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# Prevalence of Communicable Diseases and Causes of Variability among Secondary Schools in Kisumu County, Kenya

By David Otieno Odongo, Professor Jacob W. Wakhungu & Dr. S. Omuterema
*Masinde Muliro University of Science and Technology, Kakamega, Kenya*

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# Prevalence of Communicable Diseases and Causes of Variability among Secondary Schools in Kisumu County, Kenya

David Otieno Odongo [α], Professor Jacob W. Wakhungu [σ] & Dr. S. Omuterema [ρ]

*Abstract-* Prevalence of communicable diseases, which account for millions of school lost days a year, among secondary school students in Kisumu County is unknown. The number of secondary schools with school health facilities is unknown, and there is no indication from Kenya's Health Sector Strategic Plan, 2012-2017 that establishment of school health facilities will be given priority as an intervention. The overall objective of this study was to examine causes of variability in communicable disease prevalence rates among secondary schools in Kisumu County, Kenya. In order to achieve the overall objective, the following were the specific objectives: to determine prevalence rates of communicable diseases among secondary students in Kisumu County; to determine the cause of variability in communicable disease prevalence rates among students; and to evaluate public health intervention programs for optimal use in secondary schools. Survey, Correlational and Evaluation research designs were used for the three objectives respectively. A total of 400 students (212 boys and 188 girls) from 38 schools (30 mixed schools, 5 boys' only schools, and 3 girls' only schools) randomly sampled from three sub-Counties out of seven based on coefficient of variation in terms of student enrollment by gender, type of school, and locality of the school within Kisumu County. Key informants and observation units were sampled purposively while Focus Group Discussion was by quota sampling. Students who self-reported communicable disease illnesses which were not clinically confirmed were taken for medical examination at health facilities in the neighborhood of their schools where blood, urine, stool and sputum were the samples for malaria parasite test, pneumonia test, *clostridium difficile* test and *mycrobacterium tuberculosis* test respectively, while those with clinically confirmed illnesses showed clinic or hospital cards. The latter group of students were then subjected to an in-depth interview. Data analyses were done using Statistical Package for Social Science (SPSS) Windows (version 15.2; Chicago, IL) and descriptive analyses was also used. Chi-square test and ANOVA were performed for comparing proportions and probability of $<0.05$ was considered Statistically Significant. Strength of association was considered by estimating F at its 95% confidence interval. Normative evaluation was also used to evaluate public health programs. This study has revealed that prevalence of diarrhea, tuberculosis, pneumonia and other respiratory infections are lower among female students than male students while prevalence of malaria is higher in males than females. The most important communicable diseases among secondary school students were Malaria, Diarrhea, Tuberculosis and Pneumonia with prevalence rates 20.7%, 15.1%, 7.2% and 5.2% respectively. Age of students was a significant cause of variability in prevalence rates ($p<0.05$). Health seeking behavior among students and provision of water at hand washing areas were best practices among public health intervention programs. There is need to establish school health units to reverse the burden of communicable diseases in schools. Research on gender roles and variation in communicable disease prevalence rates in secondary schools should be explored.

*Author α σ ρ: Masinde Muliro University of Science and Technology, Kakamega, Kenya. e-mails: dvdotieno@gmail.com, jwanambacha@yahoo.com, omu53@yahoo.com*

## I. Introduction

### a) Background

A communicable disease is defined as an illness that arises from transmission of an infectious agent (viruses, bacteria, chlamydiae, richettsiae, fungi, protozoa or metozoa) or its toxic product from an infected person, animal or reservoir to a susceptible host, either directly or indirectly through an intermediate plant or animal host, vector, or environment (AMREF, 2004). Prevalence is a measure of disease that allows us to determine a person's likelihood of being ill.

Communicable diseases still dominate the morbidity profile in Kenya. Majority of Kenyans continue to seek treatment in health care facilities for ailments that can be controlled through preventive and promotive measures (WHO, 2007). The burden of communicable diseases is high, with malaria as the leading cause of morbidity (30%) (WHO, 2005) followed by respiratory diseases (24.5%).

HIV prevalence is 7.4%, the rate being higher in women (8.5%) compared to men (5.6%). This is partly because most sexually active youths do not consistently use condoms and most women feel powerless to negotiate safer sex with their partners. Tuberculosis (TB) control has been more challenging, with high TB prevalence of 319 per 100 000, TB/HIV co-infection prevalence of 53% and a growing threat of MDR/XDR-TB (WHO, 2008).Overcrowding and intermittent use of antibiotics are some of the challenges facing TB control. Kenyan student population has increased since the introduction of free schooling (GoK, 2012). In public secondary schools, the number has risen from 1.1 million students in 2008 to 1.85 million in 2012 leading to increased student membership in the existing hostels and other social amenities in the schools.

Kisumu County suffers from high burden of communicable diseases as well as emerging threats. According to the Kenya Demographic and Health Survey, (GoK.,2010) the County has one of the highest HIV/AIDS prevalence rates at 17% higher than the Nyanza region rate of 15.3%, and national rate of 7.4%. Kisumu West District, one of the districts in the County, suffers from high levels of HIV/AIDS, Diarrhea, Malaria, Multi-Drug Resistant TB (MDR-TB), and other communicable diseases. More than half of the population relies on surface water as the main source of drinking water. 42% of the households share toilets while 21% have no toilets (KWHDSS, 2011).

Kisumu is a highly disaster-prone county. Floods and drought affect different geographical zones annually with a varying degree of damage to health infrastructure and people's health causing interruption in access to safe water and collapse of sanitation infrastructure (Mourmie, 2011). Kisumu County is malaria endemic and has large tracks of wetlands, some of which are under rice and sugarcane farms.

*b) Statement of the problem*

Kisumu County was chosen because it is malaria endemic region (AMREF, 2004) with a very large area under agricultural irrigation. It is also adjacent to a large pool of water and wetlands. These facts indicate that many people in Kisumu County, students included, are at risk of contracting communicable diseases such as diarrhea, typhoid, intestinal parasite infections, trachoma, and schistosomiasis among others, which account for millions of school lost days (CDC, 2007). A major contributing factor to this burden of communicable disease is inadequate access to safe water and sanitation infrastructure (Boschi-Pinto *et al.,* 2008).

Integration of school health services into National and County health services will ensure timely surveillance, prevention and treatment of communicable diseases in schools. However, at present there is no national guideline to provide a framework for the transformation of school health service into an integrated County health service; strategies and interventions to work with other ministries have not been spelled out in the Kenya's Health Sector Strategic Plan, 2012-2017 (GoK, 2012).

High school students are a neglected group that very little research has been done concerning health challenges due to communicable diseases they face in school (Muna, 2010). A lot of research has been done on health challenges facing infants, under five year olds, and fifteen years and below age brackets. There is little information on the extent of prevalence rates of communicable diseases and the factors affecting theirvariability among secondary schools and thereforeneed to provide baseline information that will be used by policy makers to come up with viable intervention programs to address communicable disease burden in schools.

*c) Research Objective*

The overall objective was to examinecauses of variability incommunicable disease prevalence rates among secondary schools in Kisumu County, Kenya.In order to achieve the research objective, the following were the specific objectives for the study:

i. To determineprevalence rates of communicable disease infection among secondary school students,
ii. To determinecause of variability in communicable disease prevalence rates amongstudentsin secondary schools to inform policy formulation,
iii. To evaluateexisting public health intervention programs for optimal use in secondary schools.

*d) Research Questions*

The research, in an attempt to meet the research objective, found answers to the following questions:

Are prevalence rates of communicable diseases significant among students in secondary schools?

What are causes of variability in communicable disease prevalence rates among students within and between schools?

Which are optimal public health intervention programs for secondary schools?

*e) Significance*

Over the past few decades we have witnessed several phases in the development of approaches to public health intervention programs aimed at minimizing prevalence of communicable diseases among students and the public in general. Initially the vulnerable population was thought to be the source of problem of compliance. Later, the role of the provider was also addressed. Now we acknowledge that a systems approach is required. The idea of compliance is associated too closely with blame, be it of provider or vulnerable populations and the concept of adherence is a better way of capturing the dynamic and complex changes required of many players over long periods to maintain optimal public health intervention programs in vulnerable populations.

A major contributing factor to high communicable disease burden in low income countries is inadequate access to safe water and sanitation infrastructure (Leslie et al., 2012). There is need, in the short to medium term, to reduce the risk of communicable diseases in vulnerable populations that will not soon benefit from infrastructure interventions that will take years. Intervention programs to reduce diarrheal and respiratory diseases have been demonstrated in both clinical and community settings, including schools around the world (Anna et al., 2007; Sam et al,

2010).Involving students in a public health behavior change intervention programs ensures successful diffusion of innovation into student's homes. Therefore by examining factors affecting communicable disease prevalent rates among students and causes of its variability within and between schools, the researcher came up with significant indicators to be used in optimizing adherence to public health behavior change intervention programs in schools.

*f) Scope*

This study determine dcauses of variability of communicable disease prevalence rates among secondary students registered in public schools in Kisumu County in the months of February through to April, 2014. It was a modified retrospective study based on clinically confirmed self-reported illnesses by the studentsin the last two week sat the time of data collection. Students with unconfirmed clinical illnesses were taken for medical examination procedures at the nearest health facilities to the schools sampled and tests performed by health professionals. Stools and blood formed part of samples examined for Malaria, Typhoid, Dysentery and Tuberculosis. The results were used to corroborate responses from Focus group discussion with Key Informants. Intervention programs that were evaluated included bed spacing, ventilation, condition of floor and walls of hostels, and use of ITNs in hostels; desk spacing, condition of floor and walls of classrooms, and ventilation of classrooms; student-toilet ratio, hand washing hygiene after defecation, presence of water-soap-disposable towels at hand washing area; solid and liquid waste management; mosquito breeding control; school kitchen and food kiosk staff hygiene; and safe water provision.

## Chapter Two

## II. Literature Review

*a) Introduction*

Communicable diseases do not always develop in the same way in susceptible hosts. Some diseases produce more non-clinical cases that experience vague, non-specific symptoms or none at all (TB, Cholera, and Polio) and the infected thus spread the disease without being aware. Other diseases produce more clinical cases with easily detectable symptoms (Measles) (WHO, 2008). However, once exposed, people with specific symptoms as well as people without clinical or biological signs of infection are capable of spreading the disease to other susceptible persons. Transmission of communicable diseases can be investigated under the following thematic areas:

*b) Risk factor-based analysis*

During the modern era of public health, attention to the natural and built environment has fluctuated (McMichael, 2001).Public health scientists are increasingly discovering that the recent emergence of infectious diseases has an origin in environmental change (McMichael & Martens, 2002; Patz et al., 2000). However, a growing body of literature on environmental change and infectious disease has emerged during the past decade, returning public health to its roots (Anderson, 2004). Suggestions that public health move from a discipline concerned primarily with risk factors at the individual level, and within the realm, provide the basis for testing causal hypotheses.

This has reflected wider trends in biomedical thought and praxis. In the 19th Century, the progenitors of public health instituted a suit of interventions that astutely reflected perceived linkages between environmental conditions and poor health. Debates on the future of epidemiology offer guidance for the study of environmental change and communicable disease burden. Risk factor analysis may adeptly explain who is at risk but not why risks exist or differ within and between populations (Susser, 2004). In response, more valid and precise techniques that better accounts for bias and error have been developed (Lash &Fink, 2003). Others, on the other hand, have continued to advocate for risk factor approach, stressing the role of apparently inexplicable results in eventually guiding discovery (Greenland et al., 2004).

Although such refinement and reflection have addressed some weaknesses of risk factor analysis, others have emerged. For example, although the individual level may be an important scale for probing certain public health questions, risk factor analysis is challenged by the complexity of fundamental causes, including social and ecological drivers (Pimentel et al., 1998), gene-environmental interventions (Hunter, 2005), and life course trajectories (Susser & Terry, 2003). The causes of variability in prevalence rates o communicable diseases has not been documented as shown in the knowledge gap reported in Susser(2004).

*c) Causal inference for communicable disease*

Yet other critiques have questioned the traditional analyzed approach in epidemiology that assumes independence of outcome. The assumption of independence means that the causal link between exposure and disease is made at the individual level. This model hinges on the premise that populations are simple collections of individuals, and the nature or arrangement of interactions between individuals does not alter patterns of risk (Koopman et al., 2004). In complex systems, inappropriate inferences based on potential outcome can severely distort the interpretation of effects and misdirect the application of interventions (Eisenberg et al., 2003). Risk factor analysis for infectious disease can be sometimes be partially salvaged through employing counterfactuals (Robins et al., 2000), but results from both experimental and

observational studies warrant cautious scrutiny prior to generalization.

There are important gender differences related to epidemic prone infectious diseases. Differences between males and females arise because of biological, and as consequence of gender-based roles, behavior and power (WHO, 2007). For reasons that are not yet understood (WHO, 2003), females had lower mortality rates from severe acute respiratory syndrome (SARS) than males, a pattern that is maintained after adjusting for age. The question whether epidemiologists should assume independence of outcome or violate it when making causal inferences for communicable diseases is a question of interest. Prevalence rates within and between populations is not documented.

*d) Interdisciplinary research and integration*

Virtually all integrative reviews are, at least to some extent, interdisciplinary, as the study of environmental change and communicable disease clearly requires expertise from numerous fields (Parkens et al., 2005; Patz et al., 2004). Most integrative reviews include various biomedical sciences with more current work displaying greater inclusivity and deeper collaboration. In addition, integrative reviews that reference the gradually growing number of case studies on sustainable development or ecosystem approaches (Corvalan et al., 2005) bridge scientists, policy makers, activists, and citizens.

Interdisciplinary research collaboration is the best way to go in coming up with the optimal public health intervention programs. Use of Focus Group discussion involving professionals from diverse backgrounds is not documented in the literature on communicable diseases and environment.

*e) Systems theory-based approach*

The overt consideration of feedbacks and interactions within and between populations in a transmission model allows for a consideration of infectious diseases as inherently dynamic and interdependent processes, and thus causality as context dependent and systems based (Koopman et al., 2004). These systems all use a systems theory-based approach to extend the purview of causation across axes of space, time, and organizational level and purpose to interrelate research at different scales through feedbacks and interactions. For example, if a core group is sustaining infection in a larger group, targeting interventions based on individual- level risk factors will not, in general, address the principle cause of disease (Christly et al., 2005; Verdasca et al., 2005).

This study adopted a socio- economic systems perspective approach to epidemiologic research. It looked at social aspects of an individual or population and communicable disease prevalence rates.

*f) Conceptual Frameworks*

A set of integrative reviews articulate conceptual frameworks for comprehensively organizing knowledge about systems of interacting components that link fundamental drivers to disease resurgence through an interplay of subsystems (Weiss & McMichael, 2004; Wilcox & Colwell, 2005). Some existing conceptual frameworks could also be applied to environmental change and infectious diseases. Particularly germane are frameworks for climate change (McMichael & Butler, 2004), globalization (Woodward et al., 2001), social epidemiology and environmental health (Parkes et al., 2003).

This study borrowed heavily social epidemiology and environmental health framework models. This was done to address the fact that targeting interventions based on individuals-level risk factors when a core group is sustaining infection in a larger group will not address the principle cause of the disease.

*g) Transmission models embedded within wider systems*

The influence of social and ecological contexts on disease transmission has been recognized for diseases spread through direct contact, for example sexually transmitted diseases and airborne diseases (Shen et al., 2004); diseases with environmental reservoirs, for example waterborne diseases (Eisenberg et al., 2005); and diseases for which land use change moderates vector populations, for example vector borne diseases (Lindblande et al., 2000). Transmission models can serve as conceptual or analytical instruments to analyze the infections between environmental contexts and transmission cycle components (Smith& Desai 2005).

*h) Communicable disease burden globally*

Communicable disease burden can be expressed in Disability Adjusted Life Years (DALY), which combines the burden due to death and disability in a single index. The DALY index allows comparison of the impact of different diseases, and the contribution of environmental and other risk factors to these diseases. Table 2.1 presents the estimated contribution of selected environmental risk factors to major diseases in less developed and more developed countries (WHO, 2002).

While Table 2.1 represents the global burden of communicable diseases in all age groups, one can surmise the relative effect of environmental exposures in children. It is important to remember that children are affected disproportionately by environmental exposures as compared to adults.

*Table 2.1 :* Attributable DALY by level of development

| Risk factor | Example of disease | High mortality; developing countries('000) | Low mortality; developed countries('000) | More developed countries('000) |
|---|---|---|---|---|
| Unsafe water, sanitation and hygiene | Diarrheal diseases | 46 183 | 7 150 | 825 |
| Urban air pollution | Respiratory infections | 2 685 | 4 008 | 1 171 |
| Indoor smoke from solid fuel | Lower respiratory infections, lung cancers | 30 393 | 7 595 | 550 |
| Lead exposure | Cardiovascular diseases, hypertensive diseases | 5 953 | 5 584 | 1 388 |
| Climate change | Diarrheal diseases, malaria, unintentional injuries | 5 202 | 294 | 22 |

*Source: WHO (2002)*

David (2013) reports there are several ways of categorizing communicable diseases. However, World Health Organization uses three guiding principles for prioritization: [i] communicable diseases with large scale impact on mortality, morbidity and disability, such as human immunodeficiency virus (HIV) infection and acquired immunodeficiency syndrome (AIDS), tuberculosis (TB) and malaria, [ii] communicable diseases that can potentially cause epidemics, such as influenza and cholera; and [iii] communicable diseases that can be effectively controlled with available cost-effective interventions, such as diarrheal diseases and tuberculosis (TB) (WHO, 2005). The leading six communicable diseases mentioned by World Health Organization, which cause almost 90% of communicable disease deaths, are: acute respiratory infections (including pneumonia and influenza), human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS), diarrheal diseases, tuberculosis, malaria and measles.

i. *Pneumonia*

Pneumonia is an inflammation of the lungs most often caused by infection with bacteria, viruses (50 percent of all cases) and other organisms, although there are also non-infections causes (inhalation of food, liquid, gases or dust). It is tested by mucus test which include a Gram stain and sputum culture; rapid urine test to identify presence of bacteria that cause pneumonia; presence of Pneumocyt is carinii for those who are HIV positive (ALA, 2013). Other tests include blood tests to confirm the presence of infection and to try to identify the type of organism causing the infection; and chest X-rays to confirm the presence of pneumonia and determine the extent and location of the infection. Pneumonia is often a pre-existing condition/infection and is triggered when a patient's defense system is weakened, most often by a simple viral respiratory tract infection or a case of influenza, especially in the elderly (Hayden & Croisier, 2005). Pneumonia affects the lungs in different ways. Lobar pneumonia affects a lobe of the lungs, and bronchial pneumonia can affect patches throughout both lungs. One type of pneumonia caused by fungi is Pneumocystis carinii pneumonia (PCP) which primarily affects AIDS patients. Certain diseases, such as tuberculosis, can also predispose someone to pneumonia (WHO, 2005).

The symptoms of pneumonia are similar to influenza symptoms and include fever, dry cough, headache, muscle pain, weakness and increasingly breathlessness (WHO, 2009a). Mycoplasmas are the smallest free - living agents of disease in man with characteristics of both bacteria and viruses and generally cause a mild and widespread pneumonia. The most prominent symptom of mycoplasma pneumonia is a cough that tends to come in violent attacks, but produces only sparse whitish mucus. Mycoplasmas are responsible for approximately 15 – 50 percent of all adult cases of pneumonia and an even higher rate in school age children (US NLM, 2013).They can be treated by antibiotics, but providing antibiotics is not a simple matter in communities with little access to health care or health education. Families may delay seeking treatment for their child or not receive that treatment until it is too late. While this happens, the infected child continue to interact in school with other healthy or similarly infected students causing new infections and increased pathogen-dose effect in the healthy and infected students respectively. This can be exacerbated by overcrowding. It is for this reason that bed and desk spacing in hostels and classrooms respectively and indoor air quality were evaluated in this study to help answer research question ii] and iii].

In a study by Baker et al. (2013), a combined data from four case control and observational studies showed that children less than five years old exposed to greater household crowding had 1.69 times the odds of

pneumonia than children exposed to the least crowding. Pneumonia and influenza are together ranked as eighth leading cause of death in the United States (US NCHS, 2009). Pneumonia consistently account for the overwhelming majority deaths between the two. Less than 2 percent of these deaths take place in the European Region and less than 3 percent in the Region of the Americas.

Etiology of pneumonia infection has all indications toward personal hygiene and crowding. Evaluation of bed spacing in hostels and desk spacing in classrooms to bring up association between the two variables and prevalence of pneumonia is not documented.

ii. *Diarrheal diseases*

Diarrhea is defined in medicine as the passing per day of three or more stools which are sufficiently liquid to take the shape of a container (Keusch et al., 2006). Stools are tested for Clostridium difficile(C. difficile). Positive test for C. difficile confirms diarrhea. Diarrhea have many causes, the most common being intestinal infection. Common etiological agents are bacteria like Escherichia coli (e. coli), campylobacter, salmonella, and shigella bio-serotypes or viruses like adenovirus, rotavirus and norwalkvirus. Parasites like entamoeba histolytica and giardia lamblia also cause diarrhea (Merson et al., 2005).

Diarrheal diseases are estimated to have caused approximately two million deaths during 1998, most of which were children under five years living in developing countries. It was long thought that contaminated water supplies were the main source of pathogens causing diarrhea, but it is now been shown that food can be responsible for up to 70% of diarrheal episodes (Muna, 2010; Eisenberg et al., 2007). Infections due to pathogenic Escherichia coli (E.coli) are the common cause of diarrhea. This study determined prevalence of diarrhea and evaluated food handling hygiene practices in schools. Water sources and storage were points of interest in this study.

Human being is constantly exposed to potentially infectious organisms. The struggle to combat the organisms is a continuous and life long process. The defense against microbes and germs is a vital and essential function in survival. Its outcome depends on many factors (Scholth of, 2007): first, host factors are factors that relate to the person hosting the infectious agent. The most important host factor is the immune system. Its strength depends on factors like genetics and physical and mental state of the patient. The latter depends on among other things on nutrition, rest and stress.

It has been documented that malnutrition increases the risk of dying from diarrhea (Ochoa et al., 2004). Stress has been found to have a direct effect on the immune function through impairment of natural killer cell cytotoxicity (Cohen et al., 2007). Stress is constant in many poor countries in low-to- middle level income countries.

Secondly, agent factors are of importance to the occurrence and outcome of diarrhea and include virulence of the agent, pathophysiology and dose. Virulence is the relative ability of an organism to cause disease (Rodrigues et al., 2007). Bacteria causing diarrhea primarily act through two pathopysiological mechanisms. One is through the release of toxins that affect the secretion or absorption of fluids in the intestine; another is through invasion of the mucous membranes, usually of large bowel. Viruses that cause diarrhea often infect the small cells of the intestinal villi. This leads to malabsorption by impaired hydrolysis of carbohydrates and excessive fluid loss (Keusch et al., 2006), therefore the reason why adherence by secondary students to water and sanitation and food hygiene intervention programs were evaluated in this study.

Thirdly, frequency of exposure from diarrheal agents is a function both of specific agent factors and the environment. Characteristics of the agent that matter is for instance the ability of the agent to survive outside the human body. Shigella is very sensitive and expires quickly in the environment; Cholera (caused by vibrio cholera, a gram-negative bacterium) survives well in water and sewage, many diarrheal agents thrive in organic matter and can therefore multiply rapidly in food (Scholthof, 2007). All these various characteristics are important for control measures. In shigella, isolation of the individual is particularly important. Dysentery signifies passing of stools with blood. It is still endemic in most countries. The most common causes of dysentery are shigella and amoebiasis (Pazhani et al., 2004; Keusch et al., 2006).

In cholera, it is important to reduce the contacts between the infected and others, but it is equally important to limit the use of water sources containing the vibros (Ryan &Calderwood, 2000). Control of hygiene in public eating places is a well-established public health function to prevent the occurrence and spread of pathogens like salmonella and Escherichia coli. Keeping school environment clean by ensuring proper disposal of both solid and liquid waste, frequency of exposure from diarrheal agents will be minimized. In this study, data on solid and liquid waste management practices was collected using an observation check list during a transect walk in the school.

A model of the interaction between water and diarrhea distinguishes five pathways of transmission; within households, household-to-household, household-to-water, water-to-household, and external-to-community (Eisenberg et al., 2007). The most common route of transmission of diarrheal agents is the fecal-oral route, within households or between households

(Keusch et al., 2006). Agents are excreted though faces by carriers and transmitted to other persons either through water, food or personal contact. Hand washing after having passed stools is particularly important as a measure at individual level to reduce spread of pathogens (Clasen et al., 2006). Provision of safe water, good sanitation, waste management and food control are vital community interventions to prevent diarrhea.

Other environmental factors of relevance to the occurrence of diarrhea are traditional beliefs and cultures (Ellis et al., 2007), the health care system (Mills et al., 2006), the role and status of women (Scholth of, 2007). Socio-economic differences (Burstrom et al., 2005; Wagstaff et al., 2004), Climate and seasonal variation in temperature (El-Gilany & Hammad, 2005; Rendi-Wagner et al., 2006). A well functional disease control program will depend on a strong health system with facilities and well trained and motivated personnel in place (Lindstrom et al., 2006). Both the skills and infrastructure may be deficient due to system problems (Bryce et al., 2004; Rowe et al., 2005).

Food handling is a great challenge in food and beverage industry and with the evidence that food is responsible for up to 70% of diarrheal episodes, the need to prevent food contamination is more urgent. To gather data on food handling, this study evaluated the hygiene situation in the school kiosks, school kitchen and dining hall or eating area, and the markets adjacent to the sampled schools. The results have been used to come up with workable intervention programs to address the hygiene situation in schools.

Most studies in communicable disease prevalence are retrospective in nature. For example, in an infection study by an outbreak of Salmonella Typhimurium phage type 44, many students at a school in Kaohsiung County, Taiwan, began having food poisoning like symptoms, such as diarrhea, fever, nausea, vomiting, and abdominal cramps (Tsu-Fen Chen et al. 2011; Stephanie et al., 2009).

Studies by Fen Chen et al. (2011) and Stephanie et al. (2009) used clinical procedures for the contacts but did not carry out in-depth interviews. Use of qualitative date in retrospective method of data collection from students with clinically confirmed illnesses has not been recorded.

iii. *Malaria*

Malaria is a parasitic infection spread by Anopheles mosquitoes. The Plasmodium parasite that causes malaria is neither virus nor a bacterium- it is a single celled parasite that multiplies in red blood cells of humans as well as in the mosquito intestine. Its infection is confirmed by blood smear testing positive for malaria parasite (Nicholas et al., 2014).

The latest report on global malaria trend is based on information from 106 countries where malaria is endemic (WHO, 2011). The report estimates that globally there were: 655 000 deaths from malaria in 2010 from 216 million episodes; 91% of deaths and 81% of the episodes were in the African Region; Malaria incidence declined by 17%. These improvements are attributed to human interventions, including greater use of insecticide treated bed nets, indoor residual spraying, rapid diagnostic tests, and artemisinin based combination therapies.

The age distribution of cases of malaria is influenced strongly by the intensity of malaria transmission. In areas where the population is exposed only occasionally to an infectious bite, malaria occurs in subjects of all ages, most frequently in adults who have an occupational risk (Nankabirwa et al., 2013). In contrast, in areas of high transmission, the main burden of malaria transmission, including nearly all malaria deaths, is in young children (Snow& Marsh, 2002; Cameiro et al., 2010).

Some of the successful malaria intervention programs can be learnt from the government of Oman, Sultanate of Oman (2012) introduced School Health Program as an intervention process to reverse the upward trend of communicable diseases. This is an example of integrated preventive and curative health services.

Evaluating school health system was the first step in identifying barriers to creation of safe and healthy school environments through health education for personal and community health. From the foregoing literature, evaluation of public health intervention programs is not recorded.

iv. *Tuberculosis (TB)*

Tuberculosis is an infectious disease that usually affects the lungs. Mycrobacterium tuberculosis (M. tuberculosis) causes TB. It is spread through the air from person to person, when people with TB affecting the lungs cough, sneeze, spit, laugh or talk. A positive culture for M. tuberculosis confirms the diagnosis of TB disease (Sterling et al., 2011).

Tuberculosis has been declared as a global health emergency by the World Health Organization (WHO). This has been mainly due to the emergence of multi-drug resistance (MDR) strains and the synergy between tubercle bacilli and human immunodeficiency virus (HIV) (Niyaz & Seyed, 2004). One of the classical threats of the tuberculosis epidemic has been the MDR-TB caused by use and often abuse of misuse of antimicrobial agents. This has encouraged the evolution of bacteria toward resistance, resulting in therapeutic failure. There are evidences that bacteria have the ability to adapt to this deficit and recover fitness on serial passage (Sharma & Mohan, 2004).The other reason is that it might be a consequence of increased reactivation of previously acquired dormant bacilli and an increase in susceptibility to both the re-infection and primary infection (Ahmed et al., 2004).

It is estimated that every year two million people die from acute pulmonary tuberculosis (PTB), and that an additional 365 000 die with TB and HIV infection, while eight million become newly infected with mycobacterium tuberculosis, adding to the estimated that two billion people (15-59 years) worldwide with latent TB infection particularly in developing countries (Ayesha, 2010). The poor and the marginalized in the developing world are the most affected.

To prevent the spread of respiratory illnesses, the nose and mouth should be covered with tissue when coughing or sneezing and the tissue should be thrown in the trash immediately after use (Daphne, 2000). Schools can teach respiratory etiquette to students and staff- including coughing or sneezing into the arm if no tissue is available- and to ensure that tissues are available. The aim of teacher training is to change attitudes towards supporting health; to encourage commitment to health as a subject; and to improve skills and understanding of the subject.

In six case -control studies and another cross sectional study (Baker et al., 2013), results showed 3.78 times increased odds of tuberculosis in the most crowded compared to the least crowded households. Lester et al. (2008) in their study to describe a secondary school outbreak of tuberculosis in Palmerston North, New Zealand 2006, found out that the delayed diagnosis of the index case lead to extensive transmission. Contact investigation detected fifteen secondary cases, from five of whom Mycobacterium tuberculosis organisms was cultured which was diagnosed in the index case. Latent tuberculosis infection was diagnosed in 235 of 1828 contacts. Following logistic regression, risk of infection was significantly associated with age, exposure setting (household and school verses other settings) and duration of exposure. Large numbers of contacts were infected who had no known contact with index case, thus indicating probable tertiary transmission from five infectious secondary cases (Lester et al., 2008).

The index case was a 14 year old boy diagnosed with smear-positive pulmonary tuberculosis (TB) in August 2006 in Palmerston North. Case and contact management was conducted by Mid Central District Health Board according to national guidelines (GoN, 2003).

In a school set up, delayed diagnosis of infectious diseases can be minimized by regular medical checkups for students, which is facilitated by having a well-run school health service. Literature above confirms lack of this in the schools which relied on national health systems. This study evaluated school health services in secondary schools in Kisumu County and observed optimal practices.

*i) Intervention Programs for Communicable Diseases*

Public health research and practice are credited with several notable achievements, including gains in life expectancy; and a large part of increase is the result of safer water and food supplies, sewage treatment and disposal, control of communicable diseases and other population based interventions. Political visions and principles of health promotion as outlined in World Health Organization directives, international agreements, the national policies, suggests that increased efforts in health promotion move from a 'repair' to 'prevention' model (Barry et al.,2009). The adoption of evidence based strategies has been recommended in order to achieve international and national objectives for improvements in population health (Tones & Green, 2004).

The concept of health promotion is based on the assumption that human nature is heterostatic rather than homeostatic, a statement that is in accordance with the salutogenic orientation. Its practice involves not only the question of which individual factors lead to poor health, but also a strong focus on the interactions between people and the societal structures in which they function (Marmot, 2011). Besides focusing on human resources, the contextual conditions of living situations are also addressed (Raphael, 2010). The ability to gather and use relevant evidence of 'what works' commonly known as best practices, is a key component of a country's capacity to promote healthy living conditions (Davies et al., 2000).

There is increasing demand in all sectors across the research, policy, practice continuum for evidence based decision making and accountability. Some might argue that the origins of evidence based health promotion and public health lie in the evidence based movement in the healthcare. Unlike evidence based public health, evidence based medicine has been well defined and its processes developed in the last decade (Egger et al., 2001).

Primary research based on randomized control trials (RCT) is based on the assumption that the stronger the evidence, the more powerful its influence on practice should be (Speller et al., 2005). This has created a hierarchy of research designs. However, the pre-evidence of RCT methods is controversial when applied to health promotion and wider public health intervention. Although RCT is recognized for providing the best possible information about effectiveness when the research is appropriate to the intervention type (MacIntyre et al, 2001), RCT has been found to be inappropriate research design for evaluating complex community based public health interventions (Brownson et al., 2009). There have been several attempts to define evidence based public health. At the moment, it appears to be a consensus among investigators and public health leaders that a combination of scientific evidence and values, resources, and contextual factors should be

taken into account in decision making processes (Raphael, 2010).

Evidence based public health promotion is important because society pays a high cost when interventions that yield the highest health returns are not implemented. Evidence is also important because practitioners need justifications for decisions they make (Brownson et al., 2009). Evidence based public health has not been well defined and its processes not developed. This will only come to fruition if more evidence based research is carried out to authenticate public health processes. It is for this reason that this study determined association between public health behavior change interventions and prevalence rates of communicable diseases to come up with best practices. Evaluation of adherence to public health behavior change interventions was carried out using an observation checklist during environmental health survey of the sampled schools, and not randomized control trials (RCT) because of its inappropriateness as a research design to evaluate community based public health interventions.Evidence based decision making, practice and policy is lacking as reported by Egger et al., 2001.

*j) Public Health Intervention Programs for Schools*

Education and Health is one of the two thematic clusters of Millennium Development Goal initiatives (UN, 2011). The other is Food Security and Sustainable Growth. The pragmatic shift in the past decade in our understanding of the role of health and nutrition in school age children has fundamental implications for the design of effective programs (Donald et al., 2006). The Global health agenda is shifting from an emphasis on disease-specific approaches to a focus on strengthening of health systems (Reich, 2009).

World Health Organization (WHO) launched Global School Health Initiative in 1995, to mobilize and strengthen health promotion and education activities at the local, national, regional and global levels. The initiative is designed to improve the health of students, schools, school personnel, families and other members of the community through schools. The goal is to increase the number of schools that can truly be called "Health Promoting Schools". A Health Promoting School can be characterized as a school constantly strengthening its capacity as a healthy setting for living, learning and working (WHO, 1996).

Martin (2010) describes environment as a physical, chemical and biological condition of a region in which an organism lives. The author observes that environment is classified into internal and external. Internal environment includes every component part, cells, organ, organic system and tissues, and their harmonious functioning within the system. External environment, on the other hand, consists of those things a living organism is exposed to immediately after conception. These may include, but not limited to, physical, biological and psychological components which can affect the life of the living organism and its susceptibility to illness.

Environment components are linked to each other and significantly influence the health status of a school and students (Masike & Mojekwa, 2012). A person's ill-health can be traced to adverse environmental factors that include poor housing, presence of animal reservoirs, water pollution, and soil pollution, and insect vectors of diseases. Man is responsible for all these environmental changes (Parks, 2008). Public health intervention programs for schools have double benefits because the intended behavior change diffuses to the households during the interaction between the student and the home environment. Only successful public health intervention programs have been documented. This study has filled this gap by observing not only the successful interventions, but also those that are less optimal. Some of the successful public health intervention programs for communicable diseases in schools include:

i. *School Health Services, Training of School Health Nurses, and Teacher Education*

School Health Service has many components including health inspection (HI), health education, immunization, health survey, first aid in some cases, treatment of children with minor ailments, and referral system. Components are greatly varied from country to country and even within one country, and are dependent on financial and material resources available to render the services (Daphne, 2000).

A focus on school going children is important because children spend a lot of their time at school, away from home; because some parents tend to postpone health seeking for children's health problems; because transmission of communicable diseases in school children can easily occur due to large concentration of children in school; and because this is the time when very important health related habits develop (Vlok, 1988). Studies have shown that health inspection in schools is necessary to ensure that children derive optimum benefit from investments in education and health programs, and that they remain physically, mentally and socially healthy (Searle, 1994).
School health education is another important component of School Health Service. According to World Health Organization (WHO), health education is the most developed component of school health service (WHO, 1996). It concentrates in improving behavior that promotes health and prevents ill-health. It allows for development of skills of the youth, change of attitudes and development of positive values related to those behaviors.

The American Nursing Association (ANA), the colleges of Nurses in Canada and the Professional

Nursing Associations have developed standards of practice to nurses practicing in a school setting. The standard includes concepts, such as appropriate nursing theory; the development of a comprehensive School Health Service (SHS) program; interdisciplinary collaboration; health education; professional development; participating with other community development agencies; and extensive community involvement and research (Cookfair, 1991). Japan has a school-based nurse system of healthcare (WHO, 1996).

Components of environment significantly affect the life of the living organism and its susceptibility to illness, and so is the health status of the school and students. Students and other school community members are responsible for the health status of the school environment. School health services vary even within a County. This makes it difficult to monitor and therefore need to come up with a national framework from which school health services will be tailored. This may involve training and hiring of school health nurses and infusing school health education in the curriculum of teacher education. It will also guide allocation of funds by the County governments to support school health services. This study evaluated school health services to come up with the best in relation to communicable disease prevalence rates.

School health service is known to improve health seeking behavior of students. There are also related gender differences to health seeking behavior and access to health care. In some societies there are differences in the utilization of health care facilities and in the level and type of care given to males and females. A follow up observation study in Kolkata, India, for example, found that boys with diarrhea were more likely to be given oral rehydration fluids than girls, and were more likely to be taken to qualified health professionals for treatment. Boys were also taken for care outside the home significantly sooner than girls (Pandey, 2002). A similar result was found in Bangladesh where the time between the onset of symptoms and admission was significantly higher in girls than boys (Mitra, Rahman & Fuchs, 2000).

ii. *Building mutually-beneficial relationships between schools and communities*

Building mutually beneficial relationships between schools and communities is one of the strategies used to reduce communicable disease burden among students and the neighboring communities. It involves the use of a "School Community Connector." A school community connector is a person whose job is to find and build relationships with a wide range of neighborhood "assets"-residents, voluntary associations, local institutions, businesses-and then to connect them to the neighborhood school and its assets-teachers, students, space, equipment, among others (Dancia et al., 2013). Dozens of such connections are facilitated, resulting in significant health benefits to both the school and the community.

When parents and community members are engaged in the life of a school, the resources available for teaching and healthy learning environment expand (Henderson & Mapp, 2002). When teachers and principal build trust with each other and with parents, they can develop a common vision for school reform and work together to implement necessary changes in the school. The relationship between the school and other community institutions such as community organizations, businesses and churches can also be understood in this way.

Interpersonal relationships built between individuals across these institutions provide the glue for innovative collaborations at the institutional level (Epstein &Sheldon, 2002). These partnerships strengthen relationship among people in the entire community to meet the challenges of communicable diseases. Collaboration between the school and neighboring community is important when it is used to enforce public health interventions. School-community collaboration was evaluated in this study during focus group discussion by doing a SWOT analysis of the school and the community.

Building mutually-beneficial relationships between schools and communities is one important strategy in minimizing communicable disease burden in schools. The Asset-Based Community Development (ABCD) Institute at Northwestern University has been researching issues surrounding school-community connectedness since the early 1990s (Dancia et al., 2013). ABCD provides effective strategies for rediscovering and mobilizing the layers of resources already present in any community. According to ABCD, no plan, solution or organization from outside community can duplicate what is already there. Although some resources from outside the community are needed, the key lasting solutions comes from within. The gifts and skills of residents and assets of the physical community are always the starting point.

iii. *Water, Sanitation and Hygiene (WASH) for Schools and Communities*

WASH in schools' programming focuses on improvement of water and sanitation access; point-of-use water treatment technologies; and behavior change and hygiene promotion (Pamela, 2010). It also does assessment of WASH facilities, formation of school WASH committees, and training of students, teachers and community on operation and maintenance of WASH facilities. WASH in schools has boosted school attendance and achievement, and has promoted personal hygiene and environmental sanitation in schools and communities and at the same time reduced the burden of diarrheal diseases.

Keeping hands clean is one of the best ways to keep from getting sick and spreading illnesses (Anne, 2011; CDC, 2013). Practicing good hand hygiene gets rid of bacteria and viruses from contact with other people or surfaces. Schools play a key role in supporting hand hygiene. This involves teaching good hand hygiene practices, and providing the hand soap and paper towels necessary to reduce the spread of infectious diseases in the school. Hand washing hygiene practices was evaluated in this study. A study in Korea directly observed hand washing practices and found that only 63.4% of observed subjects truly washed their hands after using the toilet, despite the fact that 94% of subjects claimed to mostly or always wash hands after using public toilets/rest rooms (Jeong, Choi, Jeong et al., 2007)

In May 2002 more than 700 Ontario residents contracted Shigellosis and suffered through Victoria Day long weekend with fever, abdominal cramps and watery diarrhea (CMAJ, 2002). By current accounts, the source was most likely a commercially prepared pasta salad made in Toronto and distributed throughout the province. In 2001, about 860 cases of Shigellosis were reported in Canada. Ontario's 700 cases in 2002 might secure Shigellosis position as the third most common cause of bacterial food borne infections in North America after Salmonella and Campylobacter. Transmission of Shigellosis infection is by the fecal-oral route. The importance of hand washing with soap, and strict hygiene for food preparation particularly after activities such as bowel movements, changing diapers and anal sexual contact, cannot be overemphasized (Anne, 2011).

Availability of water, soap and hand towels at the hand washing area may not be indicators of good hygiene practices but are wealth indicators. Literature available does not record evaluation of food handling and storage in the school kiosks, adjacent markets, and the school kitchen; and hand washing procedure by the food handlers as practices in public health intervention.

iv. *Health Screening Programs for Students*

Health screening is a health examination procedure done to determine the possible presence of disease or other health problem (AHA, 2011). It is conducted routinely by doctors, insurers and researchers when there is a reason to suspect a particular health problem exists, and what follows, then, are common recommendations for information specific to their needs.

After non-invasive screening for Chlamydia and Gonorrhea became available in the early 1990s, the first population based high school screening program was launched in New Orleans in 1995 (Cohen et al., , 1998). There was a great deal of experiment about the potential of the method to eliminate a large reservoir of asymptomic infections. The access to high rise of adolescents was unparallel.

Many other American researchers followed suit, instituting their own school based screening programs in partnership with schools in Chicago, San Francisco, Baltimore, Philadelphia, Los Angeles, New York City and Miami. Initially in New Orleans, there was a suggestion that the repeated screening was having an impact on overall prevalence of diseases, but as time went on, it was clear that the early promise was not fulfilled. Adolescents were not fully compliant with the testing. In spite of expansion to 13 high schools in the city and participation rates at each screening reaching 35%-65% of all enrolled, high rates of infection, especially among high school girls persisted (Nsunami & Cohen, 2000).

Initially, the failure to show a decline in New Orleans was attributed to the inability to screen enough students in enough schools, so efforts to obtain more funding for an expansion were undertaken. In 2002, the city of Philadelphia developed a comprehensive program offering mass screening in every high school in the city. Yet, after 5 years and 85000 tests, Chlamydia and gonorrhea prevalence rates appear to remain steady (Anschuetz et al., 2008).

Failure to reduce prevalence could be explained by a variety of reasons: incomplete assessment of the population, high mobility, sexual contacts between high school students and others not enrolled in schools, inability to reach core group members, inadequate adoption of partner delivered therapy and insufficient frequency of screening, in light of high rates of re-infection, which typically occurs within a few months of the initial infection (Gaydos et al., 2008).If repeated screenings and treatment of infected individuals are not making a difference in the prevalence of Chlamydia and gonorrhea overtime, should such screening continue? This question has been answered with multiple cost-effectiveness studies.

A meta-physics analysis of these studies indicates that such screening is cost-effective when prevalence of Chlamydia is in the range of 3-10% (Fisman et al., 2008). Still, there is a pressing need to develop new population based approaches that may be more successful in reducing STD, over the long term, rather than merely offering never ending screening, and treatment services. Neither sex education nor abstinence-only education appears to have had any appreciable impact on sexual behavior and subsequent STD risk (Trenholmet al., 2008).

Despite periodical medical screening of students, there were still high rates of infection. It is however important to realize that screening alone cannot impact on rates of infection, as it indicates the trend of infection. Results of screening should be intended for management and control of infections. This study carried out medical examinations on students who self-reported illness which were not clinically confirmed.

This was done so as to reach the core group in the student population. Results can be used to inform policy makers on which way to go in terms of intervention programs and also to adequately budget for resources.

In 2007, WHO and UNICEF initiated a Global Action Plan for Pneumonia (GAPP) to increase awareness of pneumonia as a major killer of children and to develop a unified and equitable approach towards pneumonia control (Greenwood et al., 2007). In order to increase child survival, countries should focus on four areas that offer the best prospects for pneumonia control, namely vaccines, case management, nutrition and environment (Greenwood, 2008). Environmental interventions, such as improvement of indoor air quality through cleaner fuels and better stoves, may prevent pneumonia and should be encouraged (WHO & UNICEF, 2009). In addition, prevention and management of HIV infection is also perceived as a major area that needs to be addressed to prevent pneumonia.

The foregoing literature has outlined gaps in methodological approaches in research done to show decline in prevalence rates of communicable diseases. This study addressed sampling gaps by executing statistical sampling procedures and examined causes of variability which were not assessed.

*k) Impact of Economic Crisis on Communicable Disease Transmission and Control*

The economic downturn of the past decade is the result of a financial crisis whose scale is unprecedented in the post war period. With its proximal origins in overly complex credit instruments (Wade, 2009), the crises initially led to a tightening of private sector credit, and ultimately the collapse of several financial institutions, sharp increases in public sector debt and decline in global trade, markedly lower and in some cases negative GDP growth, and rising unemployment in many industrialized countries (OECD, 2009).

Although the early signs suggest that a fragile recovery is underway (Pandoan, 2010), it is clear that recent economic damage, principally inflicted during 2008-2009, has led to a severe economic hardship for many governments and citizens across the world. The effects of the financial crisis will almost certainly linger beyond any economic recovery. Inevitably, therefore, concerns have been raised that control of communicable diseases could have been and will continue to be adversely affected by budgetary constraints as well as the social effects of recession (Marmot& Bell, 2009; Stucker et al., 2010).

For example, some countries have cut budgets for infectious disease control, risking disruption of treatment and/or the exacerbation of drug-resistance (WHO, 2007). Pharmaceutical companies report declines in sales of prescription drugs, especially in countries with high reliance on out-of-pocket spending. Workers have been reluctant to take sick days, fearing unemployment while increasing the risk of communicable disease transmission at work (Barmby & Larguem, 2009).

Marked rises in communicable disease incidence during previous economic crises and downturns raise concerns about the current situation. During the 1990s, countries of the former Soviet Union and Eastern Europe experienced a devastating economic crisis, as GDP fell by one-third on average. Concurrently, the incidence, prevalence and mortality of tuberculosis rose markedly, and worsening treatment led to the emergence of drug-resistant strains (Shilova & Dye, 2000).

HIV also increased from relatively low pre-crisis levels; outbreaks of diphtheria (Markina et al., 2000) and tick-borne encephalitis and leptospirosis (Stoilova & Popivanova, 1999) also occurred. These effects outlasted the immediate crisis period; today, some countries from Central and Eastern Europe and former Soviet Union have not been able to achieve Millennium Development Goal (MDG) number 6, "to halt or reverse the spread of TB and HIV" (WHO, 2008).

Even in the absence of economic crisis or downturn, communicable diseases disproportionately affect vulnerable groups. In a review of the European literature, this effect could be found in every single EU Member State (Semenza &Giesecke, 2008). A separate study comparing wealth distribution and TB rates across EU Member States demonstrated a strong correlation between income equality and lower TB rates (Suk et al., 2009). Thus, health inequalities, whose importance has been thoroughly documented by WHO Commission on Social Determinants of Health (CSDH, 2008), may be as relevant for communicable diseases as they are for non-communicable diseases. The study found out that environmental changes in vector habitats may occur due to economic downturn, which could increase contact rates between humans and disease vectors.

In an analysis of cost-effectiveness of HIV interventions, mass media campaigns were found to be the most cost effective for a general population, because of the large reach and the low cost per person served (Cohen et al., 2004). Mass media was effective in the STOP AIDS campaign launched in Switzerland (Dubois-Arber et al., 1997), and is believed to be responsible in part for the decline in HIV in Uganda, mediated by decreasing numbers of sex partners and increases in condom use (Kirby, 2008).

Mass media campaigns are now being used for STD and other infectious diseases in many countries and in the USA, albeit sponsored by commercial interests; marketing of Human Papillomavirus (HPV) vaccine has resulted in at least 25% uptake by teenage girls in just a 1-year period (CDC, 2010). Mass media in America is currently dominated by messages that

encourage people to be impulsive (Chandra et al., 2008). Studies have shown that people are responsive to negative media messages than positive ones (Dijksterhuis et al., 2004) and are influenced by media, even when they are not aware of it (Law & Braun, 2000). The economic impact on school infrastructure has not been documented. These include public health intervention programs as bed spacing in hostels, desk spacing in classrooms and provision of other related amenities by school management. These are proxy indicators on economic impact on prevalence rate of communicable diseases in secondary schools.

*l) Communicable disease burden in Africa*

Communicable disease is one of the major causes of illness in Africa (CDC, 2013). A major contributing factor to this burden of disease is inadequate access to safe water and sanitation infrastructure (Boschi-Pinto et al., 2008). Diarrhea, one of the communicable diseases, causes an estimated 1.87 million deaths per year, mostly in children less than 5 years of age in developing countries (GoK, 2004).

The African Region has, in general, the highest pneumonia and influenza burden of global child mortality. Although it comprises about 20 percent of the world's population of children aged less than 5 years (UN, 2006), it has about 45 percent of global under -5 deaths and 50 percent of worldwide deaths from pneumonia in this age group (UNICEF, 2013). By contrast, More than 90 percent of all deaths due to pneumonia in children aged less than 5 years take place in 40 countries. Even more striking is that according to the official estimates from WHO for the year 2000, two-thirds of all these deaths are concentrated in just 10 countries (WHO, 2007): Nigeria (204 000), the Democratic Republic of the Congo (126 000), Ethiopia (112 000) and Niger (46 000) among others.

On 12th May 2006, the Ministry of Health of Djibouti confirmed her (and the sub regions) first human case of H5N1 avian influenza virus (WHO, 2007). The patient, a two-year old girl from a small rural village in Arta District, developed symptoms on 23rd April. Vanessa and Walkty in their studies recognized the important role school aged children play in the epidemiology of influenza (Vanessa et al., 2011; Walkty et al., 2011). A study conducted on perception of Health Care Workers (HCW) found out that HCW perceived surfaces as safer to touch than patient skin, in spite of a research that has proven that touching one contaminated surface can spread bacteria to up to the next seven surfaces touched (Anne, 2011). Prevalence of intestinal parasite infections may be attributed to poor environmental conditions and personal hygiene, and inadequate supply of drinking water, and waste disposal system which does not correspond to approved standards (Fatma & Ibrahim, 2011).

The mode of infection is by contact between the susceptible individual and the infected environment. Secondary students, especially day scholars, interact with the under- 5 year olds (who are a high risk group) at home and also with fellow students at school. It is therefore of significance to find out the contribution of this interaction to pneumonia and other communicable disease prevalence rates in schools. This study tried to answer this question.

The African continent is said to hold the vast majority of the world's HIV infected population. It is estimated that in 2007, of the 33.0 million people living with HIV/AIDS, 22.0 million of them lived in sub-Saharan Africa (UNAIDS, 2008). Young people (under 25 years old) account for half of all new infections worldwide.

In sub-Saharan Africa the most common mode of transmission of HIV is through heterosexual intercourse. The risk of infection increases with the number of sexual partners. High rates of partner exchange, the practice of certain types of sexual intercourse and the presence of anal or genital lesions combine to increase the risk of HIV infection (Akol, 2000). Having sex under the influence of alcohol is dangerous because alcohol impairs judgment. In Uganda, there are more male than female counterparts who have sex when drunk. There is need to ensure that youth are sensitized on the dangers of getting drunk (UBOS &Macro International, 2006).

Condom and vaginal microbicide gel use among young people plays an important role in the prevention of transmission of HIV and other sexually transmitted infections, as well as unwanted pregnancies. Although the use of condoms can reduce the risk of sexually transmitted diseases and unwanted pregnancies, most sexually active youths in sub-Saharan Africa do not consistently use condoms because they are expensive for them or they do not know where to get them among other reasons (Eaton & Araoye, 2008). This study by Eaton & Araoye implicates socio-cultural and religious factors as a hindrance towards negotiating safer sex. Knowledge about HIV transmission and ways to prevent it are less useful if people feel powerless to negotiate safer sex with their partners.

Despite the fact that HIV/AIDS epidemic is increasingly affecting almost all development sectors, it is widely asserted that the basic education sector in sub-Saharan Africa has been progressively affected (Bernnett & Whiteside, 2002; Carr-Hill et al., 2002; ILO, 2004a; UNICEF, 2000; Wobst & Arndt, 2004). Indeed the impact of HIV/AIDS on the basic education sector has serious implications for the effectiveness and efficiency of the sector. The number of school days lost due to illnesses by both students and teachers keeps increasing. Surveys in sub-Saharan Africa continue to indicate that young people between 15-24 years harbor serious misconceptions about HIV and how it is

transmitted (Cohall et al., 2001). Even though it is now common knowledge that the HIV agent cannot be transmitted through mosquito bites, many people still believe that mosquitoes are a good vehicle for HIV transmission. Both the survey and knowledge gap among the youth places secondary students in a high risk group of HIV infection.

Diarrhea remains a major cause of illness related to unsanitary conditions, especially among children in developing countries (Zianghao et al., 1999). Assessment of the situation in Africa exhibits a huge problem. By 2000, Africa had the lowest water supply coverage of any region, with only 62% of the total 800 million people living in Africa having access to improved water supply; the situation being very worse in the rural areas with only 47% compared to 85% in the urban having access to water supply; again sanitation coverage was at 60%, varying from 84% in the urban areas to 45% in the rural areas, and further assessment in the sub-Saharan Africa shows that only 39% and 34% have access to safe water and sanitation respectively (WHO, 2000).

The picture of poor water supply and sanitation coverage as observed above can only be understood by horrifying burden of diseases directly linked to unsanitary conditions. For example, in Malawi alone, in 2000 about 33 000 cases of cholera were reported in the country which resulted in about 1000 deaths; and diarrhea prevalence was 28% in the population while in children under-five, it is estimated at 18% qualifying it as one of the major causes of morbidity and mortality among the children (GoM, 2000).

In rural and peri-urban areas of most developing countries, the use of sewage water for irrigation is a common practice. As waste water is often the only source of water for irrigation in these areas, eating fruits and vegetables that have been irrigated with contaminated water and eaten raw is one way that E. colicanbe ingested. E. coli can also be found in raw milk from cows or other milk producing animals that carry the bacteria on unclean udder, and can also be found in fresh meat (Vernozy-Rozand et al., 2002).

The findings that deaths from malaria and its prevalence is highest in the African Region suggests that malaria is associated with poverty, which is consistent with the results of numerous other studies that have found socio-economic development to be more important than climate/weather in determining malaria prevalence and mortality (Tol & Dowlatabadi, 2001; Bosello et al., 2006; Beguin et al., 2011). In other words, it is more important to pursue sustainable economic development rather than reductions in climate change. Since reduction in cases and deaths from malaria are a result of human intervention, this indicates that its incidence and deaths are more sensitive to human actions than to changes in climate/weather therefore need to intensify malaria prevention intervention programs.

Recent resurgence of malaria in the East African highlands involves multiple factors ranging from climate and land use change to drug resistance, variable disease control efforts, and other socio-demographic factors (Hay et al., 2002). But malaria is extremely climate sensitive tropical disease, making the assessment of potential change in risk due to past and projected warming trends one of the most important climate change/health questions to resolve. Zhou et al., (2004) provide new insights towards answering this malaria/climate question.

Relationship between temperature and malaria parasite development time inside the mosquito (extrinsic incubation period, EIP) shortens at higher temperatures (Jonathan & Oslon, 2006), so mosquitoes become infectious sooner. Minimum temperature for positive development of Plasmodium falciparum and Plasmodium vivax approximates 180C and 150C, respectively, limiting the spread of malaria at higher altitudes. There is also a relationship between increasing altitude and decreasing mosquito abundance in African highlands.

Projecting into the future, (GoZ, 2006) have compared climate suitability maps for malaria in the topographically diverse country of Zambia and found that the projected warming from global climate models would make the country's entire highland area climatologically more favorable to support malaria by year 2050. Kisumu County is malaria endemic which made its choice more significant in this study.

Large epidemics of malaria elsewhere have been associated with climate and temperature anomalies such as in Uganda (Lubangaet al, 1997). Changing landscapes can significantly affect local weather more acutely than long term climate change. Land cover change can influence microclimatic conditions, including temperature evapo-transpiration, and surface runoff (Peter et al., 2010) all key to determining mosquito abundance and survivorship. Open, treeless habitats experience warmer midday temperatures than forested habitats and also affect indoor hut temperatures.

As a result, the gonotrophic cycle of female Anopheles gambiae was found by Peter et al. (2010) to be shortened by 2.6 days (52%) and 2.9 days (21%) during day and raining seasons, respectively, compared with forested sites. Similar findings have been documented in Uganda where higher temperatures have been measured in communities bordering cultivated fields compared with those adjacent to natural wetlands, and the number of anopheles gambiaeS.l per house increased along with minimum temperatures after adjustment for potential confounding variables (Einterz & Bates, 1997).

As expected, the prevalence of P.falciparum in African school age children varies widely from area to area, even within the same country, depending on the level of transmission. For example, in Uganda 14- 64% of school age children were parasitaemic at any one time, with parasite rate depending upon transmission setting and season (Nankabirwa et al., 2010; Pullan et al., 2010; Nankabirwa et al., 2014; Kabatereine et al., 2011). In Senegal, The Gambia, and Mauritania, the prevalence of infection in school age children ranged from 5 to 50% (Daiet al., 2008; Oduro et al., 2013) with prevalence rates showing marked seasonal variation.

Survey conducted in school age children in the south west province of Cameroon (Nkuo Akenji et al., 2002; Kimbi et al., 2013) found parasite rates in school age children of about 50%, with a lower rate among those living higher up Mount Cameroon. A 2009 analysis of household surveys, undertaken between 2005 and 2009 in 18 African countries, found that school aged children were the group least likely to sleep under an ITN the previous night, with between 35% and 42% of school aged children being unprotected (Noor et al., 2009). Similar low usage rates have been observed among school children in Cameroon (Tchinda et al., 2012), Uganda (Pullan et al., 2010; Nankabirwa et al., 2013).

There are rice irrigation schemes, sugar belt and large wetlands due to the large water mass in Kisumu County. These provide suitable breeding conditions for female Anopheles mosquitoes.

Tuberculosis was declared an emergency in Africa in 2005 (WHO, 2005). In 2009, there were an estimated 9.4 million incident cases of TB, most of which were in Africa. For example, the incidence rates of all forms of TB in South Africa is over 900 cases per 100 000 residents. Especially in sub-Saharan Africa, the TB epidemic has been driven by the HIV epidemic (Lalloo & Pillay, 2008).

The need to curb the epidemic was followed by the development and global implementation of World Health Organization (WHO) of a TB control program-Directly Observed Therapy (Short Course) (DOTS)- now referred to as internationally recommended strategy for the control of TB (WHO, 1994). South Africa, one country in Africa with highest burden of TB, had an estimated incidence of 218 new smear-positive tuberculosis cases per 100 000 in 2003. The country was ranked eighth in the world for total number of TB cases per country and tenth for incidence rates per population (WHO, 2005).

There is very little documented literature on the burden of communicable diseases among secondary school students in Africa. This study has filled this gap by determining prevalence of communicable diseases and causes of variability among students in secondary schools in Kisumu County, Kenya.

*m) Communicable disease intervention programs for schools in sub-Saharan Africa*

Until recently, malaria transmission in most malaria endemic areas of sub-Saharan Africa was moderate or high and control measures subsequently focused on the protection of young children and pregnant women. However, enhanced control efforts have recently reduced the level of malaria transmission in many parts of the sub-Saharan Africa (O'Meara et al., 2010; Noor et al., 2014).

Some countries in sub-Saharan Africa have implemented best practices in communicable disease control measures. For example, in Kwazulu-Natal, school nurses are involved with immunization and check-ups, and community health projects in addition to their roles and the Natal Provincial Administration (NPA) teams are giving treatment for minor ailments at schools (Taylor et al., 1997).

School health education is an important aspect of school health service. Current approaches to school health service include the Health Promoting Networks as launched in the Western Cape (Taylor et al., 1997), and the Global School Health Initiative of the World Health Organization (WHO). In an assessment of health needs for health promoting Ashram schools in rural Wardha, Dongre et al. (2011) conducted a cross sectional survey in 10 Ashram schools using qualitative (SWOT analysis, Transect walks and semi-structured interviews for teachers) and quantitative (survey) methods.

Hemoglobin examination of all children was done using WHO hemoglobin color scales. Anthropogenic measurements such as height and weight of each child were obtained and quantitative data was entered and analyzed using Epi_info (version 6.04e) software package. Some of the results were that 86, 75 and 110 out of 1287 children examined had scabies, fungal infection and multiple boils on their skins respectively, and 66 had worm infestation. About 398 (94.3%) boys and 342 (97.2%) girls did not know the modes of transmission of HIV/AIDS. It is notable that there was a high prevalence of communicable diseases in Ashram school environment.

In a study by Mohiabi et al., (2010) to identify and describe the barriers that may hamper successful implementation of the school health services at all levels of governance and to recommend strategies to overcome such barriers in the Mpumalanga and Gauteng Provinces of South Africa, a qualitative, explorative and descriptive study designs were used. The data collection of choice was focus group discussion which was conducted with all stakeholders in school health programs. The findings were barriers related to governance, for example lack of national policy guidelines for school health services and failure of government to prioritize school health services; program related issues, such as lack of intersectoral collaboration and unrealistic nurse-learner ratios; management

related issues, such as lack of support by management and managers' limited knowledge on the Health-promoting schools initiative; and community related issues as health professionals not including the community in school health programs.

Avinash Puri et al. (2008), in their study on solid waste management and its impact on health, evaluated solid waste management practices in order to find out its link with occurrence of vector-borne disease. It found out that most schools have limited storage spaces. The waste is mostly of biodegradable nature, in other schools open dumping of the garbage was noticed, which caused health hazards as well as fly nuisance.

Hygiene is the practice of keeping oneself, one's living and working environment clean in order to prevent illness and disease (CDC, 2009). Hand washing is an act of cleaning the hands with water or another liquid with or without soap or other detergents for sanitary purpose of removing soil and /or micro-organisms. Good hand washing involves the vigorous, brief rubbing together of all surfaces of lathered hands, followed by rising under a stream of water. Hand washing suspends micro-organisms and mechanically removes them by rinsing with water. Therefore, the fundamental principle of hand washing is removal not killing.

Lack of or ineffective hand washing can provide good route for disease transmission. These include diseases ranging from self-limiting infections like diarrhea (Rotaviruses); to potentially life threatening diseases like poliomyelitis and hepatitis A virus infection. Hygienic measures, including hand washing with soap before meals and after use of toilets, have been found to prevent hepatitis A virus infection (WHO, 2012). Hand washing, if regularly and properly practiced by students will go a long way in reducing prevalence of communicable diseases, hospital admission due to these diseases (loss of learning time), thereby making them grow well and healthy. In Nigeria, diarrhea prevalence rate is 18.8%; is one of the worst in sub-Saharan Africa and above the average of 16% (Limlim, 2008; Asekun-Olorinmoye et al., 2014).

Little information has been documented on burden of communicable diseases among students in secondary schools. The causes of variability in their prevalence are also lacking. These gaps have been addressed by this study.

*n) Communicable disease burden in Kenya*

Communicable diseases still dominate the morbidity profile in Kenya. Majority of Kenyans continue to seek treatment in health care facilities for ailments that can be controlled through preventive and promotive measures (WHO, 2007). Currently, the health expenditure in rural areas account for 30 percent of the government's spending on health services. The burden of communicable diseases is high, with malaria as the leading cause of morbidity (30%) (WHO, 2005) followed by respiratory diseases (24.5%).Malaria prevalence is 14% and HIV prevalence is 7.4%, the rate being higher in women (8.5%) compared to men (5.6%).

Tuberculosis (TB) control has been more challenging, with high TB prevalence of 319 per 100 000, TB/HIV co-infection prevalence of 53% and a growing threat of MDR/XDR-TB (WHO, 2008). Recently, positive gains are emerging in malaria and HIV control, owing to availability of resources and improved coordination for scale up of targeted interventions, and these need to be intensified to reach universal targets. Persistent poverty and low water and sanitation coverage have contributed to sanitation related illnesses like cholera (GoK, 2005).

In Kenya, student population has increased since the introduction of free schooling (GoK, 2012). In public secondary schools, the number has risen from 1.1 million students in 2008 to 1.85 million in 2012. These high enrollment figures underline the need for "health promoting schools" (Musembi, 2010; Mathooka, 2009; WHO, 2007). It offers opportunities for and requires commitment to the provision of a safe and health-enhancing social and physical environment" (Mead et al., 1999).

In addition to the convention on Rights of the Child, which Kenya is a signatory; the constitution of Kenya (GoK, 2010) establishes rights that have a direct bearing on health promotion in schools, such as the following: Section 34(5) No child shall be denied admission to a public school; and Section 38(1) No person shall employ a child of compulsory school going age in any labor or occupation that prevents such a child from attending school. In Children Act 2011 (GoK, 2011), Section 9 states "Every child shall have a right to health and medical care the provision of which shall be the responsibility of the parent and the government."

However, joint assessment of Kenya's Health Sector Strategic Plan (KHSSP) in November 2012 identifies gaps based on the outcome of the implementation of the second National Health Sector Strategic Plan (NHSSP II), a predecessor to KHSSP 2012-2017. The assessment brings out the fact that the future looking sections of NHSSP II did not systematically capture the "strategic shifts" that KHSSP will do "differently" to improve performance. While the strategy is very articulate on "what" needs to be achieved in the coming five years, it is inadequate in elaborating "how" strategic directions, imperatives and targets will be achieved (GoK, 2012).

Several overarching policy priorities, such as Rights-based approach, community health, and people – Centre systems are not well captured. Strategies and interventions to work with other ministries have not been spelled out. There is 'disconnect' between the situational analyses, the policy objectives and priorities of the KHSSP. School Health Service and its role as a strategy

and an intervention tool, which could be a flagship program is not mentioned (GoK, 2012).

Since January 1999, pediatric malaria admissions have significantly declined at all hospitals in Kenyan coastal region. This trend was observed against a background of rising or constant non-malaria admissions and unaffected by long term rainfall throughout the surveillance period. By March 2007, the estimated proportional decline in malaria cases was 63% in Kilifi, 53% in Kwale, and 28% in Malindi. Time-series models strongly suggest that the observed decline in malaria admissions was a result of malaria-specific control efforts in the hospital catchment areas. Severe anemia (exacerbated by malaria) is often the attributable cause of death in areas with intense malaria transmission (Adan, 2010).

Increased canopy in western Kenya is negatively associated with the presence of Anopheles gambiae complex and Anopheles in natural aquatic habitats (Hay et al., 2002). In artificial pools, survivorship of Anopheles gambiae larvae, in sunlit open areas was 50 times the survivorship in forested areas and also related to assemblages of predatory species (Beguinet al., 2011). In short, deforestation and cultivation of natural swamps in the Kenyan highlands create conditions favorable for the survival of Anopheles gambiae larvae, making analysis of land use change on local climate, habitat, and biodiversity central to malaria risk assessment.

There is strong evidence that malaria is an important cause of school absenteeism. A study in Kenya found that malaria caused a loss of 11% and 4.3% of the school year for the primary and secondary school students respectively (Leighton & Foster, 1993). Another study, undertaken in the highlands of Kenya, estimated that during a malaria endemic, malaria related absenteeism in primary school pupils varied between 17% and 34%. The estimated annual loss of school days in Kenya due to malaria in 2000 was between 4 and 10 million days (Brooker et al., 2000). A country wide survey conducted in 480 Kenyan schools between September 2008 and March 2010 found an overall prevalence of malaria parasitaemia of 4%, but this ranged from 0 to 71% between schools (Gitonga et al., 2010, 2012). There is very little information on the prevalence of other communicable diseases between schools.

There is strong evidence that, at the individual level, regular use of an insecticide treated net (ITN) or long lasting insecticide treated nets (LLIN) substantially lowers the risk of malaria (Lengeler, 2004; Lim et al., 2011) and that additional indirect “hard” effect is achieved when a high level ITN coverage is obtained. Thus, most LLIN distribution programs now aim at achieving universal coverage. Low usage rates have been observed among school-age children in Kenya (Atieliet al., 2011). In western Kenya, where malaria transmission is perennial and high, a community based trial of permethrin-treated mosquito nets showed that the use of ITNs halved the presence of mild anemia in adolescent school girls aged 12 to 13 years but was less effective in preventing anemia among school girls aged 6 to 10 years (Leenstra et al., 2003).

In Kenya, the expansion of coverage of both insecticide treated nets (ITN) and effective artemether-lumefanthrine (AL) therapy has occurred. Between 2004 and 2005, ITN coverage among children aged <5 years rose from 7% to 24% and by the end of 2006, had risen to 67% (Noor et al., 2007). Despite delays in implementing the revised drug policy supporting the use of artemether-lumefanthrine (AL) (Amin et al., 2007), over 85% of rural clinics had AL in stock between August and December 2006. Larval control may be effective in urban areas and few other epidemiological situations in Africa, such as the Kenyan highlands (Fillinger & Lindsay, 2011), but it is generally not cost effective approach to malaria control in rural areas of sub-Saharan Africa.

Apart from determining malaria prevalence rates in schools, this study also evaluated Insecticide Treated Nets (ITNs) use coverage in schools as a measure of good public health practices towards minimizing malaria infection. It also evaluated school environment as a habitat for mosquito breeding. Other intervention programs that were evaluated include personal protection measures (protective clothing, repellents) or community protective measures (use of insecticides).

School safety was identified as one of the many factors that promote learning in schools hence the development of Safety Standards Manual for Schools in Kenya (GoK., 2008). Public health safety of the learner is central to the provision of quality education in any country. While this is true for all learners at all levels of education, it is particularly crucial for learners in schools in view of their level of interaction. Ministry of Education, Kenya (2008) report that children in schools are vulnerable to public health threats due to inappropriate school facilities and infrastructure. These may include poorly constructed classrooms and hostels, insufficient and broken down toilet facilities, gender insensitive location of toilet and bathroom facilities, poor solid and liquid waste management and inadequate clean safe water provision. Such threats need to be addressed through carefully thought out measures and strategies to minimize incidences of communicable diseases.

Safety in Physical infrastructure of schools should comply with the provisions of the Education Act (Cap 211), Public Health Act (Cap 242) and Ministry of Public Works building regulations/standards. These provisions stipulate the size of a classroom, in terms of length and width should be 7.5metres by 5.85metres or 7.5metres by 6.0metres to accommodate 40 learners. It further recommends that for dormitories, space between beds should be at least 1.2metres. The pit latrines should be at least 15metres from a borehole or well or

water point. Student-toilet ratio should be: the first 30 learners; 4 holes/closets; the next 270 learners: one extra hole/closet for every 30 learners; every additional learner over 270 learners: 1 hole/closet per 50 learners. Proper considerations should be given to staff sanitation, with at least one hole/closet for 12 persons. A study by Miguel and Kremer (2004) found out that infected children perform poorly in tests of cognitive functions, and that treatment reduced school absenteeism by one-forth.

The introduction of free schooling in Kenya as a means of meeting Millennium Development Goals (MDG) on education means that the role of school health services needs to be redefined due to increased enrollment in schools. Increased enrollment may be a predisposing factor to increased incidences of communicable diseases. This study tried to find out if tuberculosis (TB) prevalence rate in schools with large enrollment is statistically significant compared to schools with low enrollment. A focus on high school students is important because students spend a lot of their time at school, away from home. Transmission of infections in students can easily occur due to large concentration of students in school (CDC, 2007).

Most secondary students are in the age bracket 15-59 years which has been reported to be a TB high risk group (Ayesha, 2010) where most new infections occur. This study evaluated the public health interventions like ventilations in hostels and classrooms, and also desk and bed spacing in classrooms and hostels respectively. The analysis tried to find out if there is a significant association between hand washing and tuberculosis prevalent rates among others. This was necessitated by the fact that some people cover their mouth with their hands when they sneeze or cough. Other than evaluating health seeking behavior of students, tuberculosis index cases were subjected to in-depth interview to get an understanding of the disease burden in the school. This would contribute towards the transformation of the public health services in schools. There is little information on the prevalence of communicable diseases among students in Kenyan Secondary Schools. The documented literature is only on the prevalence of communicable diseases nationally. Secondary school students are a neglected sector of the population.

*o) Communicable disease burden in Kisumu County, Kenya*

Kisumu County suffers from high burden of communicable diseases as well as emerging threats. According to the Kenya Demographic and Health Survey, (GoK.,2009) the County has one of the highest HIV/AIDS prevalence rates at 17% higher than the Nyanza region rate of 15.3%, and national rate of 7.4%. Kisumu West District, one of the districts in the County, suffers from high levels of HIV/AIDS, Diarrhea, Malaria, Multi-Drug Resistant TB (MDR-TB), and other preventable diseases. More than half of the population relies on surface water as the main source of drinking water. Forty two percent (42%) of the households share toilets while 21% have no toilets (KWHDSS, 2011).

HIV prevalence rates have not changed significantly in Kisumu County. In 2006, official statistics showed that the prevalence rate was 11.1 percent (UN-HABITAT, 2006). In 2008, the prevalence rate remained roughly the same as in 2006, at 11.2 percent (GoK, 2010; UNDP, 2013). Women are infected at relatively younger ages than men and tend to have much higher HIV prevalence rates than men (KNBS, 2008). This study tried to find answers to the HIV prevalence rates among secondary students.

Studies such as Glynn et al (2001) indicate that behavioral factors do not fully explain the discrepancy in HIV prevalence between men and women. One possible explanation is that women intend to have older partners, but a more plausible cause for women having high HIV infection rates is that they have greater susceptibility to the virus (other risk factors for HIV/AIDS in women include the inability to negotiate safer sex and economic privation). Moreover, a 2007 randomized controlled trial of 2784 men aged 18-24 years suggests that men in Kisumu district (now Kisumu County) have lower HIV prevalent rates because male circumcision significantly reduces the risk of HIV acquisition in younger men (Baileyet al., 2007). To date, most interventions have focused on high risk groups such as commercial sex workers, single persons, married persons and infants. However, there is need to focus on secondary students as well because they are also in high risk age group (18-24 years).

Prevention is the most effective strategy against the spread of HIV/AIDS. Although condoms remain an effective method of HIV prevention, many women in Kisumu County do not have the negotiating power to make their husbands/partners use male condoms (Cohen et al., 2004). Voluntary Medical Male Circumcision (VMMC) is another important strategy against HIV infection. Unfortunately, this often leads to the misconception among young men that they can practice unsafe sex and will not contract HIV simply because they have been circumcised.

Tuberculosis infection rate in Kisumu was 32 percent in 2008 and the cure rate was 31.8 percent (GoK, 2008). Given that the WHO target for case detection is 70 percent, Kisumu County needs to do much more to reduce tuberculosis infection. A worrying trend is that many people with HIV also contract TB and vice versa (GoK & UNDP, 2010). Knowing prevalence rate of tuberculosis in schools will help in designing a better disease surveillance system for schools for prevention, early detection and treatment of the infected. Kisumu County is malaria endemic (AMREF, 2004) and also prone to floods and has sugar plantations, large

water mass and rice irrigation schemes. It has one of the highest HIV/AIDS prevalent rates in the country (GoK, 2010); while at the same time has Kisumu City, one of the fastest growing urban centers in Kenya. A motor highway connecting Kenya and Uganda also traverse it. It is for this reasons that the study focused attention to direct contact diseases (HIV/AIDS); airborne diseases (Tuberculosis, Pneumonia); diseases with environmental reservoirs like malaria, typhoid, and diarrhea among others. It is from this study that infections between environmental contexts and transmission cycle components were analyzed.

Improvements in Public health services are key to reversing upward trend in mortality and morbidity due to infectious diseases across all ages. These include safe water, and better sanitation. Education for girls and mothers (Oindo et al., 2009) will also save children's lives. In Oindo and others (2009) study which aimed at investigating the characteristics associated with households experiencing Under 5 Mortality in Nyanza region, a complete household census was used as data collection method in some of the sub-locations in six districts of the region. Frequencies and cross tabulations were performed to determine the dominant characteristics to describe the population. Kisumu and Nyando districts in Kisumu County were among the six districts investigated. The results were that use of Insecticide Treated Nets (ITNs) was lower among households with child deaths in Kisumu district.

Very little literature has been documented on the burden of communicable diseases among secondary students in Kisumu County. Kisumu County region is Malaria endemic, however, very little is known about prevalence of Malaria among its secondary student population.

*p) Methodological Approaches Relevant to Current Study*

Schools have become overcrowded, and as recorded, overcrowding results in outbreaks of communicable diseases including cholera, tuberculosis and typhoid fever among others. The big question is; are the intervention programs community friendly? Why are communities not realizing declines in prevalence rates of communicable diseases?

The process of identifying the source of an epidemic is retrospective in nature. In this study, by asking respondents to report if they have been ill in the last two weeks, the researcher modified retrospective research design to suit the current situation. The germ theory recognizes that all communicable diseases are not only caused by microorganisms, but also as a result of biological, socio-demographic and environmental issues. It is for this reason that this study collected data on socio-demographic (Appendix 1) and environmental issues that affect the health of students in schools (Appendix 4).

Anne McLaughlin (2011) in her study did not correlate touching one contaminated surface and spread of bacterial with the number of Community Health Workers (CHW) or number of elementary school children. This study correlated the variability in communicable disease prevalence rates among students within and between schools. Rate of contact with contaminated surface may be hypothesized to increase with congestion.

Hand washing programs among school children is one of the public health intervention programs that may have a lasting effect in reducing school absences (Miguel and Kremer, 2004); however, this study evaluated hand washing, solid and liquid waste management, use of ITNs and other intervention programs (Appendix 5) to prevent spread of communicable diseases in schools. The same gaps exist in the study carried out by Vanessa et al., (2011) and also in the study by Walkty et al., (2011).

The study by Fatma and Ibrahim (2011) on prevalence and predisposing factors regarding intestinal parasite infections among rural primary school pupils in Egypt performed clinical procedures on fecal samples and evaluated sanitary facilities and conditions of hygiene, as well as conditions of hygiene of pupils. Lester et al. (2008) in their study to describe a secondary school outbreak of tuberculosis, case and contact management was conducted by Mid Central District Health Board according to national guidelines. Students were asked to get informed consent for Monteux testing, and students and staff were screened at school clinics by medical professionals.

In this study, students who self-reported illnesses in the last two weeks (Appendix 1) at the time of data collection and had not been medically examined were taken for medical examination for pneumonia, diarrhea, malaria and tuberculosis. Urine, stools, blood and sputum formed samples for the laboratory tests which were performed at the health facilities in the neighborhood of the sampled schools. Rapid urine test to identify presence of bacteria that causes pneumonia; positive test for Clostridium difficile confirming diarrhea; blood smear testing positive confirming presence of malaria parasite; and a positive culture for Mycrobacterium tuberculosis confirming diagnosis of tuberculosis (ALA, 2013; Christina et al., 2013; Nicholas et al., 2014; Sterling et al., 2011) were the procedures carried on the samples. Students who self-reported clinically confirmed illnesses produced clinic/hospital cards to confirm that clinical procedures had been undertaken. This group of respondents became index cases in this study. Anin-depth interview (Appendix 3) was held with this group to explore more on their illnesses.

Dongre et al. (2011), in their study conducted a cross-sectional survey in schools using qualitative (SWOT analysis, Transect walks and semi-structured

interviews for teachers). In Mohiabi et al. (2010) study to identify and describe the barriers that may hamper successful implementation of school health services, data collection of choice was focus group discussion which was conducted with all stakeholders in school health programs. This study collected data on school health programs using focus group discussion (Appendix 2) with stakeholders; and performed a Transect Walk during environmental health survey using observation checklist for the schools sampled.

Government of Kenya, through MoE (2008), in their Safety Standards Manual for schools, defines school safety as "measures undertaken by the learners, staff, parents and other stakeholders to either minimize or eliminate risky conditions or threats that may cause accidents, bodily injury as well as emotional and psychological distress". The same manual lists threats to school safety as accidents, school violence and harassment, lack of adequate healthcare and nutrition, lack of sensitivity to sexual maturation challenges for boys and girls, armed conflicts and insecurity, and hostile school environment.

This study evaluated (Appendix 4) bed and desk spacing in hostels and classrooms respectively, and other public health intervention programs, as predisposing factors to communicable disease prevalence rates.There are no records to show incidences of common health risks in secondary schools and causes of their variability. This study determined communicable diseases prevalent rates and factors affecting their variability among students.

*q) Conceptual Framework*

This Conceptual Framework has been developed with the goal of showing how health outcomes (dependent variables) among students are affected by the state of the environment they are in (independent variables). The health outcomes are modified by the intervening variables that include resources and their control, public health intervention programs adopted, national health system of a country, and the school health services offered in every school. A summary is shown in Figure 2.1.

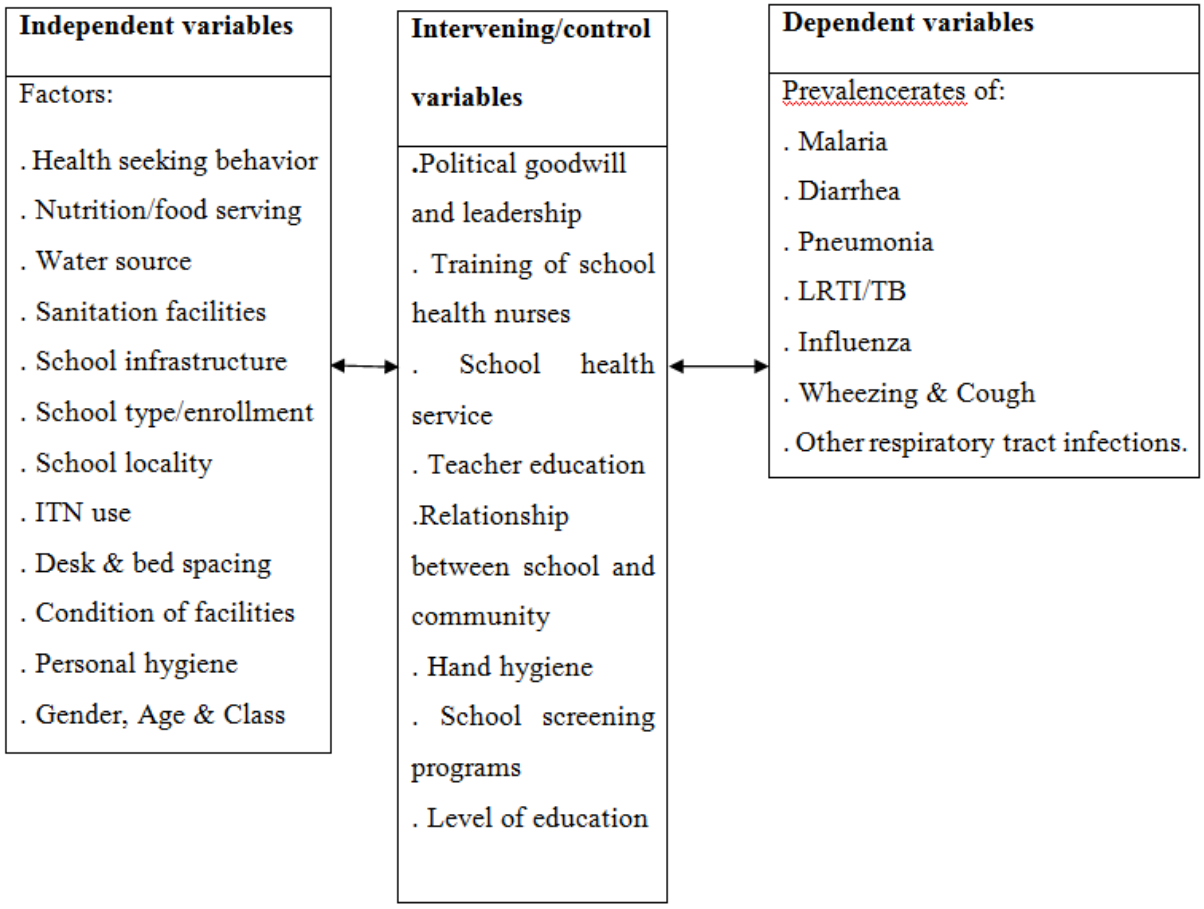


*Figure 2.1 :* Conceptual Framework on the link between independent, intervening and dependent variables

*("Source" Research, 2015)*

As students spend a significant proportion of time in school buildings and school grounds, it is vital that their environments are as safe as possible. To make or not to make the environment safe require a concerted

effort of those who own and control resources, policy makers and implementers, students, school managers and the community where the school is built.

The physical school environment has a strong influence on student's health for several reasons. First, the environment is one of the primary determinants of student's health: contaminated water supplies can result in diarrheal diseases; air pollution can worsen acute respiratory infections and trigger asthma attacks. Second, relative to their body weight, they breathe more air, consume more food and drink more water than adults. Their exposure to any contaminant in air, water, or food will therefore be higher than experienced by adults (Weiss & McMichael, 2004; Wilcox and Colwell; Parkes et al., 2003).

WHO defines a health promoting school as "one that constantly strengthens its capacity as a healthy setting for living, learning and working" To ensure that this is achieved, intervening variables like resources and their control, public health intervention programs must be controlled, among others. Their control is derived from the guiding principle of the socio ecological approach to health of the Ottawa Charter (1986) which encourages reciprocal maintenance; taking care of each other, our communities and our natural environment.

## Chapter Three

## III. Materials and Methods

*a) Introduction*

This chapter gives a detailed account of research area and study population. Research design, sampling strategy, data collection and data analysis procedures are tabulated in tables 3.1, 3.2, 3.3, and 3.4 respectively.

*b) Study Site*

Kisumu County is characterized by a rapidly growing population, high population density, water scarcity, falling food production, and low resilience to climate change (KNBS & UNICEF, 2013). The County was chosen because it is malaria endemic region with a very large area under agricultural irrigation. It is also adjacent to a large pool of water and wetlands.Schools adjacent to pools of water and wetlands are more susceptible to water related and water borne diseases (GoK, 2010).

Kisumu County experiences intermittent supply of clean and safe water (CGoK, 2013). Where the distribution of water systems functions intermittently, contaminated water may infiltrate into the pipelines. These facts indicate that many people in Kisumu County, students included, are at risk of contracting communicable diseases such as diarrhea, typhoid, intestinal parasite infections, trachoma, and schistosomiasis among others(AMREF, 2004). However, there are no records to show prevalence of communicable diseases in schools.

Kisumu County is located in Nyanza region and constitute sixconstituencies/sub - Counties and lies within 00003' latitude and 34045' longitude (Maps of world, 2012)(Figure 3.1).The population is 968 909 (Male 48.9%, Female 51.1%) with population density of 474.1 people per square kilometer against national figure of 65.3 per square kilometer, and age distribution of 0-14 years (43.5%), 15-64 (53.3%) and 65+ years (3.2%) (GoK, 2009).Figure 3.1 shows Map of Kisumu County in Kenya.

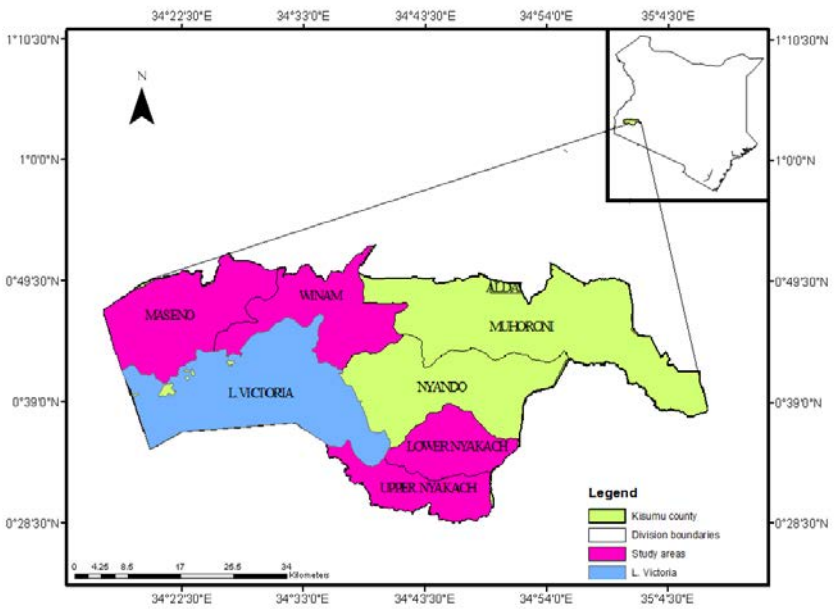


*Figure 3.1 :* Map of Kisumu County, Kenya. Source: Research (2015)

There are 187 secondary schools with an enrollment of 60 230 (31 902 males and 28 328 females) (GoK, 2013)

i. *Poverty Level*

The rate of poverty in Kisumu County is estimated at 45 percent with an average dependency ratio of 100:87. The number of people living in extreme poverty is 60 percent against the national poverty level of 45.9 percent (GoK, 2010). Accordingly, 47.8 percent of women are in employment, 49.8 percent males and 49.5 percent females live in absolute poverty where they earn a monthly salary below KES 1 562. The proportion of the population who are food poor stands at 61 percent (CGoK, 2013).

ii. *Socio-economic activities*

Kisumu County performs below the national average on most socio-economic indicators. The County scores a 0.49 on the Human Development Index (HDI)- a composite measure of development that combines indicators of life expectancy, education attainment and income (UN, 2013). This falls below the national average of 0.56. Poverty is prevalent and manifests itself in other socio-economic outcomes such as poor nutrition, health, and education, as well as lack of access to basic services. The majority of the population is employed in fishing and agricultural activities, with some limited opportunities in commercial ventures and public service within Kisumu City (GoK, 2010). The livelihoods of most County residents depend on fisheries and rain-fed small scale farming, practices that are highly vulnerable to environmental degradation and the effects of climate change (UNDP, 2010).

iii. *Network of Health Facilities*

*Table 3.1 :* Network of Health Facilities in Kisumu County, Kenya

| Type of Facility | Number of Facilities |
|---|---|
| Teaching and referral | 1 |
| Level 5 | 3 |
| Level 4 | 5 |
| Dispensaries | 53 |
| Health Centers | 6 |
| Other | 30 |

*Source: CGoK (2013)*

Infant Mortality Rate in the County was 95/1000while the Under 5 Mortality Rate was 149/1000. Prevalent diseases are Malaria, HIV/AIDS, Diarrheal diseases, Intestinal worms, Respiratory disorders.

*c) Study Population*

The study population were students in Secondary schools in Kisumu County; schools; sub - Counties; education zones; toilets; waste depots; water points; hostels/halls, kitchen facilities, sewage systems and management and other boarding facilities; classrooms; clinic/hospital cards; school nurse; boarding master/mistress/matron, and house masters/mistress of the schools. Others were School Principal, Board of Management/Parents Teachers Associations, and teachers, School Cateress, School Principal, Non-Governmental Organizations, and the Red Cross. Education Ministry's Quality Assurance and Standards Officers, Public Health Officers, Area Chief, School Kiosks and School Canteens.

Table 3.2 shows distribution of schools, staff and students in secondary schools in Kisumu County by sub - Counties and Zones.

The first three sub - Counties with the highest coefficient of variation were selected for the study. These were Nyakach, Kisumu East and Kisumu West. Coefficients of variation by gender and school type were used to determine sample sizes for students by gender and school sample size by type.

*Table 3.2 :* Distribution of zones, schools, student enrollment and coefficient Of variation by sub - Counties of Kisumu County in Kenya

| Sub - County | No. of Zones | No. of Secondary Schools | Student enrollment | Coefficient of variation by gender and type of school |
|---|---|---|---|---|
| Kisumu East | 8 | 48; Girls & Boys = 39, Boys only = 5, Girls only = 4 | Boys = 8558, Girls = 6792 | Gender School Type<br>G B G&B<br>14.21 2.139 2.679 20.85<br>11.27 |
| Kisumu West | 5 | 34; Girls & Boys = 28, Boys only = 3, Girls only = 3 | Boys = 6334, Girls = 5523 | 10.51 1.606 1.606 14.97<br>9.169 |
| Kisumu North | 3 | 19; Girls & Boys = 16, Boys only = 2, Girls only = 1 | Boys = 2737, Girls = 2151 | 4.544 1.069 0.537 8.557<br>3.571 |
| Nyando | 2 | 14; Girls & Boys = 10, Boys only = 2, Girls only = 2 | Boys = 3423, Girls = 2796 | 5.683 1.069 1.069 5.349<br>4.642 |
| Muhoroni | 5 | 25; Girls & boys = 20, Boys only = 5, Girls only = 0 | Boys = 3605, Girls = 3660 | 5.985 2.676 0.000 10.69<br>6.076 |
| Nyakach | 8 | 47; Girls & Boys = 38, Boys only = 6, Girls only = 3 | Boys = 7245, Girls = 7406 | 12.03 3.209 1.605 20.32<br>12.31 |
| **Total** | **31** | **Girls & boys = 151, Boys only = 14, Girls only = 22 Total = 187.** | **Boys = 31902, Girls = 28328 Total = 60230** | **52.962<br>47.038<br>100** |

*G= Girls' only schools, B= Boys only schools, G&B= mixed schools); last column entries derived by the researcher.*

*Source: GoK (2013)*

*d) Research Designs*

Table 3.3 is a summary of research design against measurable variables/variable indicator for each specific objective in this study.

*Table 3.3 :* Specific objectives against measurable variables/indicator and research design

| Specific Objective | Measurable variable/Variable indicator | Research Design |
|---|---|---|
| i) To determine prevalence rates of communicable disease infection among secondary students. | • Self-reported illness in the last two weeks: Malaria, diarrhea, STIs, Tuberculosis, Pneumonia, HIV/AIDS, Influenza, Typhoid fever, Wheezing and cough.<br>• Clinic card/Hospital card | Survey |
| ii) To determine the cause of variability in communicable disease prevalence rates among students within and between schools. | • Determined prevalence rates<br>• School type<br>• School size/enrollment<br>• School locality<br>• School infrastructure<br>• Gender<br>• Age<br>• Class<br>• School kiosks/canteens | Correlational |
| iii) To evaluate public health intervention programs for optimal use in secondary schools. | • Health seeking behavior<br>• Kitchen facilities<br>• Education Ministry quality assurance systems<br>• Water source, sewage system and management<br>• Solid/liquid waste management<br>• ITN use<br>• Mosquito breeding control<br>• WASH programs<br>• Bed & desk spacing<br>• Ventilation in hostels & classrooms<br>• Personal hygiene | Evaluation |

Survey research design was used in specific objective (i) to gather primary data for computing communicable disease prevalence rates (dependent variable) based on school type, enrollment and locality (independent variables). This data would be used in planning and policy development. It was also used to evaluate the effectiveness of a particular public health behavior intervention. It enabled the researcher to gain knowledge about behaviors and attitudes of students and other stakeholders.

Correlational research design wasused in specific objective (ii). This is because the researcher wanted to explore the extent to which two or more variables co-vary, that is where changes in one variable are reflected in changes in another (Creswell, 2008). The researcher collected at least two scores for each participant as each score represents each variable being studied. In this study, the two scores were from, for example, computed prevalence rates and age or gender or class level of the respondent.

The researcher adopted evaluation research design focusing on public health behavior change adherence among students and school staffto meet specific objective (iii). For example, the researcher evaluated whether schools adhere to bed spacing regulations as given out in the Ministry of Education guidelines; and also whether water, sanitation and hygiene interventions are adhered to as contained in the Ministry of Health guidelines. Some of the questions that answered included whether intervention is in place, is the intervention reaching the target population, challenges of implementation, and what appears to be working among others

*e) Sampling Strategy*

The six sub – Counties were selected purposively based on coefficient of variation by gender of students and type of school. Based on this, three sub - Counties (Nyakach, Kisumu East and Kisumu West) with the highest value of coefficient of variation were used for the study. The three sub – Counties have a student population of 41 858 (22 137 boys and 19 721 girls) (GoK, 2013).

Since the prevalence of communicable diseases among students in Kisumu County was unknown and population of secondary students was greater than 10 000, a representative cluster samples size was estimated using Fisher's *et al*. (2004) formula:

$$n = \frac{z^2 pq}{d^2} \quad \text{..... Equation 3.1}$$

Where n = sample size

z = standard deviant (1.96) at 95% confidence interval

p= known characteristic about target population

q = 1- p (probability of failure)

d= precision desired = 0.05.

Where prevalence is unknown and population is greater than 10 000, p = 0.5, q = 1- 0.5 = 0.5.

Then n = 384. However a sample size of 400wasselectedafter calculation to determine sample size from 60 230 student study population to increase representativeness and also to cater for any attrition (Bob, 2002).Students' sample size for each sub – Countywas based on coefficient of variation by gender of students. A total of 212 (Nyakach 70, Kisumu East 82 and Kisumu West 60) male students and 188 (Nyakach 71, Kisumu East 65 and Kisumu West 52) was selected for the sample.

Education zones in each of the three sub – Counties were selected by cluster sampling technique. The zones were clustered by number of students and type of school. Six zones (30% of 21 zones in the three sub – Counties)were then selected based on the highest coefficient of variation. Schools in each zone were arranged by type (Boys only, Girls only and Mixed (boys and girls) schools). Thirty percent of schools, 38out of the total 129 in the three sub – Counties were selected based on coefficient of variation by school type (30 Boys and Girls/Mixed schools, 5 Boys only schools and 3 Girls only schools).

For Boys and Girls/Mixed schools: 12 were selected from Nyakach, 12 from Kisumu East and 6 from Kisumu West; for Boys only schools: 2 were selected from Nyakach, 2 from Kisumu East and 1 from Kisumu West; for Girls only schools: 1 school was selected from each of the sub – Counties. Each school type in each zone was then arranged and selected based on the strength of coefficient of variability. Students were clustered and selected by cluster sampling.

The Key Informants which were sampled purposively included boarding masters/mistresses, senior teachers, Parents and Teachers Association (PTA) representatives, board of management, student leaders, and senior cook in- charge

Table 3.4 shown is a summary of sample size and sampling method of each study population unit.

*Table 3.4 :* Study population unit in Kisumu County against sampling method and sample size of study units in Kisumu County, Kenya

| Study population unit | Sampling Method | Sample Size |
|---|---|---|
| Sub - Counties | Cluster | 3 |
| Education Zones | Cluster | 6 |
| Schools | Cluster | 38: 30 mixed schools, 5 boys only schools and 3 girls only schools |
| Students | Cluster | 400: 212 boys and 188 girls |
| Facilities (hostels, toilets, water points, waste depots, sewage system and management, school kiosks and local markets adjacent to schools, dining halls/kitchen, ITNs | Purposive | 38 = number of schools |
| Key Informants (Boarding masters/mistress, House masters/Mistress, school nurses, Board of Governors, PTArepresentatives, NGOs, Kenya Red Cross, Education Ministry Quality Assurance and Standards Officers, Public Health Officers) | Purposive | 12 |
| Focus Group Discussion (FGD) | Quota | 8-12 for each sub-County |
| Observation | Purposive | 10 |

*f) Data Collection*

Masebo (2010) states that triangulation involves using multi-methods or more than one source of data in the research of social phenomena. In this study a number of data collection methods were used.

Table 3.5 is a summary of data management tool, sample size and sampling method against each population study unit.

*Table 3.5 :* Study population unit in Kisumu County against sampling method, sample size, data management tool and appendix

| Study population unit | Sampling method | Sample size | Data management tool | Appendix |
|---|---|---|---|---|
| Students | Cluster | 400 | Questionnaire, in-depth interview guide, medical examination, camera , voice recorder | I, III |
| Facilities (hostels toilets, water points, sewage system and management, solid waste depots, dining hall/kitchen, school kiosks/canteens and local markets adjacent to the school) | Purposive | 38 | Interview guide, camera, voice recorder | IV |
| Key Informants | Purposive | 12 | Questionnaire | II |
| Focus Group Discussion | Quota | 8-12 for each zone | FGD guide | II |
| Observation | Purposive | 10 | Observation Check List | V |

A questionnaire (Appendix I) was used to collect the survey data. Itwas administered to all respondents (students) randomly selected in each stratum. The questionnaire collected information on the characteristics of the respondents including gender, age, and class level. It was also used to collect information on dwelling units (hostels and classes) and other information on ownership and use of treated mosquito bed nets, state of respondents' health in the last two weeks at the time of data collection, bed spacing, personal hygiene, and source of drinking water.

Respondents self-reported in the questionnaire their morbiditystatus in the last two weeks and produced clinic/hospital cards to confirm the self-reported illnesses of communicable diseases. These formed the secondary data of communicable diseases in schools. Students who self-reported illnesses of communicable diseases which were not clinically confirmed were taken for medical examination at the health facilities nearest to the school. Stools, urine, sputum and blood samples were examined. The observed medical examination results of interest were blood slides testing positive for Malaria parasite; a positive culture for Mycrobacterium tuber culosisconfirming tuberculosisinfection; rapid urine test to identify presence of bacteria that cause pneumonia; and positive stool tests for Clostridium difficile confirming diarrhea. The results of medical examinations formed the primary data on communicable diseases in schools. All students who were found ill were booked for treated at health facilities nearest to their schools.

Focus Group Discussion guide (Appendix II)wasused to collect data which complemented the information collected through in-depth interviews with index cases. The purpose of conducting group discussion was to listen and gather information from different people. It helped to obtain a better understanding of how people feel issues, services or products. It enabled individuals to recall facts that other group members had forgotten. Focus group discussion was conducted with 8 – 12 quota sampled members to corroborate the data from the field. It involved identification of thematic categories and coding them by repeatedly reading the transcripts. The major themes were finally identified after all the categories were coded. In-depth interview (Appendix III) was conducted with Index Cases to create a direct interaction between the researcher and the respondents. Boyce and Neal (2006) defines in-depth interview as a qualitative technique that involves conducting a small number of respondents to explore their perspective on a particular idea, program or situation. In this study, an in-depth interview was conducted with Index Cases who identified themselves from the questionnaire (Appendix I). (Index Cases are defined as respondents who self-reported confirmed clinical cases of the respiratory system and other infectious diseases in the last two weeks at the time of data collection). This enabled the researcher to get their perspective, definitions of situations and construction of reality (Punch, 2005).

In-depth interview (Appendix III) was done on a one-on-one basis as to engage respondents who do not feel free to participate in a group discussion (Appendix II). By doing this the researcher got valuable insights on the thematic situations as perceived by the respondent. The researcher was aware of the challenges of data collection using in-depth interview method. The challenges included ambiguity resulting from qualitative analysis particularly for less experienced researchers. The researcher was involved in all data collection procedures. This was done to minimize possibility of bias. A voice recorder was used during the interview and later transcribed.

Data on the state of facilities used for communicable disease intervention was collected using interview guide (Appendix IV). Issues it addressed were on ambient (outdoor/indoor) air quality, provision of safe drinking water, pest management, water storage facilities and spill prevention, waste management

system, and food storage .More data on intervention programs were collected by an observation checklist (Appendix V).

*g) Validity and Reliability of data instruments*

Validity encompasses the entire experimental concept and establishes whether the results obtained meet all of the requirements of the scientific research method. For example, there must have been randomization of the sample groups and appropriate care and diligence shown in the allocation of controls. While the idea behind reliability is that any significant results must be more than a one-off finding and inherently repeatable (Martyn, 2008).

i. *Validity*

*Content Validity:* Content Validity addresses the match between test questions and the content or subject (Martyn, 2009). The questionnaire for students, Appendix I, covered demographic information, morbidity and health seeking behavior, sexual activity and dietary pattern among others. Focus Group Discussion guide, Appendix II, captured groups' perception on skills-based education, communicable disease surveillance system in the school, campaigns against sexually transmitted infections, school health policy, and sanitation and hygiene practices.

An in-depth interview guide for index cases (Appendix III) collected information on experiences of index cases before they became ill and how they were coping since the onset of their illness. This corroborated information in appendix II. Interview guide for boarding masters and mistresses (Appendix IV) was on environmental health of the school. Lastly, observation checklist for schools (Appendix V) was about the general health status of the school and public health intervention programs in place. This was done to corroborate the information collected in appendices I, II, III and IV. The items on the test represented the entire range of possible items the test should cover. The data collected will be subjected to statistical tests to determine level of significance of the results.

*Face Validity:* Face Validity is a simple form of validity in which researchers determine if the test seems to measure what it intends to measure. In this study, during data collection process, the researcher validated with the interviewees and focus group discussion members transcriptions of every interview and group discussion respectively, in order to seek clarification and gain understanding of the aspects that were unclear to the researcher. Data collection tools were validated by researchers' supervisors.

ii. *Reliability*

Data collection instruments were prepared under the guidance of researchers' supervisors and a test and re-test method of reliability for the instruments was done with respondents within Kisumu County. These were respondents who were not sampled for the research. After piloting, the respondents were debriefed to find out if there were confusing questions, and their understanding of each question. This gave an insight whether there was consistency in responses given by different groups.

To certify reliability of the instruments, a correlation coefficient was determined based on the responses given by different groups on same data collection tool. Data was qualified as reliable if correlation coefficient was> 65% (0.65). For example, the number of respondents sampled during piloting was65 and in one question 40 respondents understood it correctly, then the coefficient of variation in that question was40/(60 ) x100% = 66.7%. The question was reliable and taken for actual research.

*h) Ethical Considerations*

The researcher ensured that the study was conducted within the international standard procedures for medical examinations. As a result, the procedures (medical examination) were carried out in health facilities in the neighborhood of the schools and performed by medical professionals. Verbal consent from participants was obtained prior to the commencement of focus group discussion, in-depth interviews, use of questionnaire, school transect walk during environmental health observation, and medical examination. Permission to capture some of the research sessions on tape was obtained prior to the event. Participants were informed of the intention to utilize data collected for dissertation. Research Authorization was sought from School of Graduate Studies (Masinde Muliro University of Science and Technology) and administration of Kisumu County, Kenya.

*i) Assumptions*

Meeting research objectives or answering research questions was one important aspect of research findings. To answer research questions stated herein, the following assumptions were made:

i) Prevalence rates constructed were assumed to apply to all public schools in the county and by large the county.
ii) Some of the respondents required to go for medical examinations at the health facilities near their schools where samples of stools and blood were taken. It was therefore assumed that all of them cooperated.
iii) All intervention programs that were evaluated were assumed to meet World Health Organization (WHO) standards
iv) All schools sampled for this research were aware of a "Health Promoting School" concept.

*j) Limitations*

The foreseen limitations were listed with related solutions to minimize their effects on the findings.

i.) Caution was taken in interpreting computed prevalence information that was presented in this study because it used information from a sample of the districts and not all the districts in the county to construct the rates. The selected districts were the three with the highest values of coefficient of variation in the study units.

ii.) Data collection to compute communicable disease prevalence rates was from students who self-reported communicable disease illnesses in the last two weeks at the time of data collection. The respondents who did not report illnesses in the last two weeks were considered to be in good health.

iii.) Computed communicable disease prevalence rates were modified by respondents from day schools and therefore may not give the actual prevalence rates as influenced by the school environment. This was used to answer questions on variability of prevalent rates.

*k) Data Analysis and Presentation*

Sample size of 400 was drawn from student population for this study. Table 3.6 is a summary of data analysis and presentation procedure against each specific objective.

For specific objective I, analysis of prevalence rates was based on intent-to-treat. A p value $<0.05$ was considered to be significant at 95% confidence interval. Chi Square was computed to show the association.

This answered a question like "is malaria prevalence rate associated with insecticide treated nets use?" or "Is diarrhea prevalence associated with water, sanitation and hygiene status of the school?" among others.

*Table 3.6 :* Specific objective against measurable variable/indicator, research design, method of analysis and presentation of study units in Kisumu County, Kenya.

| Specific Objective | Measurable Variable/indicator | Research Design | Method of analysis and presentation |
|---|---|---|---|
| i. To determine prevalence rates of communicable disease infection among secondary students | -Self reported illness in the last two weeks: Malaria, Diarrhea, STIs, Tuberculosis, Pneumonia, HIV/AIDS, Influenza, Typhoid fever, Wheezing and cough. Clinic card/Hospital book, medical examination | Survey | • Descriptive statistical analysis<br>• Chi Square. |
| ii. To determine the cause of variability in communicable disease prevalence rates among students within and between schools. | Determined prevalence rates, school type, school size/enrollment, school locality, gender, age, class, school kiosks, and Local Markets adjacent to the schools. | Correlational | • Descriptive statistical analysis<br>• Chi Square<br>• ANOVA |
| iii. To evaluate public health intervention programs for optimal use in secondary schools. | Health seeking behavior, nutrition/food serving, kitchen facilities, water source, sewage systems and management, solid/liquid waste management, ITN use, bed spacing, aeration, personal hygiene, condom use, Family Planning method use, Education Ministry quality assurance and standards systems. | Evaluation | • Descriptive statistical analysis<br>• Chi Square<br>• Normative evaluation |

For specific objective II analysis, Chi Square was used to determine the type of association (Lodico et al., 2006). For example, in this study the researcher determined association between prevalence of communicable diseases (dependent variable) and school type (independent variable). ANOVA was used, for example, it helped answer a question like "Is there a difference between Boys only, Girls only and Mixed schools with respect to communicable disease prevalent rates?" or "is there a difference between urban and rural schools with respect to communicable disease prevalence rates?"

In specific objective III, data were collected by direct observation, surveys and interviews. Computed Chi Square showed association or no association between public health interventions (the independent variable) and prevalence rates of communicable diseases among students (the dependent variable). In addition, specific objective III was also subjected to normative research analysis. This study adopted normative implementation environment evaluation which explores the environment in which the program is delivered, considering, for example, participants, implementers, partner organizations and mode of delivery (Hirjarvi et al., 2000). Evaluation questionnaire (Appendix IV) was used to assess the public health intervention programs in place in schools. The house Masters and Mistresses were given an opportunity to comment in open questions in this section of the questionnaire, in order to explore some of the intervening mechanisms contributing to the impact of each intervention.

# Chapter Four

## IV. Results and Discussion

*a) Introduction*

The results are clustered in four main thematic areas based on the most important communicable diseases namely; malaria, diarrhea, and the diseases of the respiratory system (tuberculosis and pneumonia). An insight of the respondents is given by their demographic characteristics as illustrate.

*b) Socio-Demographics of Respondents*

Characteristics of respondents have been shown by age, gender, class/form, and by religion.

i. *Respondents Age*

Age of respondents was clustered in three groups: 18-21 years, 14-17 years and 10-13 years. Those who were 18-21 years were 127 (31.8%) out of 400, the age bracket 14-17 years formed 67.8% (271 out of 400), and age group 10-13 years formed 0.2% (1 out of 400) (Figure 4.1). There was a significant ($p<0.05$) variation in age of respondents ($X^2_{3, 0.05} = 380.784$).

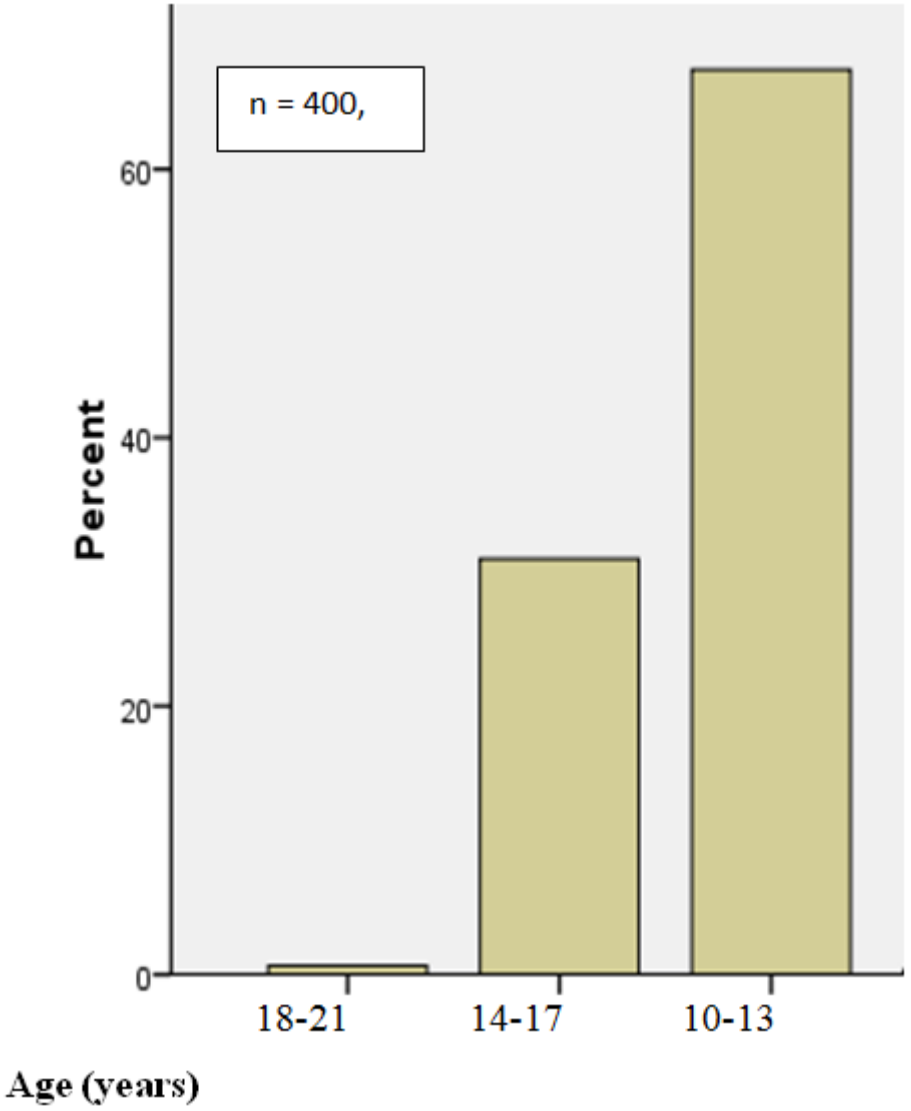


*Figure 4.1 :* Age distribution of respondents.

ii. *Respondents gender*

Male respondents formed 53% (212 out of 400) while female respondents formed 47% (188 out of 400) of student population sampled (Figure 4.2).

In form 1, male and female respondents were 19.3% each (41 out of 212) 19.7% (37 out of 188) respectively. In form 2, male respondents were 40.1% (85 out of 212) while female respondents were39.4% (74 out of 188). In form 3 and form 4, male proportion was 16.3% (35 out of 212) and 24.3% (51 out of 212) respectively while female proportion was 26.6% (50 out of 188) and 14.3% (27 out of 188) respectively. There was significant ($p<0.05$) variation in gender of respondents ($X^2_{1, 0.05} = 10.652$).

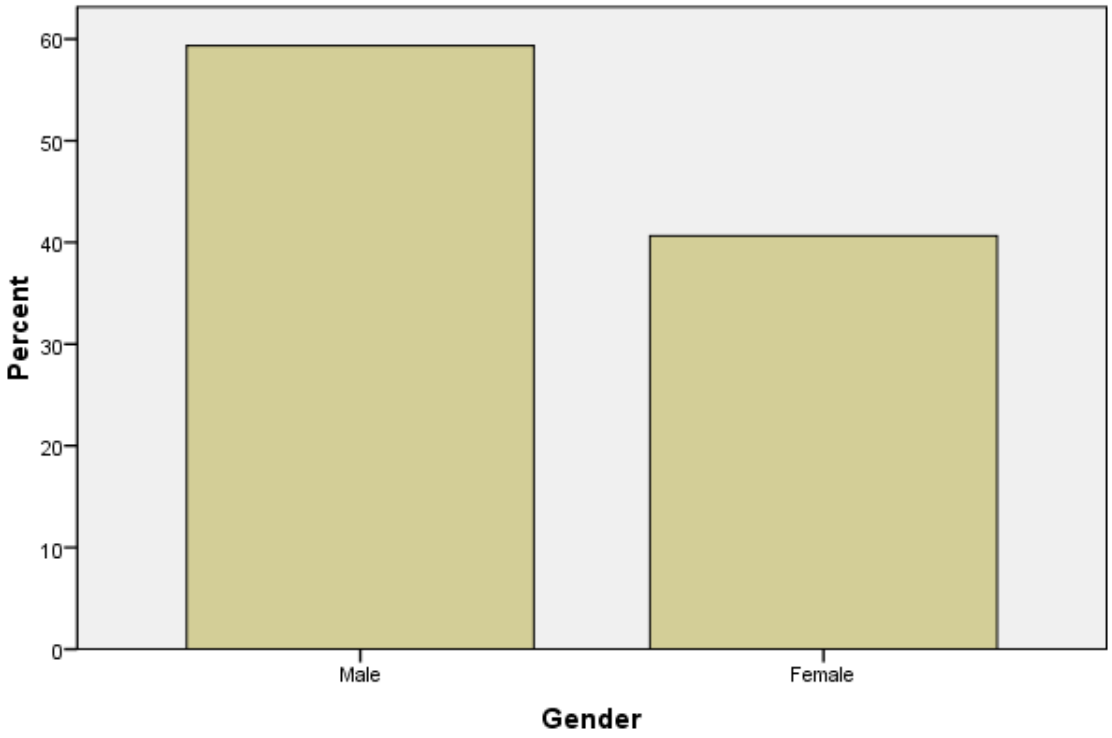


*Figure 4.2 :* Gender distribution of secondary students in Kisumu County, Kenya

iii. *Respondents Religion*

Thirty three point eight percent (33.8%), 135 out of 400 were Catholics, 17.0% (68 out of 400) Anglican; 17.2% (69 out of 400) Seventh Day Adventists; 8.0% (32 out of 400) Indigenous Churches; Muslims 5.5% (22 out of 400); those who did not belong to any church 2.0% (8 out of 400); and other Churches 16.5% (66 out of 400) (Figure 4.3).There was no significant variation in religion of students in Kisumu County ($X^2_{6,\ 0.05}$=1.719).

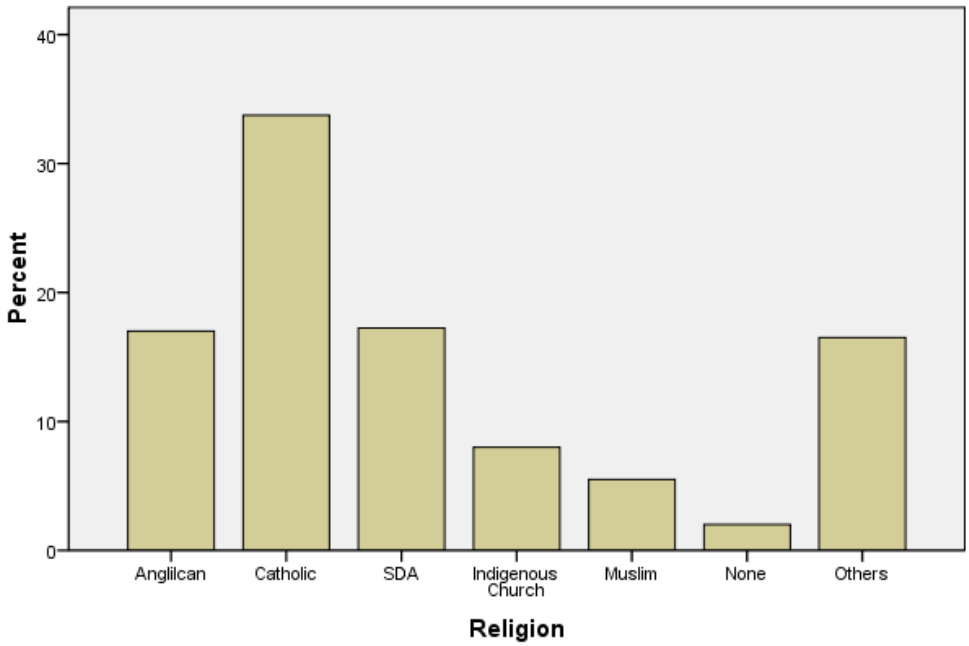


*Figure 4.3 :* Religion of secondary students in Kisumu County, Kenya

c) *Prevalence of communicable diseases in secondary schools in Kisumu County*

The most important communicable diseases among secondary students were Malaria, Diarrhea, Tuberculosis and Pneumonia. Malaria prevalence was 20.7% (20700 per 100000 students), Diarrhea 15.1% (15100 per 100000 students), Tuberculosis 7.2 %( 7 200 per 100 000 students), Pneumonia 5.2% (5200 per 100 000 students), other respiratory related infections 3.7% (3700 per 100 000 students), Pregnancy related 0.2% (200 per 100 000 students), other illnesses 0.2% (200 per 100 00 students). There was a significant ($p<0.05$) variation in prevalence of communicable diseases among secondary schools in Kisumu County ($X^2_{5,\ 0.05}=252.672$).

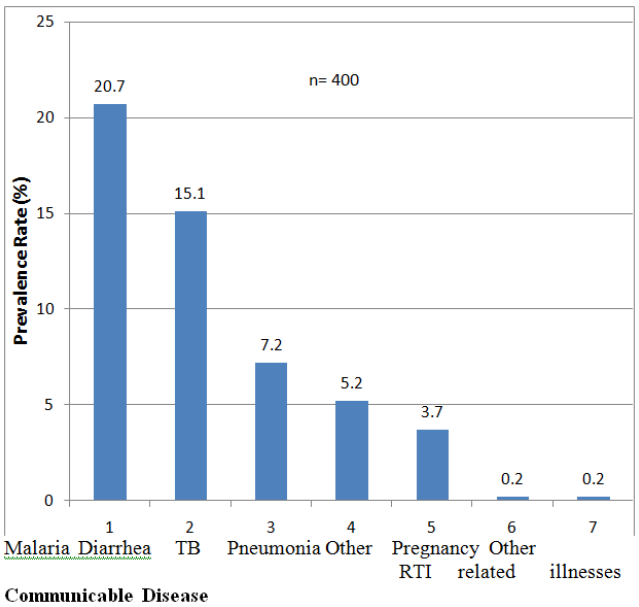


*Figure 4.4 :* Prevalence of communicable diseases in secondary schools in Kisumu County, Kenya.

Students who had positive blood smear test confirming presence of malaria parasite were 20.7%. Positive test for Clostridium difficile confirming diarrhea was observed in 15.1% of the stool samples examined, and 7.2% of sputum samples had a positive culture for Mycrobacterium tuberculosis confirming diagnosis of

tuberculosis. Rapid urine test to identify presence of bacteria that causes pneumonia was positive in 5.2% of the samples examined. Other respiratory tract infections, pregnancy related and other illnesses were also observed during the medical examinations (Figure 4.4).

*d) Causes of variability in prevalence rates between schools*

Variability in communicable disease prevalence rates are caused by various factors. The extent of link between the factors and prevalence rates are shown.

i. *Prevalence Rates against Locality of the School*

Prevalence of malaria was higher in urban (11%) schools than in rural (9.7%) schools, however, prevalence of diarrhea was higher in rural (7.8%) schools than in urban (7.3%) schools. Prevalence of tuberculosis (4.2%) and pneumonia (3.2%) were higher in urban than rural schools ($X^2_{1, 0.05}$=1.237) (Fig. 4.5).

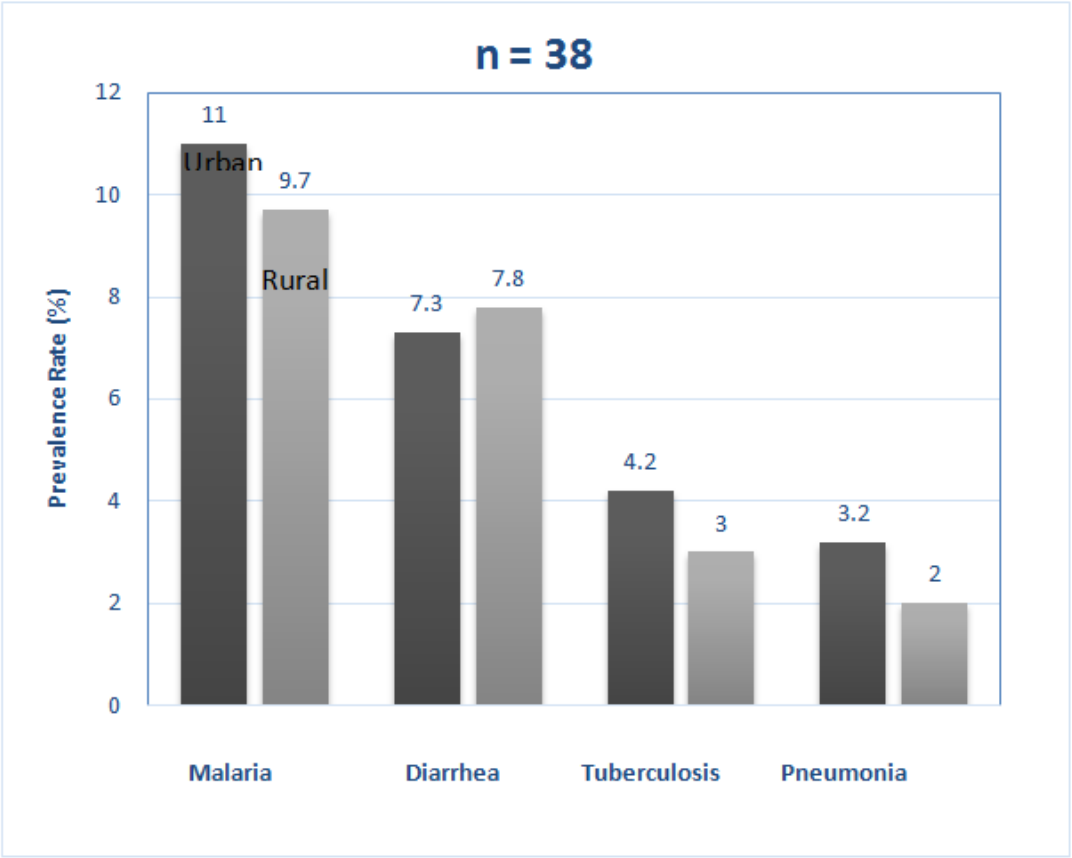


*Figure 4.5 :* Prevalence rates against Locality of schools in Kisumu County

There was no significant association between prevalence rates and locality of the school

ii. *Prevalence Rates against Type of School*

Prevalence of malaria was highest (7.78%) in boys' boarding schools and lowest (2.98%) in Boys' and Girls' day schools; prevalence of diarrhea was highest (7.13%) in Girls' boarding schools and lowest (2.38%) both in Boys' and Girls' day, and Boys' and Girls' day and boarding schools.

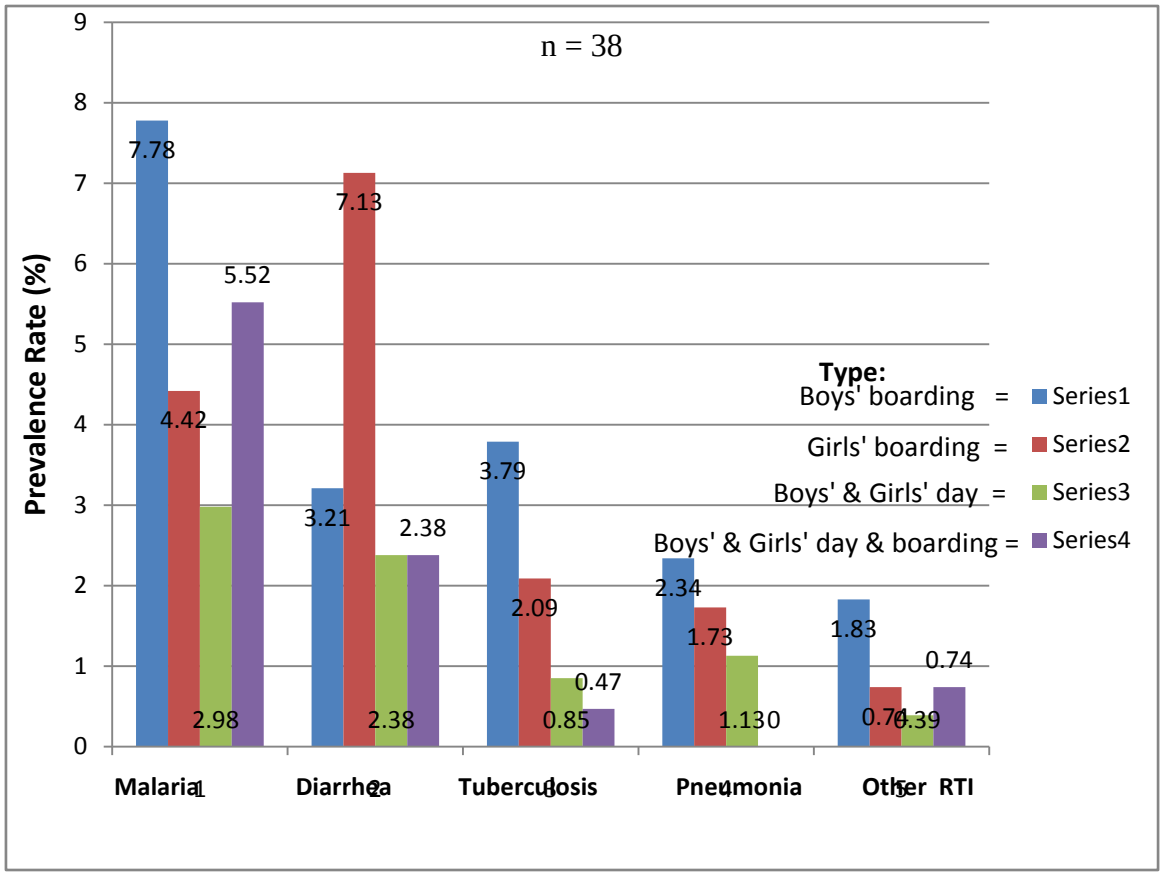


*Figure 4.6 :* Prevalence rates against Type of School in Kisumu County, Kenya

However, prevalence of tuberculosis (3.79%), pneumonia (2.34%) and other respiratory tract infections (1.83%) were highest in Boys' boarding schools and lowest (0.47%, 0.00% and o.74% respectively) in Boys' and Girls' day and boarding schools (Fig. 4.6).

The Pearson chi square ($X^2_{12,\ 0.05}$=15.865) showed that there was no significant association between prevalence rates and type of school.

iii. *Prevalence Rates against Size of the School*

The results were such that prevalence of malaria was highest (8.5%) in schools with population 201 – 400 and lowest (1.10%) in 1 – 200 population;

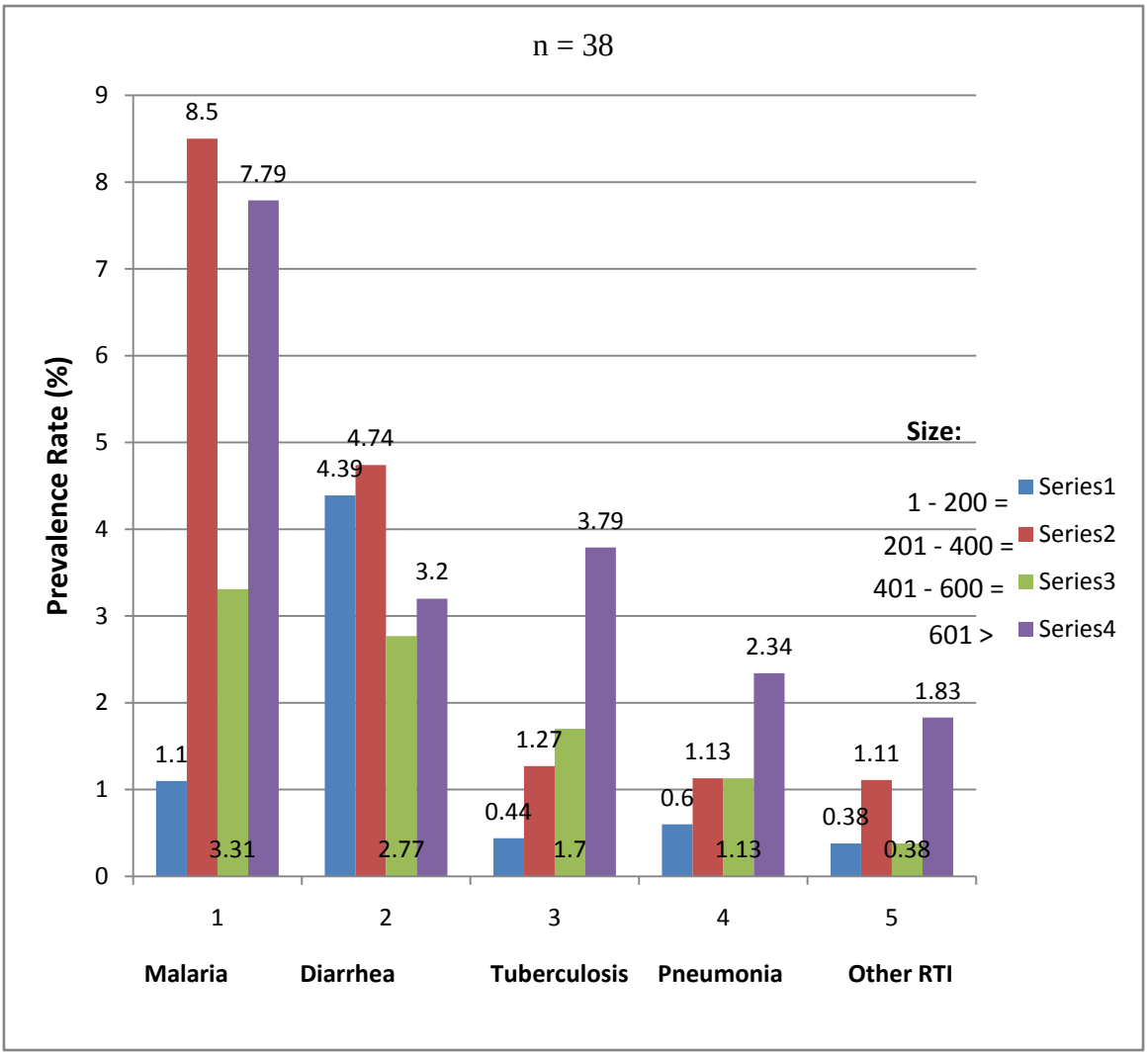


*Figure 4.7 :* Prevalence rates of communicable diseases against Size of secondary schools in Kisumu County, Kenya.

diarrhea prevalence was highest (4.74%) in 201 – 400 and lowest (2.77%) in 401 – 600 populations respectively, while prevalence of tuberculosis (3.79%) and pneumonia (2.34%) and other respiratory tract infections (1.83%) were highest in 600 and greater populations, and lowest, 0.44% and 0.60% and 0.38% respectively in 1 – 200 populations (Fig. 4.7 ). The Pearson chi square ($X^2_{12, 0.05}$=18.636) showed there was a significant association between prevalence rates of communicable diseases and size of secondary schools in Kisumu County.

iv. *Prevalence rates against Gender of Secondary students*

Malaria prevalence was highest (14.02%) among male students while diarrhea was highest (7.96%) among female students.

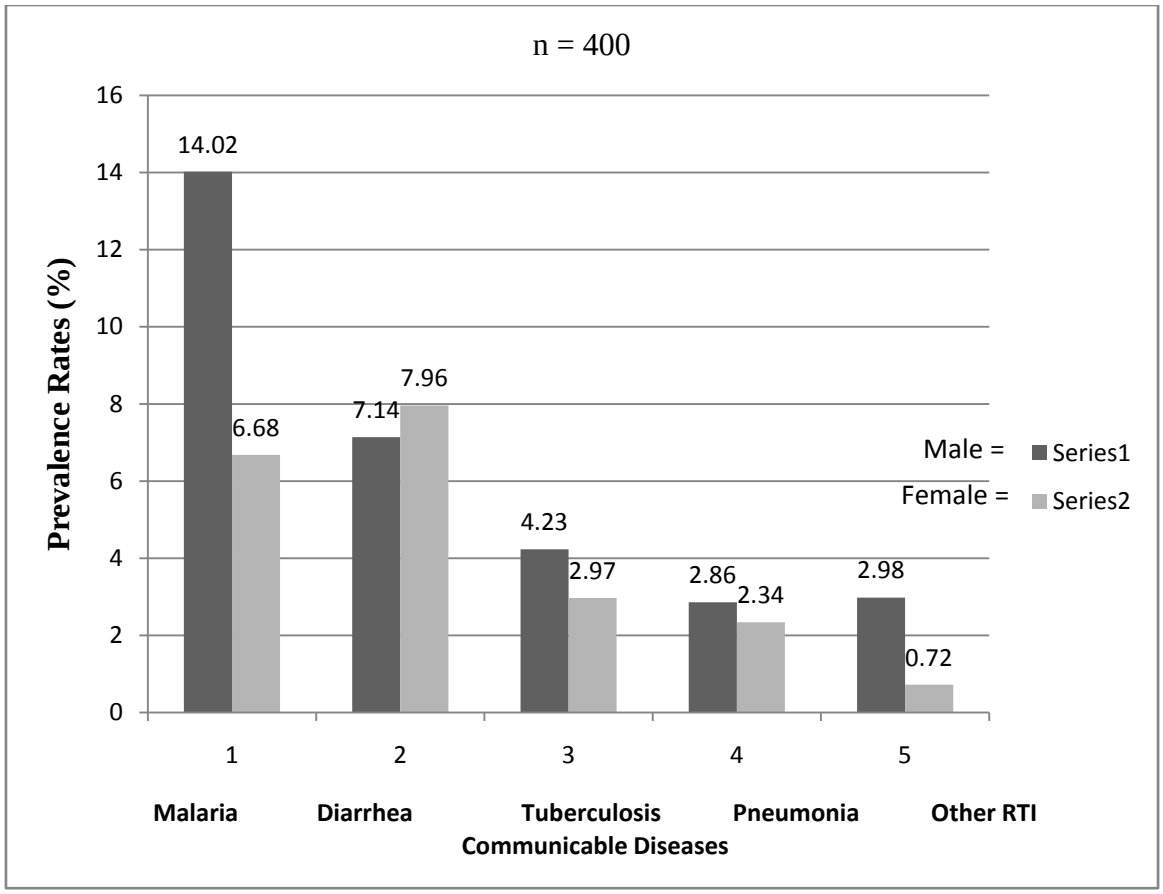


*Figure 4.8 :* Prevalence rates of communicable diseases against Gender of secondary school students in Kisumu County, Kenya

Prevalence of tuberculosis, pneumonia and other respiratory tract infections were highest (4.23%, 2.86% and 2.98% respectively) among male students (Fig. 4.8) than female students. There was a significant association ($X^2_{4,\ 0.05}$=5.723) between gender and prevalence rates of communicable diseases among secondary students in Kisumu County.

World Health Organization (WHO, 2007), while addressing sex and gender in epidemic prone infectious diseases found that differences between males and females arise because of biological and as a consequence of gender based roles, behavior and power. For most infectious diseases (Fig. 4.8), difference in prevalence rates between males and females are more likely to be due to differences in exposure than to differences in immunity. For example, in many societies females spend more time at home than males during the day, and therefore, experience greater daytime household exposure to infections, for example caring for the sick, exchanging baby nappies, than males. Male students, in their normal lives, spend more time outside the households in the evening than female students, they are more exposed to mosquito bites than females.

This study has revealed that prevalence of malaria, tuberculosis, pneumonia and other respiratory tract infections are lower among female secondary students than males. For reasons that are not well understood, a study by WHO (2003) found that females had lower mortality rates from severe acute respiratory syndrome (SARS) than males, a pattern that was maintained after adjusting for age. Despite scarcity of information, there are strong indications that sex and gender are important for transmission and control of epidemic prone diseases.

v. *Prevalence Rates againstAge (years) of Secondary students*

Prevalence of malaria (15.90%), diarrhea (9.57%), tuberculosis (5.50%), pneumonia (4.07%), and other respiratory tract infections (2.60%) were highest among students in age bracket 14-17 years than in age group 18 and above years (Fig.4.9).

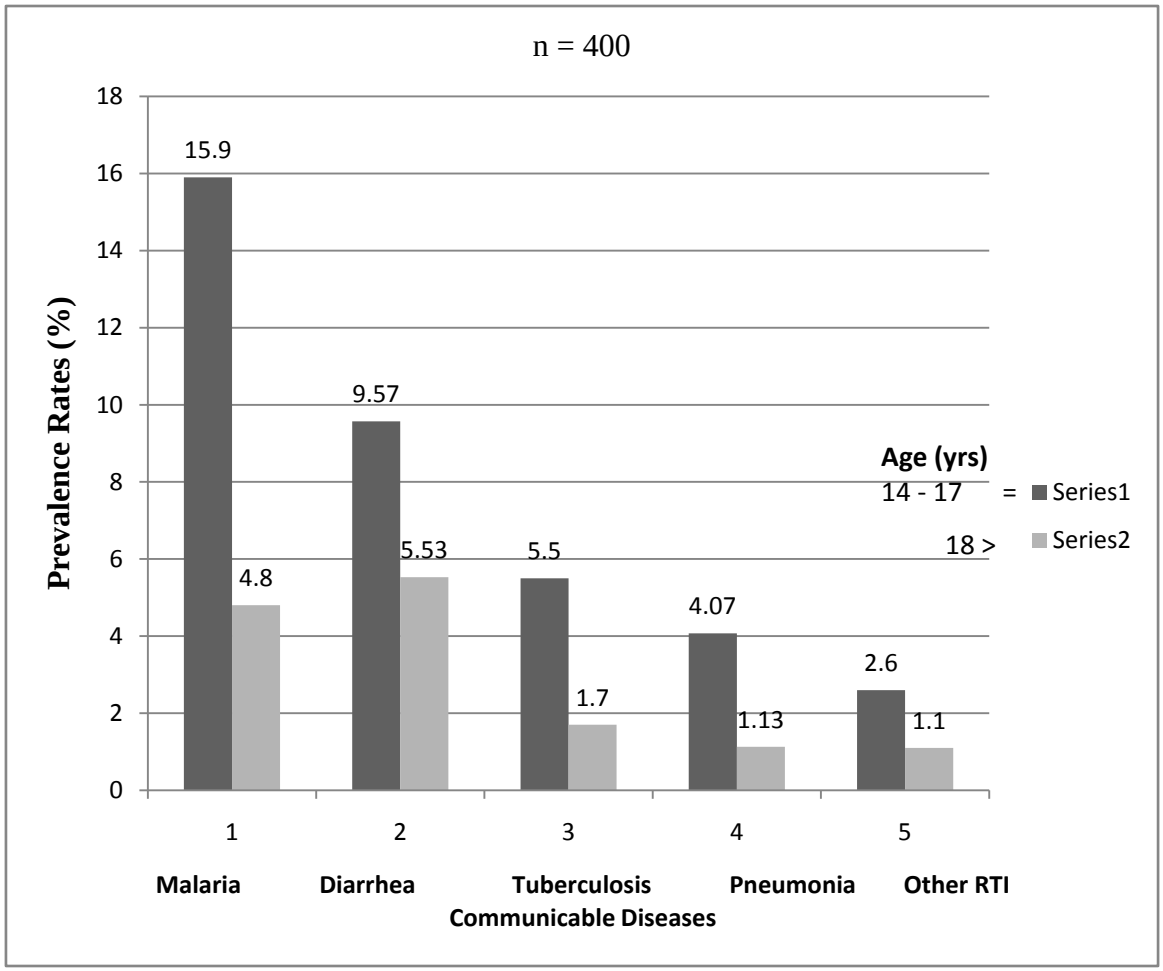


*Figure 4.9 :* Prevalence rates against Age of secondary students in Kisumu County, Kenya

The Pearson chi square ($X^2_{4,\ 0.05}$=2.458) showed there was a significant association between prevalence of communicable diseases and age of students in secondary schools in Kisumu County.

Combined data by Baker et al., (2013) from four case-control and observational studies showed that children less than five years old exposed to greater household crowding had 1.69 times the odds of pneumonia than children exposed to the least crowding. The findings of this study has shown that prevalence of tuberculosis and pneumonia is high among students where there is overcrowding in hostels and classrooms (Fig. 4.25 (a) &4.25 (b)). It has also revealed that students in age bracket 14-17 years have more incidences of tuberculosis and pneumonia than age bracket 18 years and greater (Fig. 4.9).

vi. *Prevalence Rates against Class/Form of Secondary students*

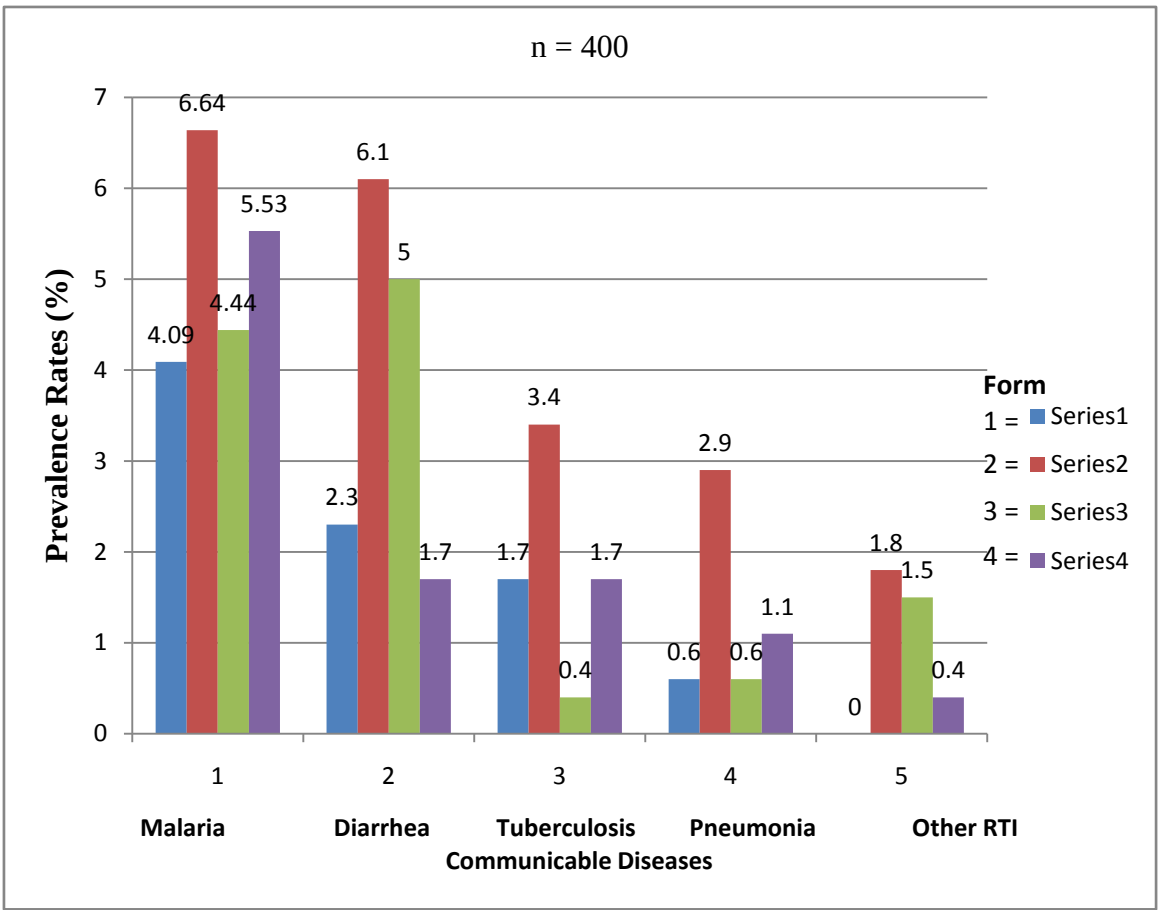


*Figure 4.10 :* Prevalence rates of communicable diseases against Class/Form of secondary school students in Kisumu County, Kenya

Prevalence of both malaria (6.64%) and diarrhea (6.1%) were highest among Form 2 students, the same is true with tuberculosis (3.4%), pneumonia (2.9%), and other respiratory tract infections (1.8%) (Fig.4.10). There was a significant association ($X^2_{12,\ 0.05}$=15.202) between prevalence rates of communicable diseases and Class/Form of secondary students in Kisumu County.

a) *Relationship between factors of variability and prevalence ratesof communicable diseases among Secondary Schools*

On further analysis using ANOVA, the following results, in Table 4.1, were obtained.

*Table 4.1 :* Relationship between factors of variability and prevalence ratesof communicable diseases among Secondary schools in Kisumu County, Kenya

| Factors of variability | Statistical Indices | | |
|---|---|---|---|
| | df | F | Significance at 95% confidence interval. |
| Locality of the school | 1 | 0.154 | 0.695 (ns) |
| Type of the school | 5 | 0.828 | 0.530 (ns) |
| Size of the school | 3 | 1.229 | 0.299 (ns) |
| Gender of respondent | 1 | 0.506 | 0.477 (ns) |
| Age of respondent | 2 | 3.033 | 0.049 (ss) |
| Class/Form of respondent | 3 | 0.515 | 0.672 (ns) |

*ns-there is not strong evidence that the variable has effect*
*ss- there is strong evidence that the variable has effect.*

This study has revealed that age of students is a predisposing factor to infectious diseases (Table 4.1). The same results were observed by a study done by Baker et al., (2013) on infectious diseases attributable to household crowding in New Zealand.

*e) Public Health intervention programs in Secondary Schools in Kisumu County, Kenya*

Public health intervention programs were evaluated for optimal use in secondary schools. The intervention program was then analyzed against communicable disease prevalence rates and the discussion herein was based on the four important communicable diseases as was observed in this study. The following were the results:

i. *Malaria Infection in Secondary Schools*

Malaria infection is one of the most important communicable diseases among secondary schools in Kisumu County with a prevalence rate of20.7% (20 700 per 100 000 students) (Figure 4.4).

*a. Insecticide Treated Mosquito Nets (ITNs) use.*

Prevalence of malaria was highest (11.09%) among students who did not sleep under insecticide treated nets (Fig. 4.11). It was also highest among students suffering from tuberculosis, pneumonia, and other respiratory tract infections who did not sleep under insecticide treated nets.

There was significant ($X^2_{4,\ 0.05}$=1.613) association between malaria prevalence rate and insecticide treated bed nets use among secondary students in Kisumu County. On further analysis using ANOVA, there was not strong evidence that the intervention has effect (Table 4.2).Prevalence of malaria varies widely from area to area as has been shown by several studies in Uganda (Nankabirwa et al., 2010, 2013; Pullan et al., 2010 & Kabatereine et al., 2011). The findings of these studies that in Uganda 14-64% of school- age children were parasitaemia at any one time concurs with the determined prevalence rate of malaria (20.7%) in this study (Figure 4.4). This also concurs with the results of a study on prevalence of malaria parasitaema by Gitonga et al., (2010, 2012) in 480 Kenyan schools between September 2008 and March 2010 that found an overall prevalence rate of 4%, but this ranged from 0% to 71%. It also agrees with the findings of a study by Dia (2008), Ouldabdallahi (2011), Clarke (2012), Oduro (2013), and others for Senegal, The Gambia, and Mauritania that the prevalence of malaria infection in school-age children ranged from 5% to 50%.

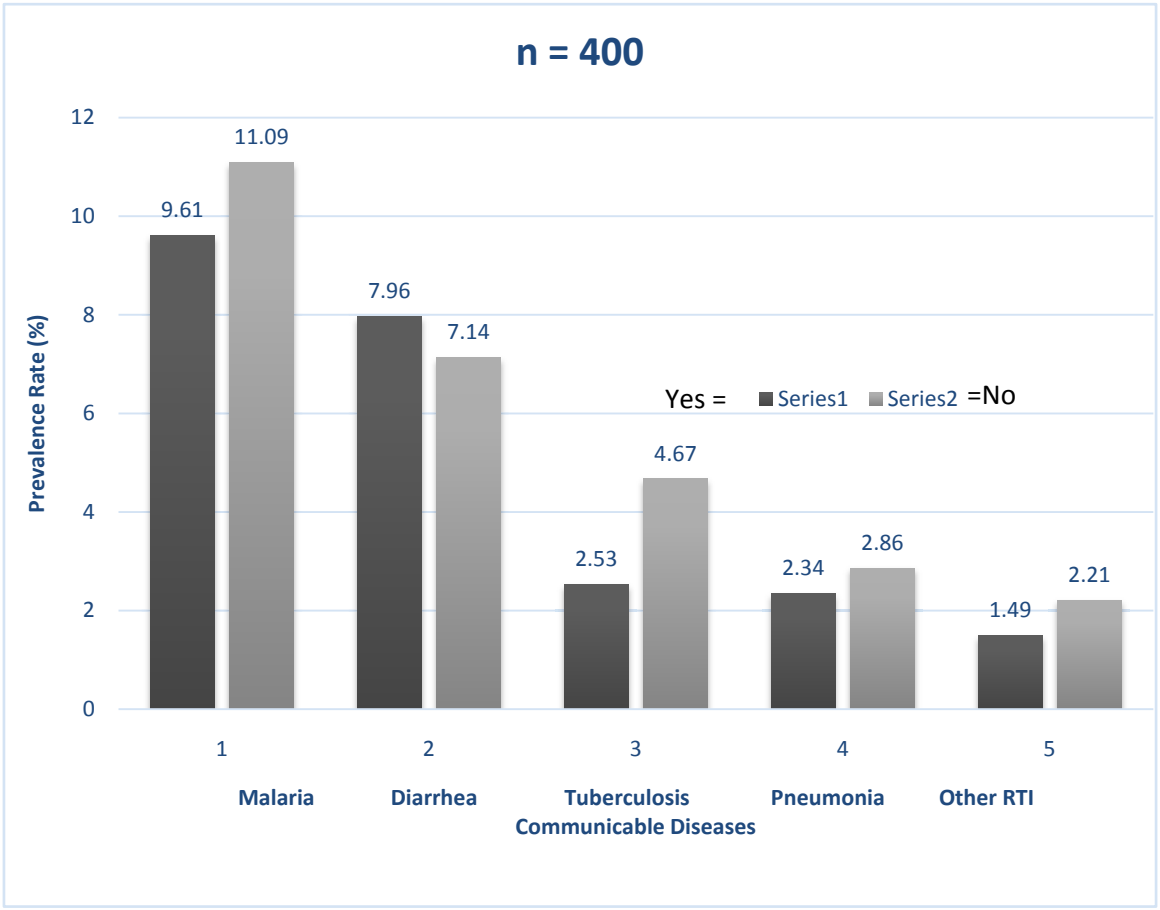


*Figure 4.11 :* Prevalence rates of communicable diseases against use of insecticide treated bed nets (ITNs) among secondary school students in Kisumu County, Kenya

It is therefore of great concern that malaria prevalence among secondary school students may interfere with their educational development. The effect of malaria infection on school absenteeism has been confirmed in several studies (Leighton & Foster, 1993; Some, 1994; Brooker et al., 2000) that it contributes to between 17% and 54% on school absenteeism per year.

Studies by Lengeler (2004), Lim and others (2011) have shown there is strong evidence that, at the individual level, regular use of an insecticide treated net (ITN) or long lasting insecticide treated nets (LLIN) substantially lowers the risk of malaria infection. The findings of this study (Figure 4.7) concur with the findings of Lengeleret al. This may be attributed to by the fact the fact that as children become older and more independent, parents have less control over the time when they go to bed, where they sleep, and whether they use a net, frequently resulting in low net coverage in children in this age group. This is confirmed (Figure 4.7) by a large proportion of respondents (11.5%) out of 46.3% of those who did not use insecticide treated nets, and reported confirmed incidences of malaria. The results also agree with the findings of a study by Noor and others (2009) that school –age students were least likely to sleep under an insecticide treated net (ITN).

Education targeted directly at the older children, for example through malaria education in schools, is likely to be the most effective way of increasing regular use of ITNs in this age group. Education and Health is one of the thematic clusters of Millennium Development Goals (MDGs) (UN, 2011). Global health agenda is shifting (Reich, 2009) from disease specific approaches to strengthening of health systems. One way of doing this is to advocate for establishment of health promoting schools.

*b. Prevalence rates of communicable diseases against Mosquito Breeding Control among Secondary Schools*

Prevalence rate of malaria was higher in schools where mosquito breeding control was not observed (Figure 4.12) and lower in schools where mosquito breeding control was observed to a high degree. The elimination of mosquito breeding sites in and around the home is important for vector control. There is considerable literature to support the hypothesis that males and females have different roles and responsibilities regarding vector control activities for dengue.

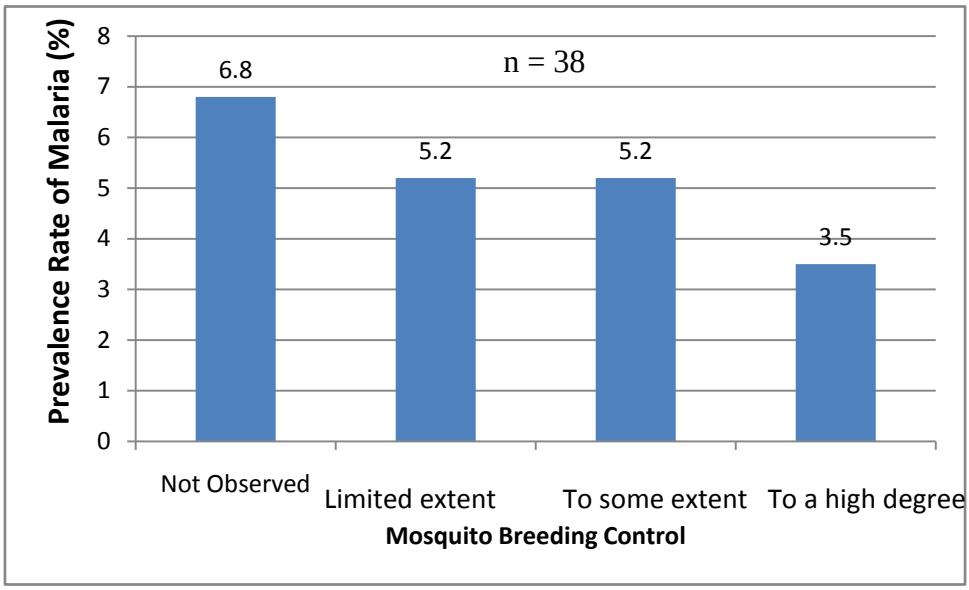


*Figure 4.12 :* Malaria prevalence rate against Mosquito Breeding Control among Secondary Schools in Kisumu County, Kenya

Although gender roles and responsibilities vary from culture to culture, women are usually responsible for the maintenance of the containers that hold the family drinking water and of the water vessels for doing laundry (both of which may be prime breeding sites for Aedes mosquitoes). However, the responsibility for maintenance of other potential vector breeding areas such as large water vessels stored outside the immediate living area, or disposed of or discarded solid wastes may be primarily taken by men in some cultures. This study has shown that in schools where mosquito breeding control is not observed, the prevalence of malaria is high (Figure 4.12).

During focus group discussion, the consensus was that schools and communities where schools stand rarely work together to improve their health status. There is no significant ($X^2_{3,\ 0.05}$=3.154) association between Mosquito Breeding Control intervention and prevalence rates of communicable diseases among secondary schools in Kisumu County. Also, there is not strong

evidence that the intervention has effect (Table 4.2). Environmental components are linked to each other and significantly influence the health status of a school and students (Masike & Mojekwa, 2012).

This study found that there is not strong evidence that the intervention has effect (Table 4.2). These findings agree with the finding of a study by Fillinger & Lindsay (2011) that larval control may be effective in urban areas and a few other epidemiological situations in Africa, such as the Kenyan highlands, but it is generally not a cost effective approach to malaria control in rural areas of sub-Saharan Africa. Thus, there is likely to be little health benefit from encouraging school students to destroy potential breeding sites in school grounds, although this may help to reduce the number of "nuisance" mosquitoes

*c. Malaria prevalence rate against Solid Waste Disposal among secondary schools*

Malaria prevalence was 12.4% in 47.3% of schools that observed to a very limited extent solid waste disposal. In schools that observed solid waste disposal to a high degree, malaria prevalence was 2.1% and 6.2% in schools where solid waste disposal was observed to some extent (Figure 4.13). Plate 4.1 is a photograph showing state of solid and liquid waste disposal in schools.

During health survey of the schools, 65.8% (25 out of 38) of schools had limited storage spaces, and most of the waste was biodegradable. Most schools (84.2%) (32 out of 38) used open dumping as a method of waste disposal, and unattended.

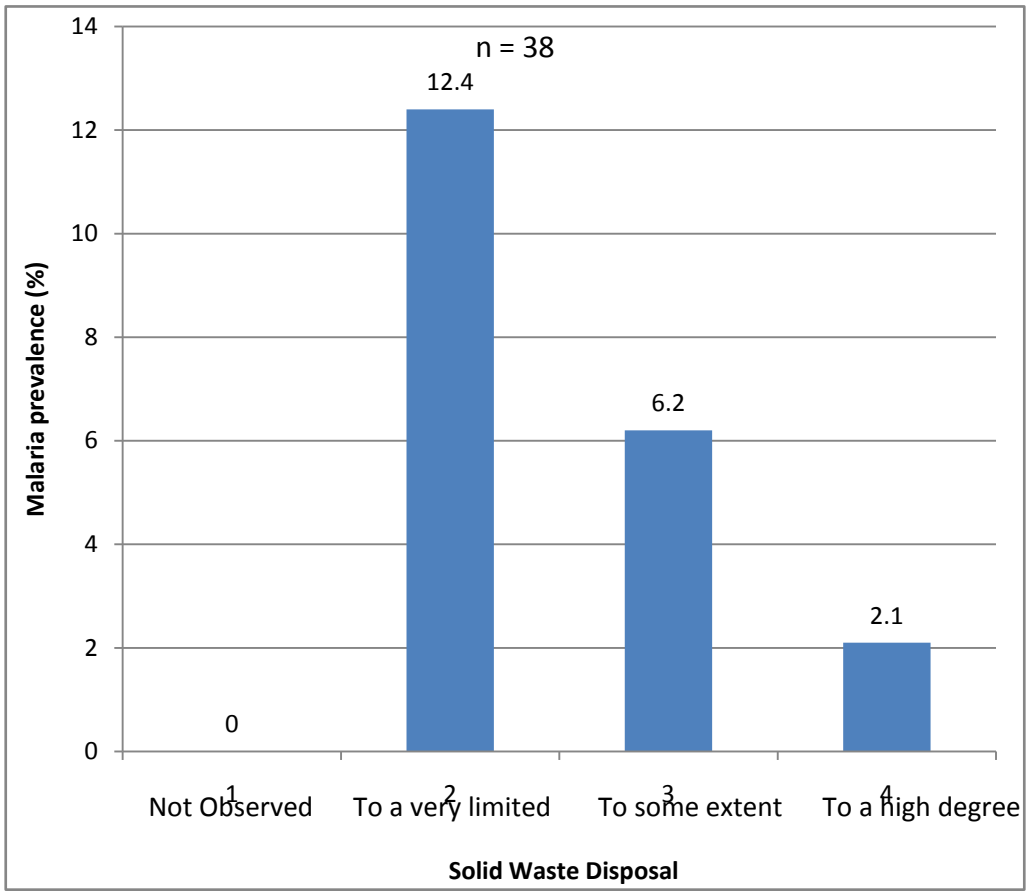


*Figure 4.13 :* Malaria prevalence rate against Solid Waste Disposal among secondary schools in Kisumu County, Kenya

The Pearson chi square showed there in no significant association ($X^2_{2,\ 0.05}$=9.692) between Solid Waste Disposal intervention and prevalence rates of communicable diseases among secondary schools in Kisumu County; there is not strong evidence that the intervention has effect (Table 4.2).

*Plate 4.1:* A photograph showing state of solid and liquid wastes among secondary schools in Kisumu County, Kenya

The influence of social and ecological contexts on disease transmission has been recognized for disease spread through direct contact, for example, sexually transmitted diseases and airborne diseases; diseases with environmental reservoirs. Transmission models can serve as conceptual or analytical instruments to analyze the infections between environmental contexts and transmission cycle components.

During the health survey of the schools, 65.8% were found to have limited disposal places for solid wastes, and 84.2% had open dumping sites which were also unattended. The results of this study concur with the findings of a study done by Aninash Puri et al., (2008) that a large number of residents, up to 90-95%, were found suffering from fever. This is indicative of a strong, to moderate health impact on the resident population due to the solid waste being dumped in the vicinity. Open dumping cause health hazards as well as fly nuisance.

There are various problems that could be related to handling and storage of solid wastes, and if unattended create small nuisance. Stray animals like pigs, dogs and cows further aggravate the problem of spreading and littering of solid waste as they are seen at the sites. Solid wastes is a major part of environmental pollution, it is responsible for spreading many harmful and infectious diseases. An unattended waste is normally wet and decomposes and leads to epidemics. It also affect water bodies and causes water-borne diseases to the surrounding communities.

ii. *Diarrhea Infection in Secondary Schools*

Diarrhea is the second most important communicable disease among students in secondary schools with a prevalence rate of 15.1% (15 100 per 100 000 students) (Figure. 4.4). Some of the findings causing the high prevalence rates are discussed below:

a. *Diarrhea prevalence rates against Safe Water Provision*

Prevalence rate of diarrhea was 9.8% in schools where safe water provision was not observed; 4.6% in schools where provision of safe water was observed to a very limited extent and 0.7% in schools where safe water provision was observed to some extent. However, prevalence was 0.0% in schools where safe water provision was observed to a high degree (Fig. 4.14). The Pearson chi square showed a significant association ($X^2_{2,\ 0.05}=16.769$) between provisions of safe water as an intervention and prevalence of diarrhea among secondary schools in Kisumu County. Plate 4.5 illustrates the state of safe water provision in some schools in Kisumu County.

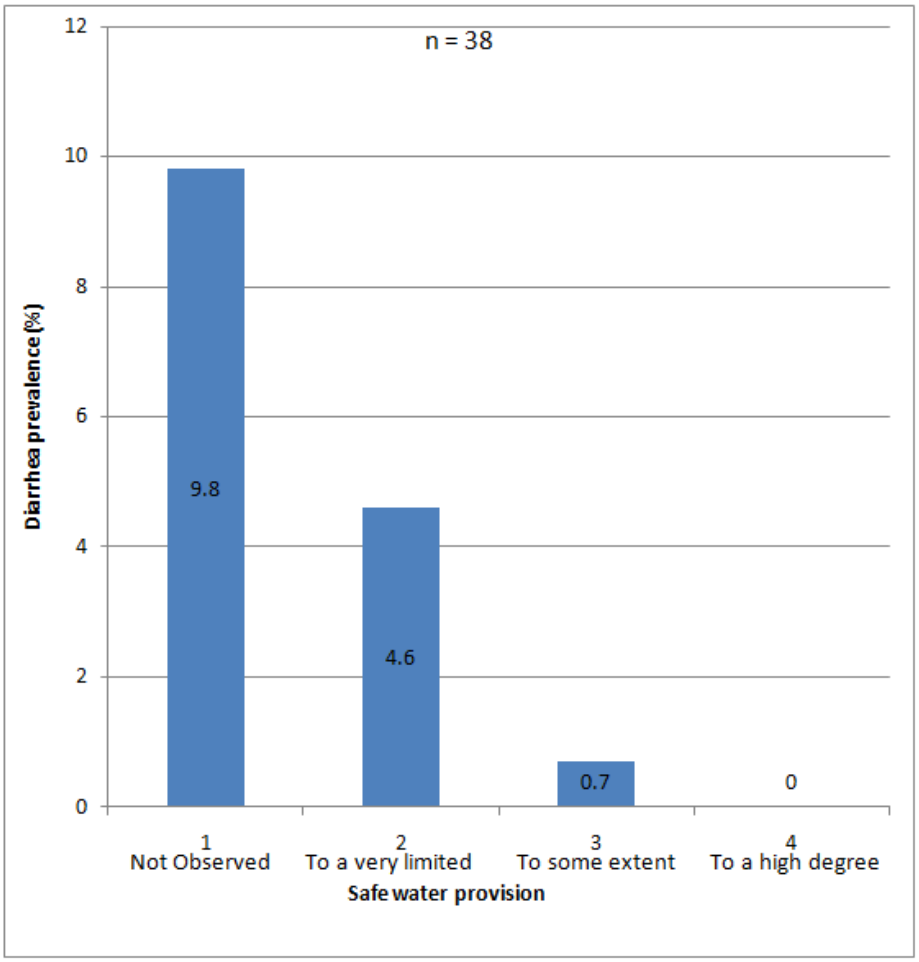


*Figure 4.14 :* Diarrhea prevalence rate against Safe Water provision among secondary schools in Kisumu County, Kenya

Plate 4.2 shows a photograph of a section of a school kitchen where water is stored in containers without taps and jugs used to scoop it.

*Plate 4.2 :* A photograph showing state of Safe Water provision in secondary schools in Kisumu County, Kenya

Contaminated water causes diarrhea. Food is the main source of pathogens causing diarrhea. Safe water provision is important to control of diarrhea. In the absence of safe water provision, food handling becomes a risk factor to spread of diarrhea. This study has revealed that in schools where safe water provision was not observed, prevalence of diarrhea was high (Fig. 4.14). Studies by Muna (2010) and Einsenberg et al., (2007) had similar findings. Boschi-Pinto et al., (2008) in their study also observed that the major contributing factor to burden of communicable diseases is inadequate access to safe water and sanitation infrastructure.

*b. Diarrhea prevalence rate against Hand Washing before eating among secondary students*

Prevalence rate of diarrhea was 10.3% in schools where hand washing before eating was not observed; 4.6% in schools where the intervention was observed to a very limited extent and 0.4% in schools where hand washing before eating was observed to some extent. However, the prevalence was 0.0% in schools where hand washing before eating was observed to a high degree (Figure 4.15).

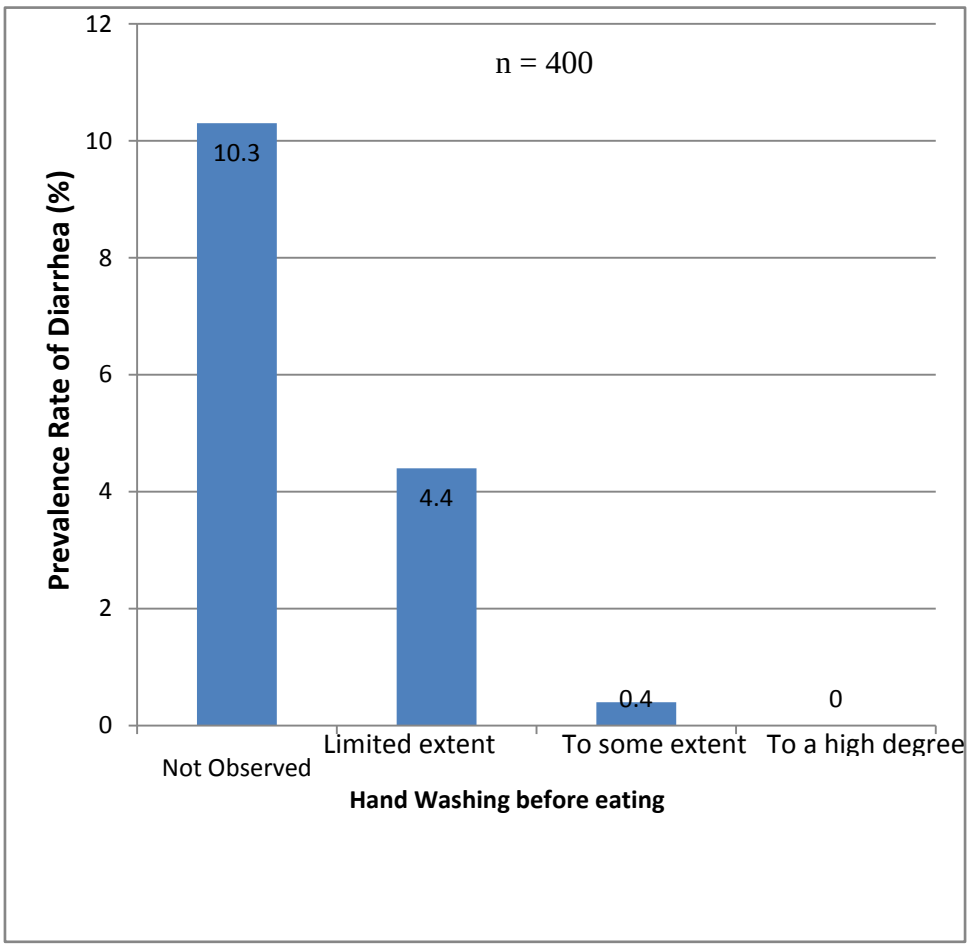


*Figure 4.15 :* Prevalence of Diarrhea against Hand Washing before eating among secondary students in Kisumu County, Kenya

Of the 84.7% schools that observed handwashing before eating, 5.3%, 2.6% and 7.9% had confirmed incidences of diarrhea, tuberculosis and pneumonia respectively. There were no confirmed incidences of diarrhea, tuberculosis and pneumonia for 10.5% of schools that observed hand washing to some extent before eating.

There was a significant ($X^2_{2,\ 0.05}=44.42$) association between prevalence of diarrhea and Hand Washing before eating intervention among secondary school students in Kisumu County; there was not strong evidence that the intervention has effect (Table 4.2).

*c. Diarrhea prevalence rates against provision of Water only at Hand washing place among secondary schools*

Prevalence rate of diarrhea was 11.3% in schools where water only at hand washing area was not observed; 3.1% in schools where the intervention was observed to a very limited extent; 0.7% in schools where water only at hand washing area was observed to some extent and 0.0% where the intervention was observed to a high degree (Figure 4.16).

There was a significant ($X^2_{2,\ 0.05}$=44.42) association between provision of water only at handwashing area and prevalence of diarrhea among secondary schools in Kisumu County; there is not strong evidence that the intervention has effect (Table 4.2).

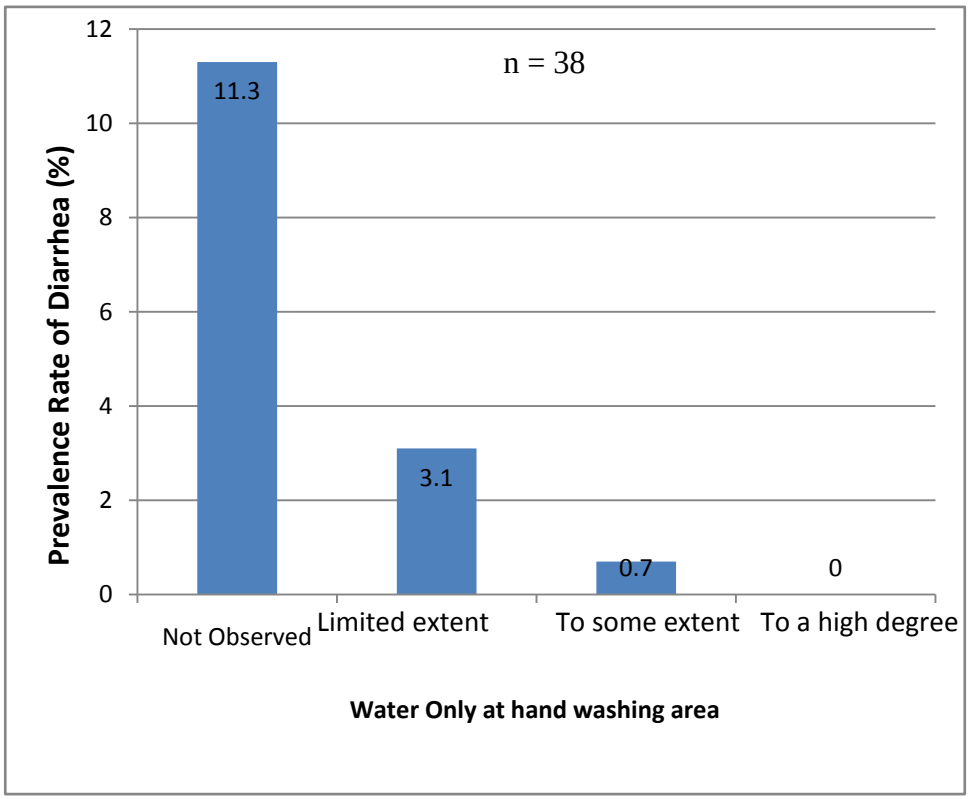


*Figure 4.16 :* Diarrhea prevalence rates against provision of Water only at hand washing area among secondary schools in Kisumu County, Kenya

*d. Prevalence rates against provision of water and soap at handwashing area among secondary schools*

Prevalence rate of diarrhea was 12.3% in schools where water and soap at hand washing area was not observed; 2.5% in schools where the intervention was observed to a very limited extent; 0.3% in schools where intervention was observed too some extent, and 0% in schools where the intervention was observed to a high degree (Figure 4.17).

The Pearson chi square ($X^2_{2,\ 0.05}$=10.158) showed there was a significant association between provision of soap and water at handwashing area , and prevalence of diarrhea among secondary schools in Kisumu County; there is not strong evidence that the intervention has effect (Table 4.2).

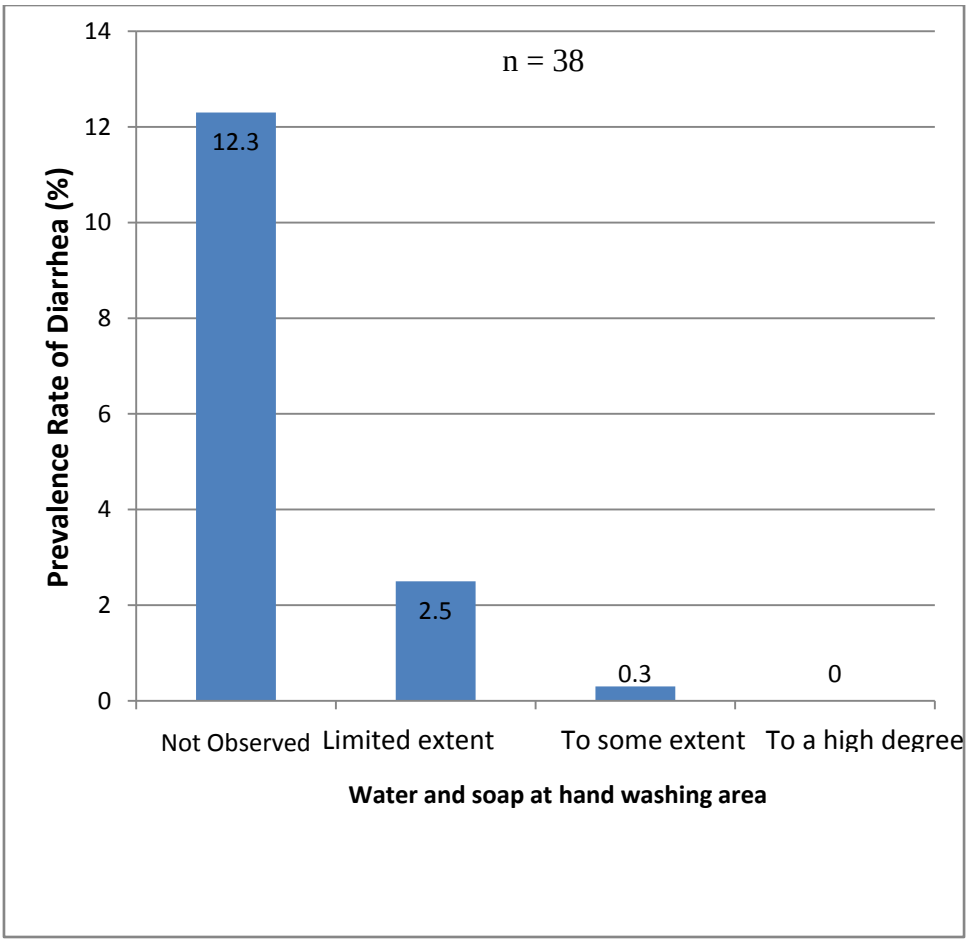


*Figure 4.17 :* Diarrhea prevalence rate against provision of Water and soap at hand washing area among secondary schools in Kisumu County, Kenya

e. *Prevalence rates against provision of Water, Soap and Disposable towel at Handwashing area among secondary schools*

Prevalence rate of diarrhea was 12.4% in schools where water, soap and disposable towel at hand washing area was not observed, 2.4% in schools where water, soap and disposable towels was observed to a very limited, and 0.3% in schools where the intervention was observed to some extent. However, there were no schools where water, soap and disposaltowel at hand washing area was observed to a high degree (Figure 4.18).

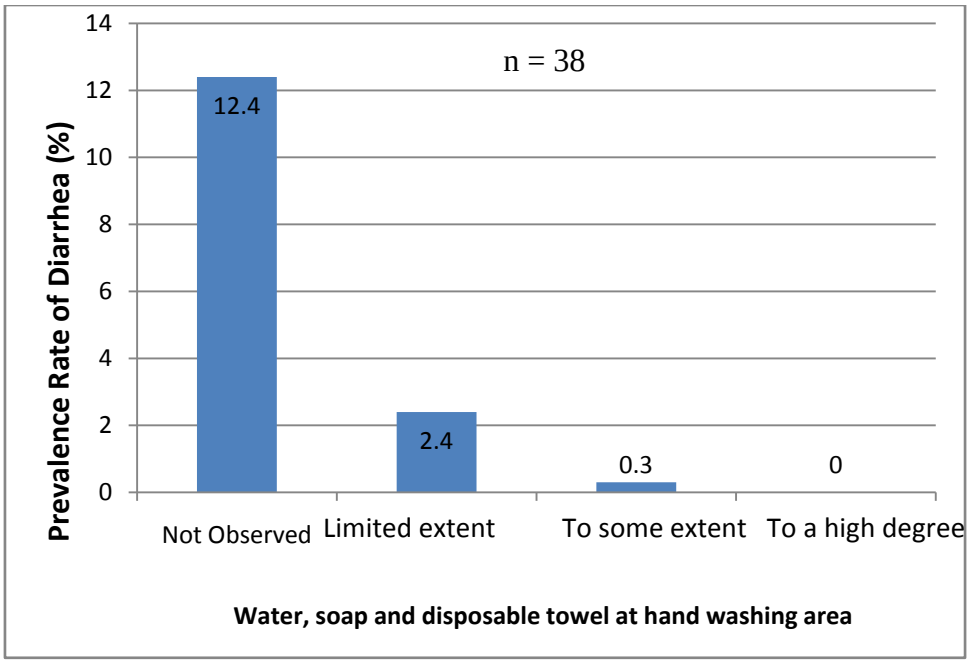


*Figure 4.18 :* Diarrhea prevalence rates against provision of Water, Soap and disposable Towel at Handwashing area among secondary schools in Kisumu County, Kenya

There was not a significant ($X^2_{2,\ 0.05}$=10.158) association between provision of Water, Soap and disposable Towel at Hand washing area intervention and prevalence rates of diarrhea among secondary schools in Kisumu County; there is not strong evidence that the intervention has effect (Table 4.2).

During Focus Group Discussions (FGD), one of the thematic issues that generated a lot of interest among the participants was the contribution of hand washing practices to prevalence rates of most communicable diseases. "Hand sanitizers are good, but we cannot discount the fact that soap and water is still the best way to get rid of germs," said area health officer, Dr. Mathews (not his real name). Debbie Hellen (not real name), an infection prevention expert at Nyabondo Mission Hospital, said sanitizers have 60 percent alcohol for them to be effective. "The alcohol kills bacteria on contact." When using soap and water, we are rubbing our hands together and then you wash them off and you wash the germs and bacteria into the sink."

Hellen said sanitizers have made it easier to practice protecting ourselves from germs. "They are so much convenient, and they have proven to be effective," she said. Maurice Baya (not real name), a public health nurse in Mombasa and a member of management committee in one of the schools said he does not advocate for the use of fragrant sanitizers. "I want the real stuff, the ones you can smell the alcohol in," he said. Assistant Area Chief in one of the schools said it seems more food kiosk owners than ever are not conscious of good hygiene. "I haven't seen a food kiosk or grocery in this area where some kind of hand sanitizer is placed in an area of reach for use," he said.

Dr. Hellen said, "Hand washing technique is what is so important." Health officials agree, the technology and the convenience of the hand sanitizer does not replace tried-and –true hand washing. Hand sanitizer is good for an extra level of precaution.

Case studies on sustainable development (Corvalan et al., 1999) or ecosystem approaches (Corvalan et al., 2005) bridge scientists, policy makers, activists, and citizens. This agrees with the results of the focus group discussion of this study given that it was a group of professionals and other stakeholders in Education sector. It was by consensus that hand washing continues to be one of the most important steps we can take to avoid spreading germs and infections to others, both in our personal and professional lives. Ensuring that there is regular hand washing education and on-site supplies are easily accessible and adequately stocked is essential for retention and infection control in any school. Like was said by a member of District Education Quality Assurance and Standards Committee, hand washing needs to become something that people think of on a consistent basis throughout the day. Simply being aware of the risks associated with poor hygiene can help make a difference in a person or business attention to hand washing, and health and wellness overall.

*f. Diarrhea prevalence rates against Handwashing after defecation among secondary students*

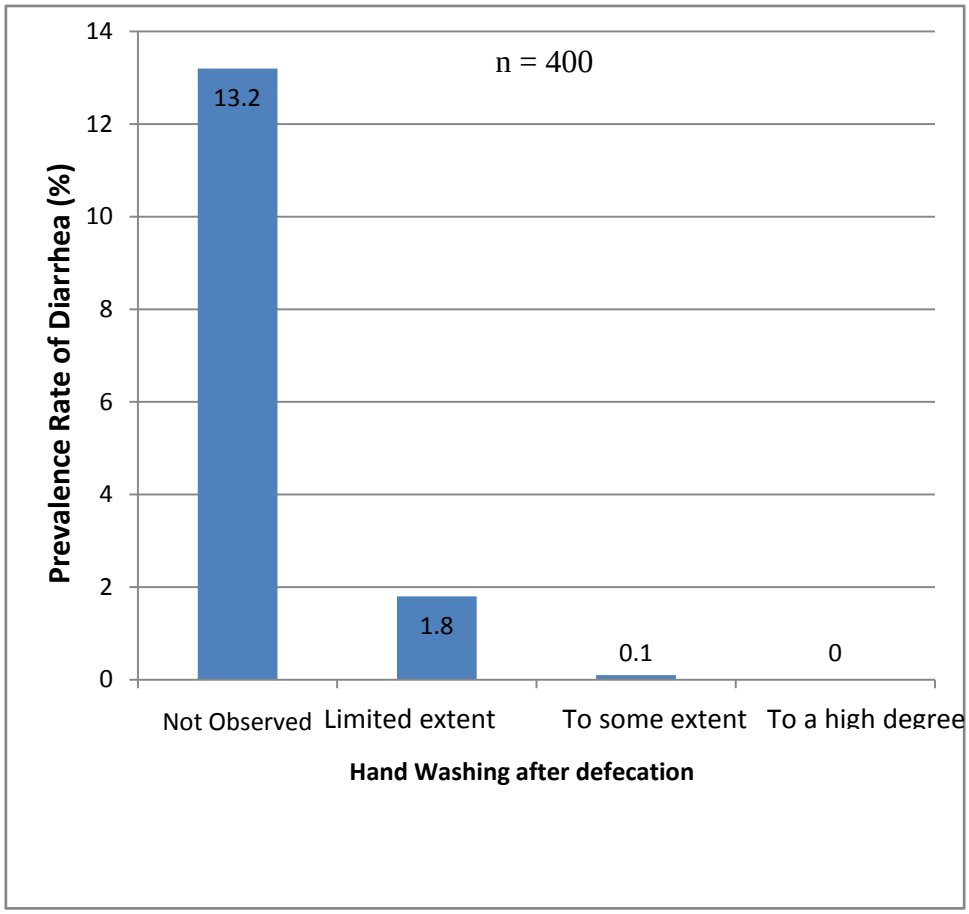


*Figure 4.19 :* Diarrhea prevalence rates against Handwashing after Defecation among secondary students in Kisumu County, Kenya

Prevalence rate of diarrhea was 13.2% in schools where hand washing after defecation was not observed; 1.8% in schools where the intervention was observed to a very limited extent; 0.1% in schools where the intervention was observed to some extent, and 0% in schools where hand washing after defecation was observed to a high degree (Figure 4.19).

The Pearson chi square ($X^2_{2,\ 0.05}$=16.158) showed a significant association between Hand washing after Defecation intervention and prevalence of diarrhea among secondary school students in Kisumu County; there is not strong evidence that the intervention has effect (Table 4.2).

The most common route of transmission of diarrheal agents is the fecal-oral route, within and between populations (Keusch et al., 2006). This finding concurs with the results of this study (Figure 4.19) revealing that prevalence rate of diarrhea among students is high in schools where hand washing after defecation was not observed. Hand washing after having passed stools is particularly important as a measure at individual level to reduce spread of pathogens (Clasen et al., 2006). Safe water, good sanitation, waste management and food safety are vital community interventions to prevent diarrhea.

*g. Diarrhea prevalence rates against Kitchen Staff Hygiene among secondary schools*

Prevalence rate of diarrhea was 10.7% in schools where Kitchen Staff Hygiene was not observed; 4.2% in schools where the intervention was observed to a very limited extent; 0.1% in both schools where the intervention was observed to some extent and also to a high degree (Figure 4.20).

There is a significant ($X^2_{2,\ 0.05}$=16.158) association between Kitchen Staff Hygiene and prevalence rate of diarrhea among secondary schools in Kisumu County; there is not strong evidence that the intervention has effect (Table 4.2).

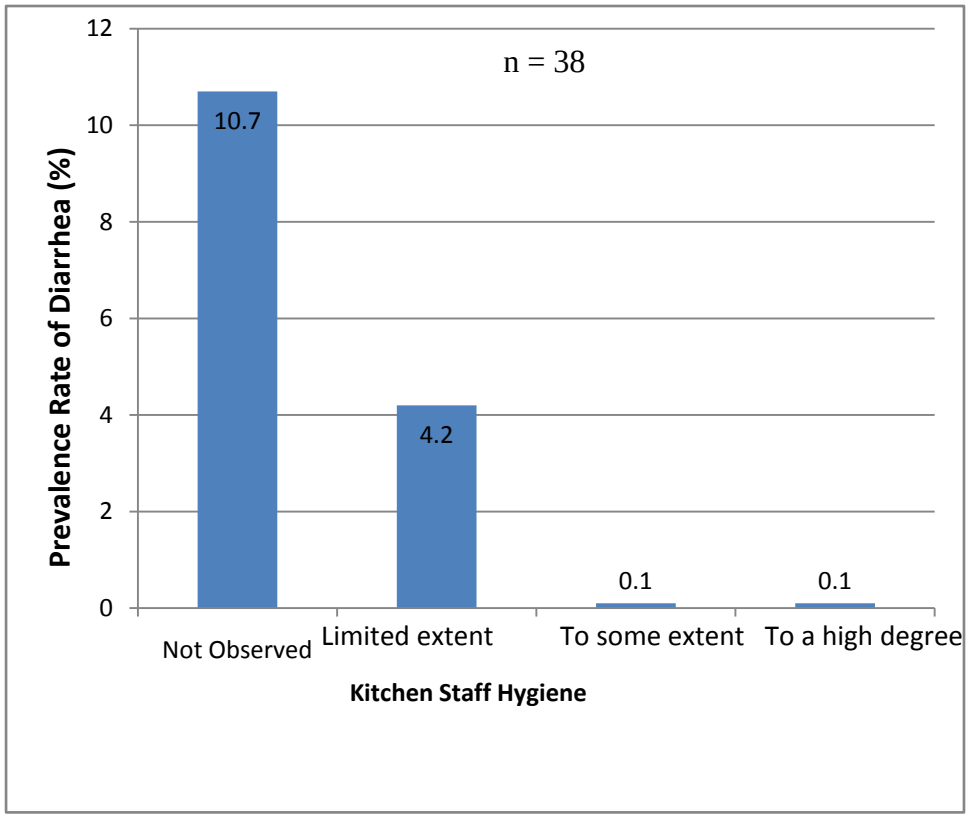


*Figure 4.20 :* Diarrhea prevalence rates against Kitchen Staff Hygiene among secondary schools in Kisumu County, Kenya

Health inspection in schools is an important component of school health service. Studies have shown that the health inspection in schools is necessary to ensure that children derive optimum benefit from investments in education and health programs, and that they remain physically, mentally and socially healthy. WASH in schools' programming focuses on improvement of water and sanitation access; point-of-use water treatment technologies; and behavior change and hygiene promotion (Pamela, 2010).

WASH in schools has boosted school attendance and achievement, and has promoted personal hygiene and environmental sanitation in schools and communities and at the same time reduced the burden of diarrheal diseases. Keeping hands clean has reduced communicable diseases burden (Anne, 2011; CDC, 2013). Shigellosis infection is by fecal-oral route. The importance of hand washing with soap, and strict hygiene for food preparation particularly after activities such as bowel movements cannot be overemphasized (Anne, 2011). Results of this study reveal the prevalence of diarrhea is high among students in schools where Kitchen Staff hygiene was not observed (Figure 4.20).

*h. Diarrhea prevalence rates against Student – Toilet Ratio among secondary schools*

Prevalence rate of diarrhea was 4.0% in schools where Student- Toilet Ration was not observed; 3.4% where the intervention was observed to a limited extent; 3.9% where the intervention was observed to some extent; and 3.8% where the intervention was observed to a high degree (Figure 4.21).There was a significant ($X^2_{2,\ 0.05}$=39.84) association between Student –Toilet Ratio and prevalence rate of diarrhea among secondary schools in Kisumu County; there is not strong evidence that the intervention has effect (Table 4.2).Prevalence of intestinal parasite infections may be attributed to poor environmental conditions and personal hygiene, and inadequate supply of safe water and waste disposal (Fatma & Ibrahim, 2011). These findings concur with the results of this study showing that prevalence of diarrhea is high in schools where student-toilet ratio was not observed (Figure 4.21).

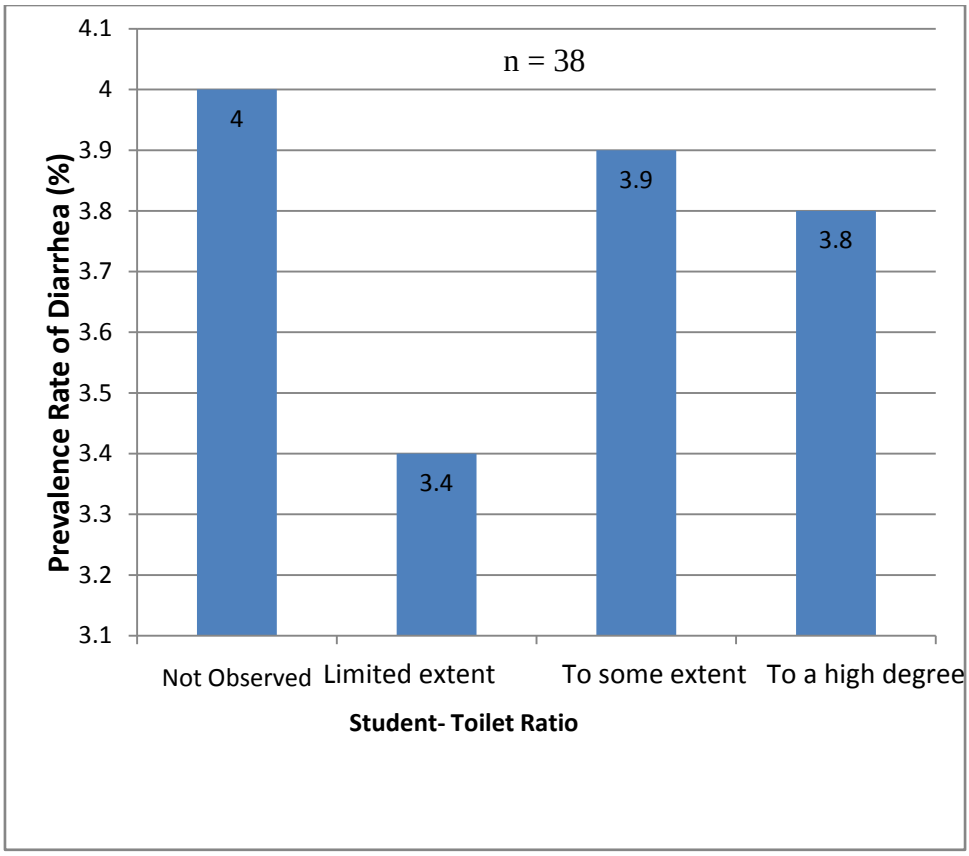


*Figure 4.21 :* Diarrhea prevalence rates against Student-Toilet ratio among secondary schools in Kisumu County, Kenya

*i. Diarrhea prevalence rate against Condition of Eating Area among secondary schools*

Prevalence rate of diarrhea was 3.9% in schools where Condition of Eating Area was not observed; 3.5% where the intervention was observed to a very limited extent; 4.1% where the intervention was observed to some extent; and 3.6% where the intervention was observed to a high degree (Figure 4.22); prevalence also high in schools where liquid waste disposal was not observed (Figure 4.23) and illustrated in Plates 4.3 and 4.4.

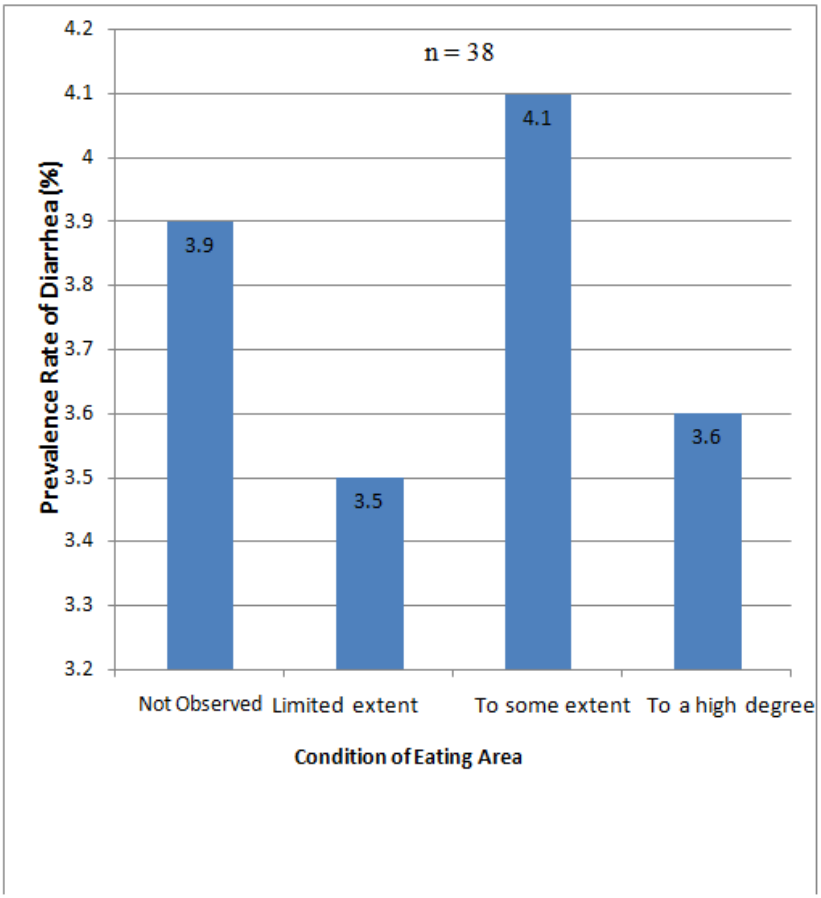


*Figure 4.22 :* Diarrhea prevalence rates against Condition of Eating Area among secondary schools in Kisumu County, Kenya

There was a significant association ($X^2_{3,\ 0.05}$=34.000) between condition of eating area (floor/walls) and prevalence of diarrhea among secondary schools in Kisumu County ($p<0.05$); there is not strong evidence that the intervention has effect (Table 4.2).

*Plate 4.3 :* A photograph showing a smoky kitchen area among secondary schools in Kisumu County, Kenya

*Plate 4.4 :* A photograph showing cooked foods kept uncovered in a school kitchen among secondary schools in Kisumu County, Kenya

Many diarrheal agents thrive in organic matter and can therefore multiply rapidly in cooking areas with poor floors and walls and therefore in food kept in such places (Scholthof, 2007). Figure 4.22 reveal that most schools did not observe conditions of eating areas to the highest degree; the net effect was that more students had incidences of diarrhea in these conditions that in schools where condition of eating area was observed to the highest degree. Control of hygiene in public eating places is a well-established public health function to prevent the occurrence and spread of pathogens like salmonella and Escherichia Coli. Keeping school environment clean by ensuring proper maintenance of eating areas ensures frequency of exposure from diarrheal agents is minimized.

*j. Diarrhea prevalence rate against Liquid Waste Disposal among secondary schools in Kisumu County*

Prevalence rate of diarrhea was 10.3% in schools where Liquid Waste disposal was not observed; 3.1% where the intervention was observed to a very limited extent; 1.7% where the intervention was observed to some extent; and 0.0% where the intervention was observed to a high degree (Figure 4.23 ).

There was a significant ($X^2_{2,\ 0.05}=11.692$) association between Liquid Waste Disposal intervention and prevalence of diarrhea among secondary schools in Kisumu County; there is not strong evidence that the intervention has effect (Table 4.2).

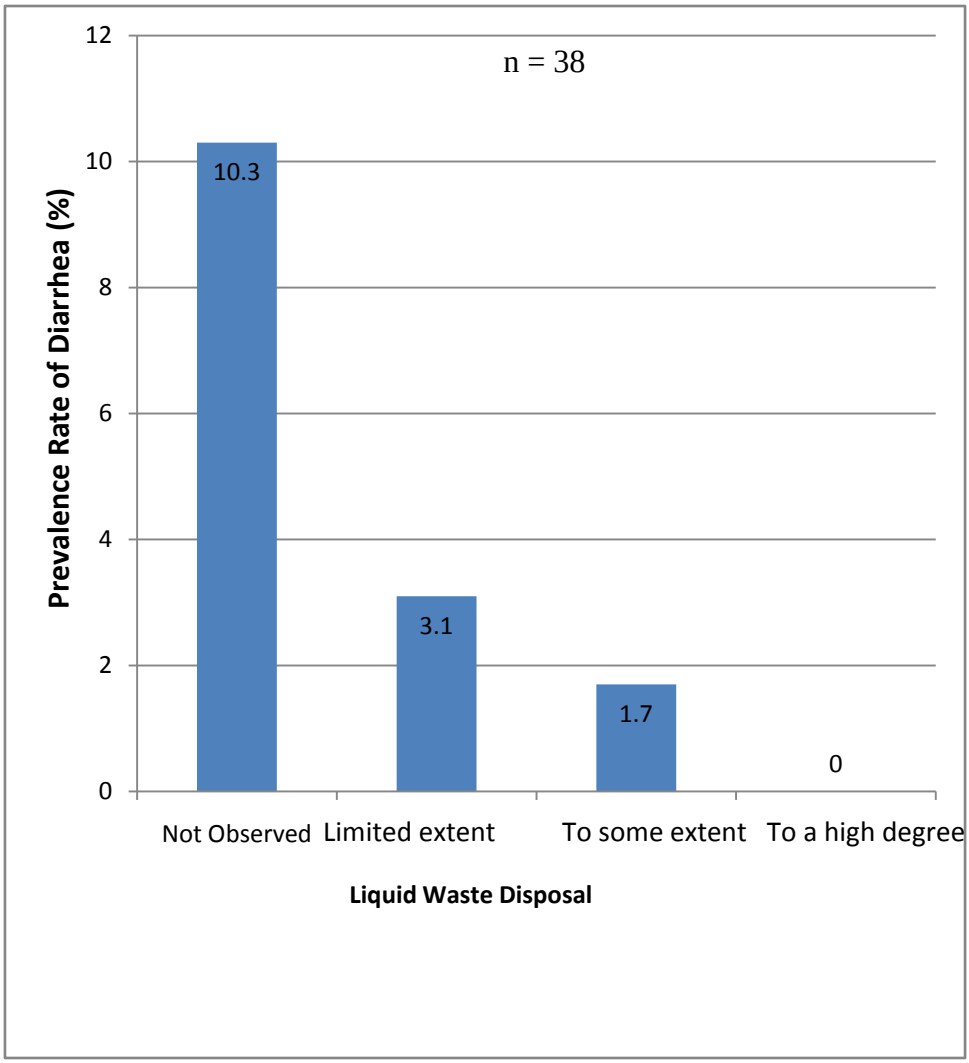


*Figure 4.23 :* Diarrhea prevalence rates against Liquid Waste Disposal among secondary schools in Kisumu County, Kenya

*k. Tuberculosis and Pneumonia Infection in Secondary Schools*

Tuberculosis and Pneumonia are the third and fourth most important communicable diseases among secondary students with prevalence rates of 7.2% (7200 per 100 000 students) and 5.2% (5200 per 100 000 students) respectively (Figure 4.4), and these results are discussed at the end of section 4.6.3.

*l. Tuberculosis and Pneumonia prevalence Rates against Ventilation in Hostels among secondary schools*

Prevalence rate of Tuberculosis and Pneumonia were 7.2% and 5.2% in schools where ventilation in hostels was observed to some extent, and 0% for other observations (Figure 4.24).

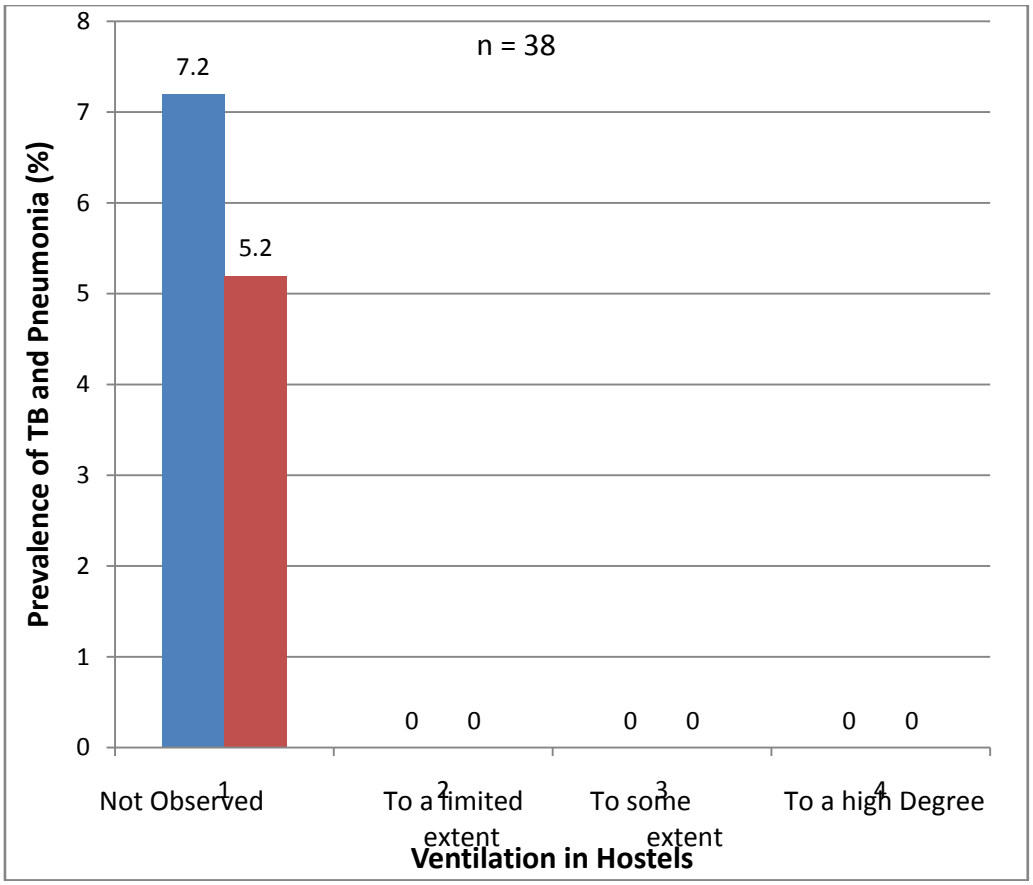


*Figure 4.24* Tuberculosis and Pneumonia prevalence rates against Ventilation in Hostels among secondary schools in Kisumu County, Kenya

There was a significant ($X^2_{6,\ 0.05}$=11.385) association between tuberculosis and pneumonia prevalence rates and ventilation in hostels of hostels among secondary schools in Kisumu County.

*m. Tuberculosis and Pneumonia prevalence rates against Bed Spacing in Hostelsand Desk Spacing in Classrooms among secondary schools in Kisumu County*

Prevalence rate of Tuberculosis and Pneumonia were 7.2% and 5.2% in schools where bed spacing in hostels was not observed and 0% for other observations (Figure 4.25 (a)).

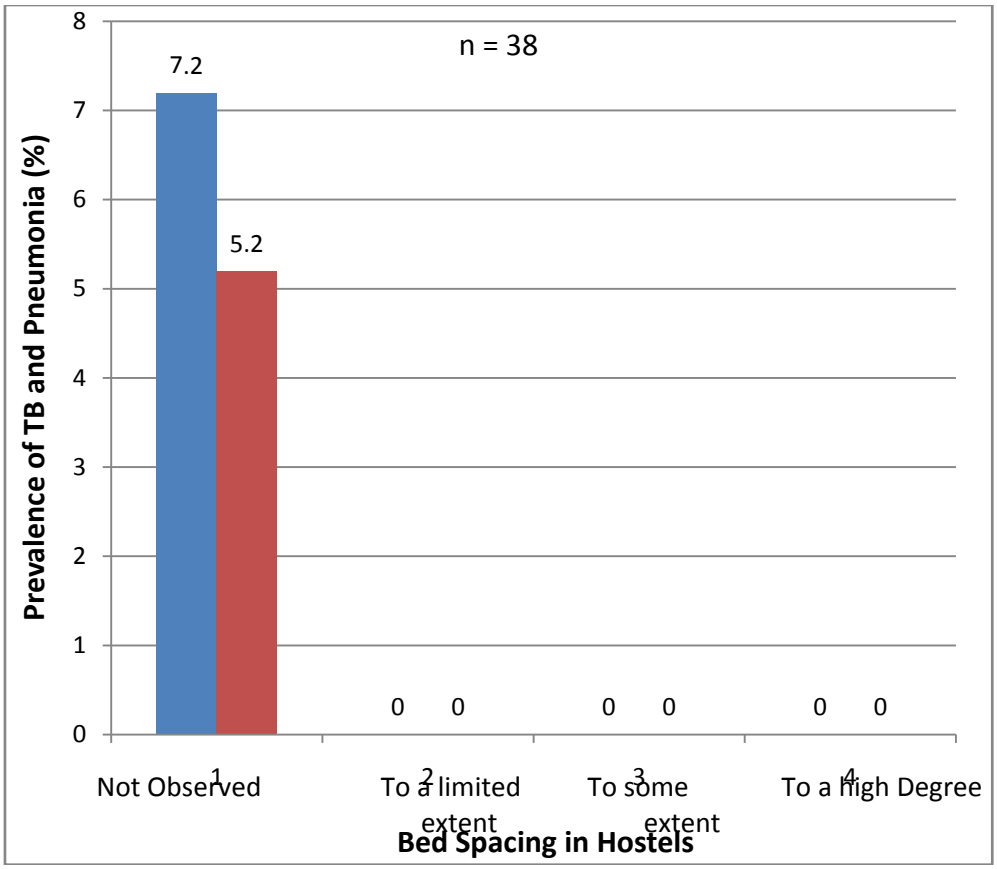


*Figure 4.25 (a) :* TB and Pneumonia prevalence rates against Bed Spacing in Hostels among secondary schools in Kisumu County, Kenya

There was a significant ($X^2_{6,\ 0.05}$=8.21) association between bed spacing and prevalence rates of tuberculosis and pneumonia among secondary schools; there is not strong evidence that the intervention has effect (Table 4.2).

Prevalence rate of Tuberculosis and Pneumonia were 4.8% and 5.0% respectively in schools where desk spacing in classrooms was not observed; 2.4% and 0.2% respectively in schools where desk spacing was observed to a very limited extent, and 0% for other observations (Figure 4.25 (b).There was a significant ($X^2_{6,\ 0.05}$=8.21) association between desk spacing and prevalence rates of tuberculosis and pneumonia among secondary schools; there is not strong evidence that the intervention has effect (Table 4.2).

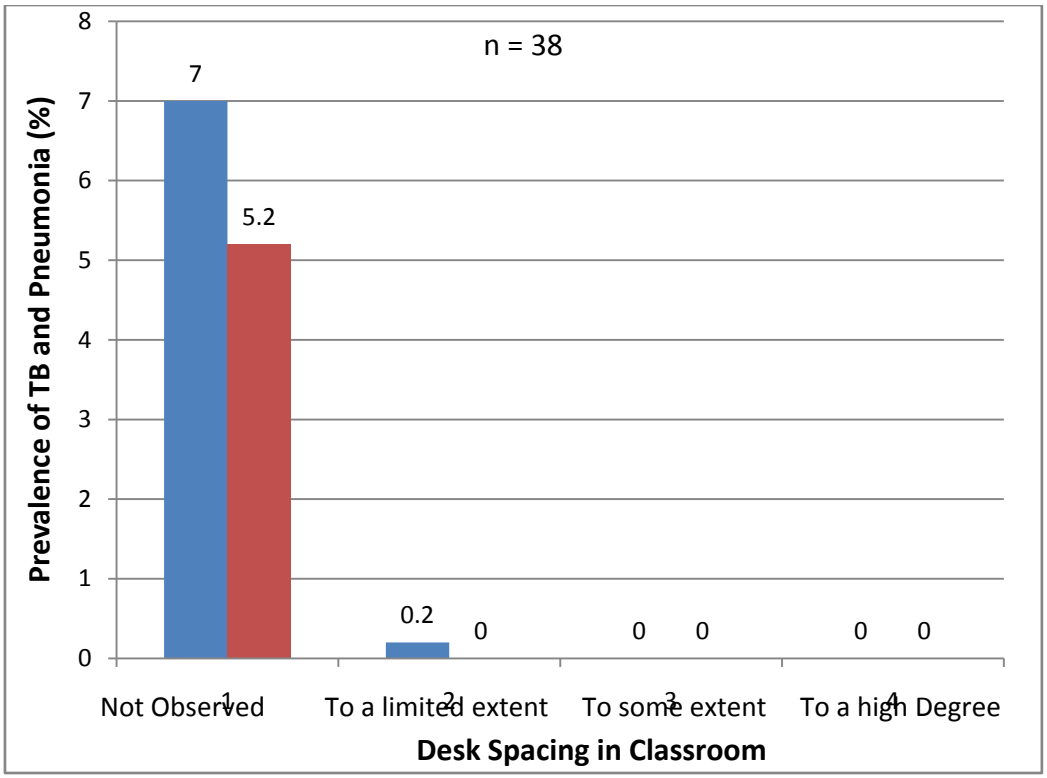


*Figure 4.25(b) :* TB and Pneumonia prevalence rates against Desk Spacing in classrooms among secondary schools in Kisumu County, Kenya

Transmission of infections in students can easily occur due to large concentration of students in a school (CDC, 2007). This is supported by the findings in Figure 4.24; Figure 4.25 (a) and Figure 4.25 (b).

*n. Tuberculosis and Pneumonia prevalence rates against Ventilation in Classrooms among secondary schools*

Prevalence rate of Tuberculosis and Pneumonia were 5.3% and 5.1% respectively in schools where desk spacing in classrooms was not observed; 1.9% and 0.1% respectively in schools where desk spacing was observed to a very limited extent, and 0% for other observations (Figure 4.26).

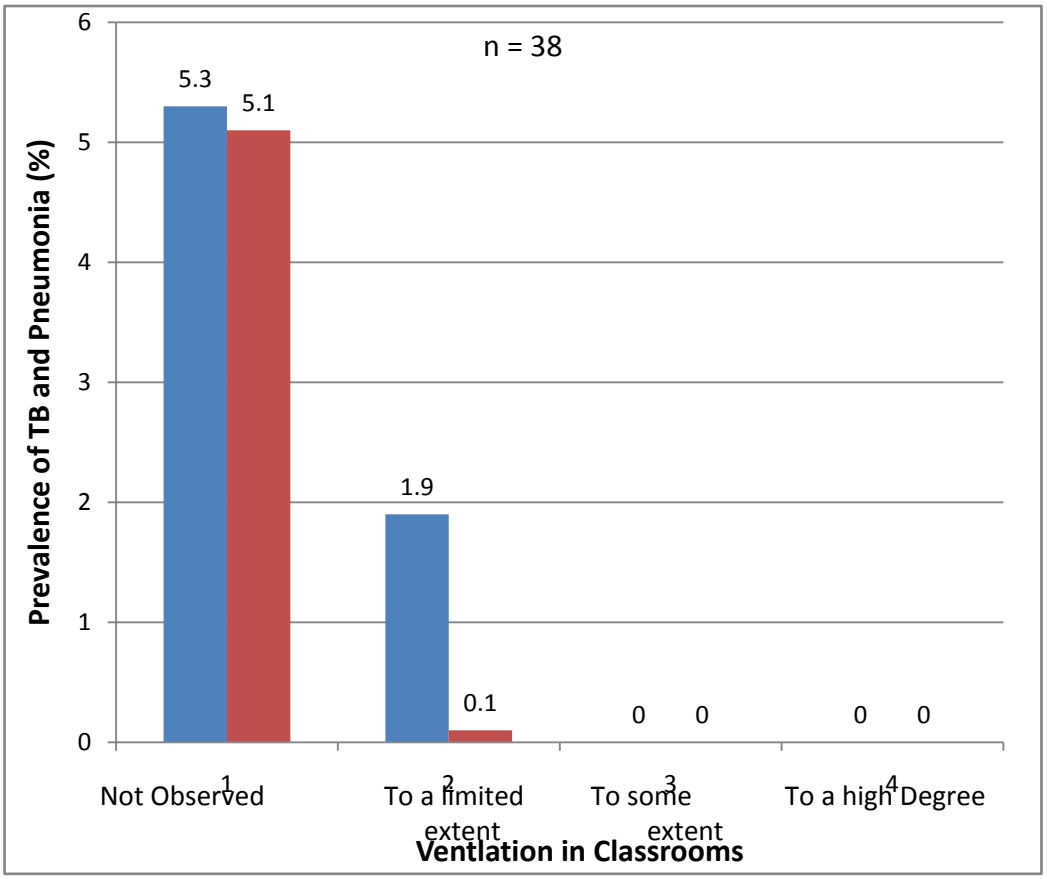


*Figure 4.26 :* Prevalence rates of Tuberculosis and Pneumonia against Ventilation in Classrooms among secondary schools in Kisumu County, Kenya

There was a significant ($X^2_{6,\ 0.05}$=11.309) association between ventilation in classrooms and prevalence of tuberculosis and pneumonia among secondary schools; there is not strong evidence that the intervention has effect (Table 4.2).

o. *Tuberculosis and Pneumonia prevalence rates against Condition of Classroom among secondary schools*

Prevalence rate of Tuberculosis and Pneumonia were 7.0% and 5.2% respectively in schools where condition of classroom was not observed; 0.2% and 0% respectively in schools where desk spacing was observed to a very limited extent, and 0% for other observations (Figure 4.27).

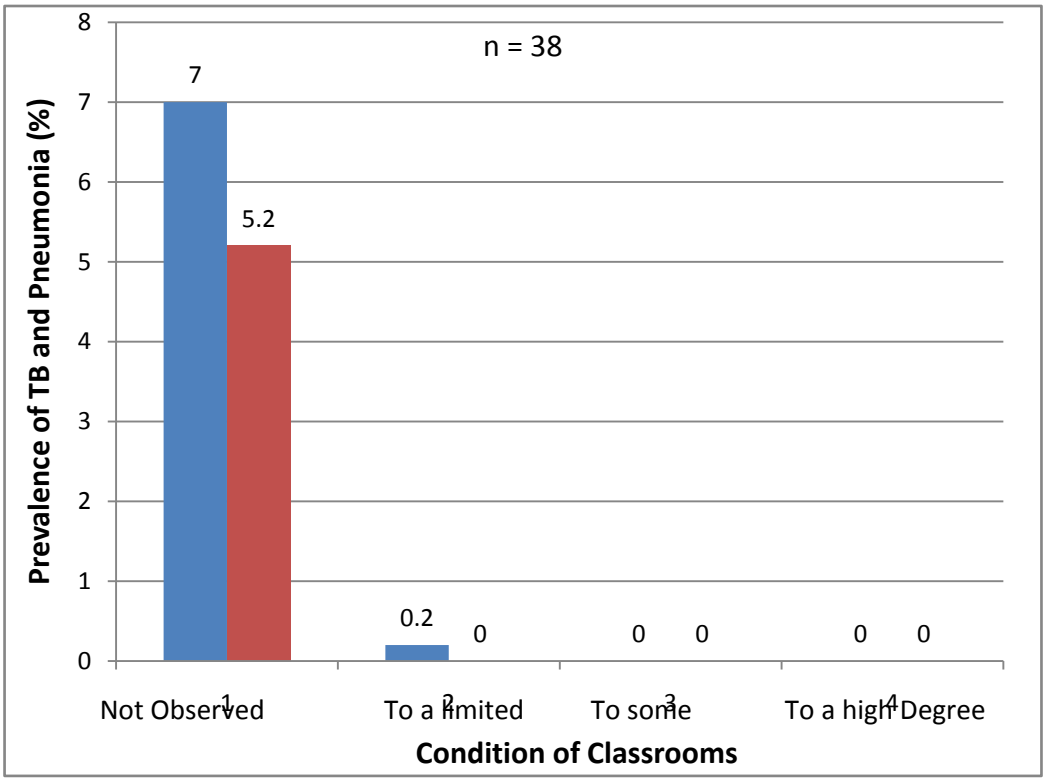


*Figure 4.27 :* TB and Pneumonia Prevalence rates against condition of classroom among secondary schools in Kisumu County, Kenya

The findings of this study agree with the findings of Baker et al., (2013) which revealed that children less than five years old exposed to greater household crowding had 1.69 times the odds of pneumonia than children exposed to the least crowding. It has been documented that children play an important role in the epidemiology of diseases.

*p. Health Seeking Behavior among secondary Students in Kisumu County, Kenya*

Health seeking behavior among students is one important health indicator in a school. The findings are discussed in terms of places where treatment was sought, whether recovered or not recovered, and availability of health clinics in the school compound.

*q. Place of treatment among secondary students in Kisumu County*

A large proportion (77.5%, 310 out of 400) of respondents confirmed sickness in the last two weeks from the time of data collection.

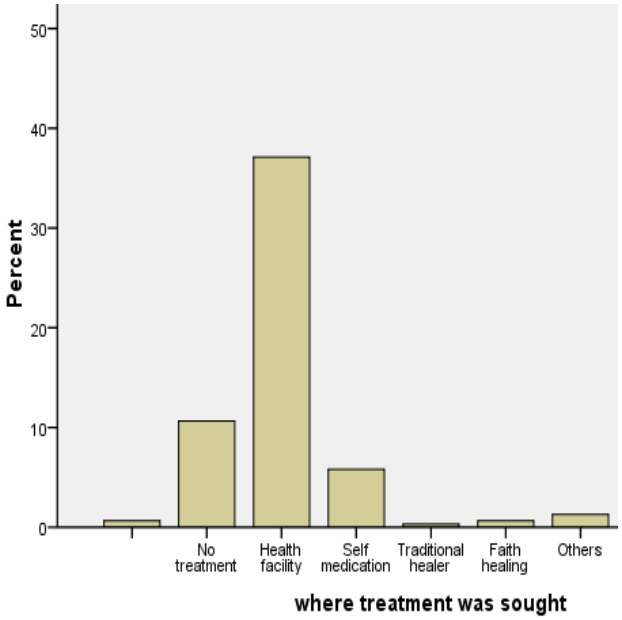


*Figure 4.28 :* Proportion of secondary Students in Kisumu County against place where treatment was sought

Thirty eight percent (38.0%) sought treatment in health facilities when ill. However, 9% did not seek treatment, 5.2% had self-medication, 0.5% sought treatment from traditional healers, 0.8% went to faith healers and 2.5% had other treatment procedures not specified (Figure 4.28).

*r. Recovery Status among secondary students in Kisumu County*

Out of the 310 respondents who were sick, 147(47.4%) sought treatment. Seventy eight (78) out of 310 (25.2%) sought treatment and recovered while 59 out 310 (19.0%) sought treatment and did not recoverbut were still on treatment.

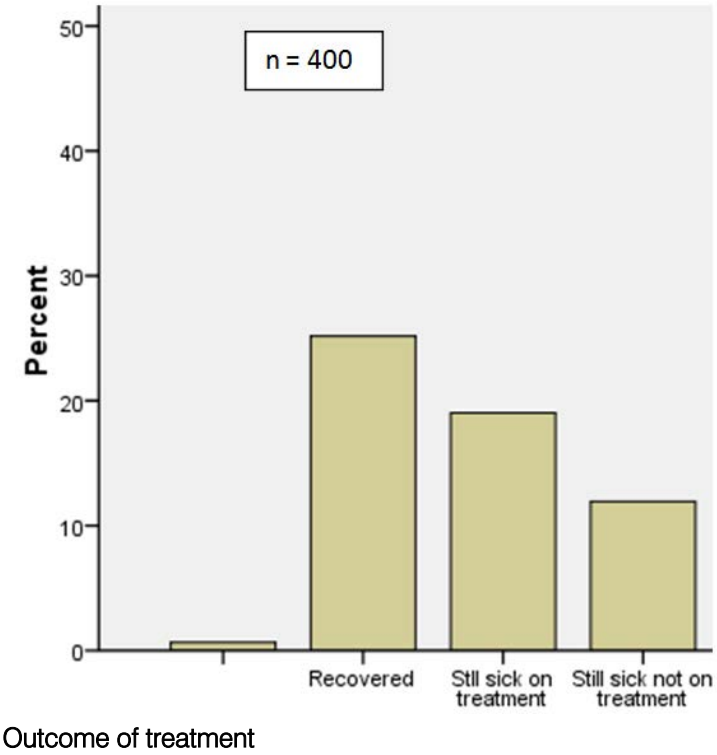


*Figure 4.29 :* Proportion of secondary Students in Kisumu County against Outcome of treatment

Thirty seven (37) out of 310 (11.9%) of those who were ill and did not seek treatment were still sick (Figure 4.29). There was a significant ($X^2_{4,\ 0.05}$=184.374) association between communicable disease prevalence rates and health seeking behavior in schools; there is strong evidence that the intervention has effect (Table 4.2).

*s. Health Unit status among secondaryschools in Kisumu County*

Only 4 out of 38 (10.5%) schools had health units with trained nurses, compared to 31 out of 38 (81.6%) schools that had no health units.

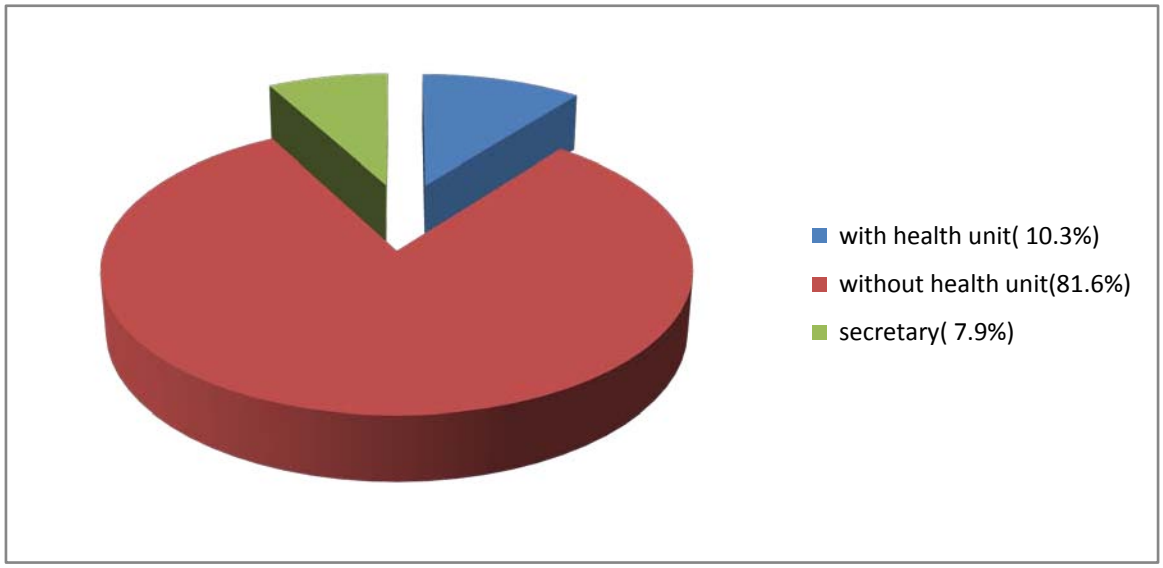


*Figure 4.30 :* Proportion of Secondary schools with Health Units in Schools

Schools without health units engaged school matrons or school secretaries to dispense drugs to students (Figure 4.30).

There are important gender differences (Figure 4.8) related to health seeking behavior and access to health care. In some societies there are differences in the utilization of health care facilities and in the level and type of care given to males and females, for example, Pandey *et al.* (2002) in their follow up observational study in Kolkata, India, found that boys with diarrhea were more likely to be given oral rehydration fluids than girls, and were more likely to be taken to qualified health professionals for treatment. A similar result (Mitra, Rahman & Fuchs, 2000) was found in Bangladesh where the time between the onset of symptoms of diarrhea and hospital admission was significantly higher in girls than for boys. Having health clinics with qualified staff in schools may improve health seeking behavior which is an intervention pillar in reversing trends of communicable disease burden in schools (Table 4.2).

Health care system is an environmental factor of relevance to the occurrence of diarrhea (Mills *et al.,* 2006). A functional school health system is key in prevention of diarrhea; disease control program will depend on a strong health system with facilities and well trained and motivated personnel (Linstsrom *et al.,* 2006). This study has shown that a large percentage (Figure 4.28; Figure 4.29) of students who go to health facilities for treatment also recover from their illnesses.

*t. Relationship between Intervention Programs and Prevalence Rates among secondary schools*

On analysis of variance (ANOVA), the results are shown in Table 4.2. This study has revealed that health seeking behavior is an important public health intervention program that should be enforced in all schools (Figure 4.29).

*Table 4.2 :* ANOVA for public health intervention programs among secondary schools

| Intervention Program | Statistical Indices | | |
|---|---|---|---|
| | df | F | Significance at 95% Confidence Interval |
| Safe water provision | 2 | 1.031 | 0.368 (ns) |
| Insecticide Treated Mosquito Net Use (ITN) | 2 | 0.335 | 0.717 (ns) |
| Ventilation in Hostels | 2 | 0.849 | 0.437 (ns) |
| Health seeking behavior | 6 | 340.995 | 0.000 (ss) |
| Bed Spacing in Hostels | 2 | 0.276 | 0.761 (ns) |
| Desk Spacing in Classrooms | 2 | 0.307 | 0.738 (ns) |
| Ventilation in Classrooms | 2 | 0.824 | 0.447 (ns) |
| Condition of Classrooms | 2 | 0.074 | 0.929 (ns) |
| Hand washing before eating | 3 | 0.839 | 0.482 (ns) |
| Water only at hand washing area | 2 | 0.214 | 0.809 (ns) |
| Water and soap at hand washing area | 2 | 0.402 | 0.672 (ns) |
| Water, soap, and disposal towel at hand washing area | 1 | 0.020 | 0.889 (ns) |
| Condition of eating area | 3 | 1.640 | 0.199 (ns) |
| Kitchen Staff Hygiene | 2 | 0.308 | 0.737 (ns) |
| Student-Toilet Ratio | 2 | 0.099 | 0.906 (ns) |
| Hand washing after defecation | 2 | 0.471 | 0.628 (ns) |
| Solid waste disposal | 2 | 0.780 | 0.930 (ns) |
| Liquid waste disposal | 3 | 0.308 | 0.819 (ns) |
| Mosquito breeding control | 3 | 0.173 | 0.914 (ns) |

*Key: ns- there is not strong evidence that the intervention has effect ss- there is strong evidence that the intervention has effect*

## CHAPTER FIVE

## V. Conclusions and Recommendations

*a) Introduction*

This chapter is divided into four sections, namely summary of findings; conclusions which are based on the findings of the three research objectives; recommendations are given in terms of policy statementsfor the control and prevention of communicable diseases in secondary schools; and suggestions for further research based on research priorities for gaining a better understanding of the challenges of communicable diseases in secondary schools.

*b) Summary of findings*

A total of 400(out of 60 230) students in 38 (out of 187) secondary schools were sampled in Kisumu County in the year 2014. The most predominant student age bracket was 14-17 years forming 67.8% of the sampled population. By gender, the male students were 53% while female population was 43%. More students were Catholics (33.8%), while 2.0% did not belong to any religious grouping.

Computed communicable disease prevalence rates revealed that Malaria 20 700 (20.7%) per 100 00, Diarrhea 15 100 per 100 000 (15.1%), Tuberculosis 7200 per 100 000 (7.2%), and pneumonia 5200 per 100 000 (5.2%) were the most important communicable diseases among students in secondary schools in Kisumu County, Kenya.

There was no significant association between school locality and prevalence rates of communicable diseases. However, type of school, size of school, gender and age of the student, and class of the student were significantly associated with the prevalence rates of communicable diseases among secondary students in Kisumu County, Kenya. Prevalence rate of malaria was higher in male students (14.02%) than female students (6.68%) compared to prevalence of diarrhea which was higher in female students (7.96%) than male students.

Insecticide treated mosquito net use was the best practice in Malaria control among students in secondary schools. Provision of water at handwashing area was best practice for diarrhea control while health seeking behavior among secondary school students was the gold standard for control of the burden of communicable diseases.

*c) Conclusions*

This study has revealed that prevalence of diarrhea, tuberculosis, pneumonia and other respiratory

tract infections are lower among female secondary school students than males, and that prevalence of malaria is higher in males than females. These differences are more due to differences in exposure than the differences in immunity. Male students spend more time outside houses in their normal life than female students and therefore exposed more to mosquito bites than females while females spend a lot more time in the households caring for the sick and changing nappies, for example, and more exposed to diarrhea, tuberculosis and pneumonia causing pathogens.

Age of secondary school students is a significant vulnerability factor to Malaria, diarrhea, tuberculosis and pneumonia which were the important communicable diseases most prevalent among secondary school students in Kisumu County, Kenya.

Provision of water only for hand washing, and health seeking behavior were the best public health interventions practices observed among secondary schools and students respectively in Kisumu County, Kenya.

*d) Recommendations*

- Education about causes of malaria, diarrhea, tuberculosis and pneumonia; clinical features and prevention to be an important part of the curriculum for all schools in areas where students are at risk of infection.
- National communicable disease control programs to play increasing attention to the problem of malaria, diarrhea, tuberculosis and pneumonia among secondary school students.
- All secondary schools to provide running water for hand washing to prevent diarrhea, tuberculosis and pneumonia infections.

*e) Suggestions for further research*

- Epidemiology

Acquisition of better knowledge of the magnitude and features of communicable diseases in secondary schools, especially, in areas where the overall incidence of communicable diseases is declining.

- Prevention

Gender roles and prevalence of communicable diseases among students should be explored.

Establishment of functional school health units with trained school health nursesto diagnose using rapid diagnostic tests, and treat effectively in different settings malaria and tuberculosis infections. This will improve students' health seeking behavior which is a flagship in communicable disease control.

## VI. Acknowledgement

My sincere thanks go to my supervisors Professor J. Wakhungu and Dr S. Omuterema, both of department of Disaster Management and Sustainable Development for their academic guidance and ensuring that I am kept on my toes, not only during the writing of this thesis but also as I pursued the entire course. I cannot forget my classmates for their co-operation, support and group discussions which enlightened me a great deal.

Last but not least, I am grateful to everyone who contributed to my studies in one way or another, though not mentioned here by name, may God bless you all.

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## Appendix I

Questionnaire for students

IDNTIFICATION PAGE
DISTRICT……
LOCALITY…….. 1= Rural; 2= Urban
EDUCATION ZONE……
SCHOOL NAME……
SCHOOL TYPE……..1= Boys only boarding; 2= Girls only boarding; 3= Boys and Girls day; 4= Boys and Girls day and boarding; 5= Boys only day; 6= Girls only day
SCHOOL SIZE……1= 1- 200; 2= 201- 400; 3= 401- 600; 4= 601>
NAME OF ENUMERATOR…….
DATE OF INTERVIEW……
SUPERVISOR……..

**Confidentiality and consent [Parental/Guardian/Teacher consent should be sought for all students age 10-15 years];**

'I'm going to ask you some personal questions.

Your answers are completely confidential.

Your name will never be used in connection with any information you give me.

The purpose of asking these questions is for us to share the burden of communicable diseases in your school with a view of sharing the same with the government in order to improve school health services.

The results of this research will be disseminated to all schools participating in the study and at national level in order to inform public health policy for schools in Kenya.

The interview will take 30 minutes and I will appreciate your help in responding to these questions.

Would you be willing to participate?

Signature of the interviewee……., indicating that an informed consent has been given verbally by the respondent.

## 1.00 Demographic Information

1.10 Respondent's Gender……1= Male; 2= Female

1.11 Respondent's Date of Birth [DD/MM/YYYY]

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

1.12 Respondent's class/Form……1= F1; 2= F2; 3= F3; 4= F4

1.13 Have you been absent from your class this term? ..... 1= Yes; 2= No

If Yes, give reason……1= Sickness; 2= School levy; 3= other

(Specify……..)

1.14 Religion….. 1= Anglican; 2= Catholic; 3= SDA; 4= Indigenous Church; 5= Muslim; 6= None; 7= Others

(Specify……..)

2.00 MORBIDITY AND HEALTH SEEKING BEHAVIOR

2.10 Have you been ill in this school in the last two weeks? ……..1= Yes; 2= No

If yes, answer questions 2.11, 2.12, 2.13 and 2.14.

2.11 Duration of illness…….1= Less than 4 weeks; 2= 4 weeks or >

2.12 Type of illness encountered……..1= Malaria; 2= Diarrhea; 3= Tuberculosis (TB); 4= Pneumonia; 5= Other RTI (Specify……..) 6= Pregnancy related; 7= other (Specify……); 8= Don't know

2.13 Where was treatment sought? .....1= No treatment; 2= Health facility; 3= TBA/CHW; 4= Self medication; 5= Traditional healer; 6= Faith healing; 7= others (Specify……); 8= Not applicable

2.14 What was the outcome? ……. 1= recovered; 2= still sick on treatment; 3= still sick not on treatment; 4= others (Specify……..); 7= Not applicable

2.20 Have you experienced an unexplained weight loss in the past 3 months? ..... 1= Yes; 2= No

2.30 Have you experienced persistent diarrhea (Lasting more than 1 month) in the past 3 months? …… 1= Yes; 2= No.

2.40 Do you use insecticide treated net (ITN)at night when you sleep? ……1=Yes; 2=No.

2.50 Are there water points near the school toilets? 1= Yes; 2= No

2.5.1. If yes, state how you use them……
……

2.5.2. If no, state where students get water from for personal use……
……

2.6.0. State why it is important to wash hands with running water
……

2.8.0. In your opinion, what would make one wash his/her hands……
……

2.9.0. What challenges do you have in school that would stop you from washing your hands?.....
.....
.....

THANK YOU

## Appendix II

### Focus Group Discussion Guide

Focus group discussion is defined by Krueger and Casey (2000) as a special type of group in terms of purpose, size, composition and procedures. The purpose of conducting group discussion is to listen and gather information from different people. It helps to obtain a better understanding of how people feel issues, services or products. It enables individuals to recall facts that other group members have forgotten. Focus group discussion will be conducted with 8 – 12 quota sampled members to corroborate the data from the field. It will involve identification of thematic categories and coding them by repeatedly reading the transcripts. The major themes will finally be identified after all the categories are coded.

*Composition of the group:* Selection will be by quota sampling and the researcher will have a wide choice in the selection of the respondents from different cells to meet their quotas. The cells will include school administration, the health sector, Non-Governmental Organization, County administration and Ministry of Education. These will be selected as follows to give a total of 10 members for the FGD:

- School administration (PTA/BoM, School principal, Boarding Master/Mistress, Cateress)----------4 members
- Health sector (Public Health Officer, School health nurse)----------2 members
- NGOs (CARE, ACTION AID, SANA, Plan Int., etc)---------- 2 members
- County Administration (Area chief or rep.)----------1 member
- Ministry of Education (Quality Assurance and Standards Officer)—1 member

*a) The Objective of the study*

To get better understanding of the thoughts, experiences, attitudes and perceptions of the group members and what they would prefer as a better school heath intervention program to help them manage challenges and continue with provision of better health services for schools.

*Main thematic issues:* Groups' perception on skill-based education; communicable disease surveillance system; campaigns against sexually transmitted

infections; medical checkups; school health policies; sanitation and hygiene practices; water quality; waste management; inspection procedures; isolation/ quarantine measures; food safety and nutrition

1. What is your opinion on skill based education on prevention of endemic conditions as well as care of affected and infected? And what bothers you about it?
2. Do you collect data on daily disease incidences? What do you use the data for?
3. What do you do to reduce incidences of sexually transmitted infections and unplanned pregnancies? How do you support those infected and affected by the scourge?
4. What can students and other members of staff do in case of a health related incidence?
5. What possible solutions do you have for early detection and management of infectious diseases/outbreaks?
6. Who works in the sanatoria? What services do you provide here?
7. What kind of services do you promote and encourage to manage the environment and keep away insects and other vectors in order to reduce contacts with such organisms?
8. Who do you normally invite to carry out inspection on the health status of the school? How often do you do this? What would prompt you to carry out health inspection?
9. What do people in this school say about food storage and handling? What is your opinion on this?
10. What are your reasons for providing adequate and safe water to the school community? How would you ensure that water provided is safe? How often do you do this?
11. Would you say you have adequate latrines/or sanitation facilities in terms of official guidelines?
12. What would make you take measures such as isolation and quarantine to sick students? Which diseases would need such measures?
13. You represent one of the organizations that have health promotions programs in this area. Share with us your contribution towards promoting good health practices in this school. How do you assess your programs; would you say you have succeeded? Tell us more.
14. Provincial administration is key in the promotion of good health practices in the community. Share with us the programs you have to ensure the community is healthy. How do you rate the relationship between the community and the school in terms of resource sharing? What are the challenges you face in terms of communicable disease control?
15. In your opinion, based on the intervention programs we have discussed, rank them in order of best performing.
16. What are your future expectations?

*Wrap up:* Given your own experiences, what did I miss to ask you about health intervention programs in this school? Would you like to ask me anything?
*Note:* the order of questioning may change depending on who is being probed.

## Appendix III

### An In-depth Interview Guide for Index Cases

*Note:* Index Cases are students with clinically confirmed illnesses of communicable diseases.

**I am interested in learning about some of the experiences you had before you became ill and how you have been coping since then. May be you could start by telling me about the environment where you spent most of your time in.**

1. Were there other students/people having the same ailment in that environment?
2. What would make you become ill? Please explain.
3. From what you have told me what would you say was the main reason why you became ill?
4. If you were in the same environment again what would you do differently? Tell me how this would stop you from becoming ill.
5. Give an approximation of bed spacing in the halls of residence. Use a 30cm ruler.
6. What do you remember about the teachings on how to protect yourself from such infections? Do you clean your hands with soap and running water after visiting a toilet?

**I would like to learn a little bit about what the school was like when you became ill.**

What kind of situations were in the school that contributed to your illness? Have the situations changed? Please explain.

7. Have you recovered/recovering from the ailment? Please explain.
8. What kinds of things did your parent/guardian/school do to assist you in recovery?
9. What are other students/school community say about the health and hygiene situation in the school? Explain.
10. In your opinion what would you want improved/put in place to reduce incidences of such diseases?
11. In your stay in this school, have you ever seen health inspectors in school doing inspection?
12. Given a chance, what would you do with the current situation in the school to reduce incidences of such diseases?

Thank you very much for your time and contribution.

## Appendix iv

### Observation checklist for schools

On a scale of 0-3, mark the extent to which the following public health interventions are observed during this period.

| Intervention | Not observed score=0 | Observed to a very limited extent score=1 | Observed to some extent score=2 | Observed to a high degree score=3 |
|---|---|---|---|---|
| Ventilation in hostels | | | | |
| Bed spacing in hostels | | | | |
| Condition of hostel floor/walls | | | | |
| ITNs use | | | | |
| Desk spacing in classrooms | | | | |
| Ventilation in classrooms | | | | |
| Condition of classroom floor/walls | | | | |
| Hand washing before eating | | | | |
| Water only at handwashing area | | | | |
| Water+soap at hand washing area | | | | |
| Water+soap+disposable towels at handwashing area | | | | |
| Condition of eating area floor/walls | | | | |
| Kitchen staff hygiene | | | | |
| Student-Toilet ratio | | | | |
| Handwashing after defecation | | | | |
| Solid waste disposal | | | | |
| Liquid waste disposal | | | | |
| Mosquito breeding control | | | | |
| Safe water provision | | | | |