we do as a community to ensure that we always live in a clean and healthy environment?
8) In your view, what is the best way to enable households' access good quality water in adequate amounts as well as improve hygiene standards? Probe to establish both short-term and long-term solutions to water access.

Appendix IV: Budget

The researcher quoted for the provision of a total of 265 days at a daily fee rate of KES. 20, 000.00 per supervision and other administration costs. Table 1 gives more details.

Table 1: Research Budget

Series	Activity	Days	Number of Persons/ Quantity	Daily Rate KES.	Total KES.
Preparation Phase	Pre-planning, consultative meetings, desk review	1	4	10,000	40,000
	Pre-testing and refining the data collection tools	14	10	5000	70,000
	Sub-total				**110,000**
Field work	Data collection- Research Assistants (daily allowance and lunch)	30	10	500	150,000
	Sub-total				**150,000**
Data Management	**Statistician / Data Analyst** Data cleaning and analysis Transcribing the KII and preparation of thematic	Lump sum			50,000
	Sub-total				**50,000**
Administrative Support	ICT support	Lump sum			20,000
	Transport (local transport)				20,000
	Photocopying and communication				10,000
	Sub-total				**50,000**
Total in KES.					**360,000**
VAT (16%)					**57,600**
GRAND TOTAL KES					**417,600**

Appendix V: Work Plan

The work plan for this research work commenced on January, 2019 and final report was expected to be submitted by end of December, 2019. However, COVID-19 Pandemic; which led to alteration of the university academic calendar led to an extension of the research work period by approximately 12 months. The research work was expected to take 265 days spread over a period of twelve months as indicated in table 2 below.

Table 2: Original Work Plan for the Research work completed.

		1	2	3	4	5	6	7	8	9	10	11	12
1.	Development of a research concept note, proposal and defense and approval, sending the proposal to ERC for approval, seminar 1												
2.	ERC Approval and Appointment of supervisors												

3.	Pilot study, Data collection, Descriptive data analysis, seminar 2					
4.	Data Analysis, Development and publication of 2 manuscripts, seminar 3					
5.	Thesis report writing of the project					
6.	Intent to submit to the Board of Postgraduate Studies (BPS) of the thesis report					

Appendix VI: Ethical Approval

NACOSTI ACCREDITED

ERC/PhD/005/2019

Pwani UNIVERSITY

ETHICS REVIEW COMMITTEE

ACCREDITED BY THE NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION (NACOSTI, KENYA)

CERTIFICATE OF ETHICAL APPROVAL

THIS IS TO CERTIFY THAT THE PROPOSAL SUBMITTED BY:

FRANCIS G. MWATSAHU

REFERENCE NO:
ERC/PhD/005/2019

Effectiveness of community led total sanitation activities on selected Health outcomes of cholera epidemic in Kaskazini Sub County, Kwale County

TO BE UNDERTAKEN AT:
KWALE COUNTY, KENYA

FOR THE PERIOD
FROM: 29/4/2019 TO: 28/4/2020

HAS BEEN **APPROVED** BY THE ETHICS REVIEW COMMITTEE

AT ITS SITTING HELD AT PWANI UNIVERSITY, KENYA

ON THE 29/4/2019

CHAIRMAN	SECRETARY	LAY MEMBER

Pwani UNIVERSITY
Ethics Review Committee

Pwani University, www.pu.ac.ke, email: [illegible], tel: 0719 182218
The ERC: Giving Integrity to Research for Sustainable Development

NACOSTI ACCREDITED

ERC/PhD/005/2019

Pwani UNIVERSITY

NOTICE:

Appendix VII: Publications

1. **Original Research Article**

Mwatsahu, F., Karanja, S., Karama, M., Zimmermann, M., & Otieno, C. (2021). Effect of Community-Led Total Sanitation on Development of Anemia among Children Aged Below Five Years in Kinango Sub-County, Kwale County. *Africa Journal of Technical and Vocational Education and Training*, *6*(1), 189-198. Retrieved from https://www.afritvetjournal.org/index.php/Afritvet/article/view/134

Effect Of Community-Led Total Sanitation On Development Of Anemia Among Children Aged Below Five Years In Kinango Sub-County, Kwale County

ABSTRACT

Anemia is a widespread public health problem with detrimental effects on both children and adults. The problem is particularly severe in the developing world, as anemia is closely associated with inadequate nutrition and poor sanitation. Though in Kenya the overall prevalence of anemia among the children is estimated to be 28.8%, a recent nested study of a 2012-2016 maternal-child cohort in coastal Kenya reported that 76% of children have been anemic on at least one time point since birth. Community Led Total Sanitation (CLTS) is a widely used approach to improve community sanitation. In Kwale County, the prevalence of open defecation is high at 51 %. Though CLTS is not primarily a nutritional intervention, previous studies have established that it has potential to reduce helminthic infections among children, improve iron absorption and thus reduce anemia. This study sought to establish the effect of CL TS on Anemic status of children under five years in in Kinango Sub-County, Kwale County. This was a quasi-experiment with an intervention and control site. The intervention site received the Community-Led Total Sanitation (CLTS) intervention while the control site received no sanitation related intervention at all. Data on Anemia among children under five years was collected before and after the intervention in a sample size of 402 and 405 respondents in control and intervention sites respectively. Results established that CLTS was found to be effective in reducing the prevalence of Anemia in intervention site compared to control site. A Difference in Differences (DiD) statistic indicated that CL TS reduced prevalence of anemia by 16.1 % in intervention site compared to control site. Children in intervention site were 3 times less likely to develop Anemia compared to children in the control site (Adj. OR= 3.064, 95% CI of OR=2.026-4.634, P<0.05). To help reduce Anemia among children under five years, there is need to scale up implementation of CL TS in other parts of K wale County and in Kenya. Studies linking reduction of Anemia with adequate sanitation are not common. Therefore, more studies are also recommended to help establish more evidence linking CL TS with reduced prevalence of Anemia among children less than five years of age.

2. Original Research Article

African Journal of Health Sciences **Mwatsahu1, Karanja1, Karama, Zimmermann and Otieno.** ***Afr. J. Health Sci. 2021 33(6):107-117***
www.ajol.info/index.php/ajhs/index eISSN: 1022-9272.

Effects of Community-Led Total Sanitation on Malnutrition Status of Children Under 5 Years in Kwale County

ABSTRACT

Malnutrition among children below 5 years negatively impacts their physical and cognitive development. The government and its development partners have implemented several strategies to eradicate malnutrition. Studies have suggested that there is a significant link between malnutrition and poor hygiene and sanitation practices. Poor hygiene and sanitation related practices are associated with undernutrition due to diarrhea, parasitic infections and environmental enteropathy. The aim of this study was to assess the effects of Community-Led Total Sanitation (CLTS) on malnutrition status of children under 5 years in Kwale County, Kenya.

MATERIALS AND METHODS

The study employed a quasi-experimental study design with one intervention and control site. The quasi experiment adopted a Pretest-Post Test Study approach. The intervention site received the Community-Led Total Sanitation (CLTS) intervention which included health education and construction of latrines. Fleiss method was used to determine the sample size where 402 and 405 respondents were sampled in the control and intervention sites respectively.

RESULTS

Data from the baseline survey shows that malnutrition rates were 53.2 % and 42.7 % in the control and intervention sites respectively. In the end term survey, malnutrition rates were 48.5% and 29.4% in the control and intervention sites respectively. Student T test showed a significant difference in the means of children suffering from malnutrition in intervention compared to control sites ($t = -5.675$, $p < 0.05$). Data further showed that children in the control site were three times more likely to suffer from malnutrition compared to children in the intervention site [(Adj. OR = 3.482, 95% CI= 2.453- 4.942, $P<0.05$)].