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Research Article

Public Health Intervention Programs in Kenyan Schools and Prevalence of Communicable Diseases

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Abstract

Purpose: To evaluate existing public health intervention programs for schools to inform the variability in communicable disease prevalent rates among secondary school students in Kisumu County, Kenya.

Methods: A normative evaluation research design focusing on public health behavior change adherence among students and school staff was adopted. For example, it was 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 answered included whether intervention strategies were in place, was the intervention reaching the target population, challenges of implementation, and what appears to be working among others. Comparisons between risk factors were made by chi-square and ANOVA using SPSS for Windows (version 15.2; Chicago, IL) software. A p value of <0.05 was considered statistically significant.

Results: Use of insecticide treated mosquito net was the best practice in malaria control among students in secondary schools. Provision of water at hand washing 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, $X^2_{2, 0.05}$=44.42.

Conclusion: Provision of water for hand washing as a public health intervention strategy had strong evidence that the intervention strategy had effect in reduction of prevalence rates of diarrhea, tuberculosis and pneumonia, whereas health seeking behavior of students had a strong effect in reduction of burden of malaria, diarrhea, tuberculosis and pneumonia ($X^2_{4, 0.05}$=184.374).

Keywords: Prevalence, Intervention, Malaria, Diarrhea, Tuberculosis, Pneumonia, Normative evaluation, Schools

Background

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 [1,2]. Now we acknowledge that a systems approach is required [3]. 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 of time 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 [4]. 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 [5,6]. Involving students in a public health behavior change intervention programs ensures successful diffusion of innovation into student's homes. Therefore need to evaluate public health intervention programs in schools for optimal use and its correlation with prevalence rates of communicable diseases.

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Public secondary schools in Kenya have become overcrowded [7,8], and as observed in their studies [9,10], overcrowding results in outbreaks of communicable diseases including cholera, tuberculosis and typhoid fever among others. The big question is; are the intervention programs student friendly? Why are communities not realizing declines in prevalence rates of communicable diseases? Malaria, diarrhea, tuberculosis and pneumonia are the most prevalent communicable diseases and with significant variation among students and schools in Kisumu County [11].

Kisumu County suffers from high burden of communicable diseases as well as emerging threats. According to the Kenya Demographic and Health Survey, [12] the County has one of the highest HIV/AIDS prevalence rates at 17% higher compared to rest of Nyanza region rate of 15.3%, and the national rate of 7.4%. Kisumu West sub-County, one of the sub-Counties 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 while 42% of the households share toilets and 21% have no toilets [13].

Kisumu County was chosen because prevalence rates of communicable diseases are higher than both regional and national rates. 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. A major contributing factor to this burden of communicable disease is inadequate access to safe water and sanitation infrastructure.

Materials and Methods

Research design

The researcher adopted normative evaluation research design focusing on public health behavior change adherence among students and school staff. 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 answered included whether intervention strategies were in place, was the intervention reaching the target population, challenges of implementation, and what appears to be working among others.

Sampling strategy

A representative cluster sample size (n=400) for 60,230 students was estimated using Fisher et al.'s formula. There are six sub-Counties in Kisumu County. Based on coefficient of variation by gender of students and type of school, three sub - Counties (Nyakach, Kisumu East and Kisumu West) with the highest value of coefficient of variation were selected. The three had a student population of 41 858 (22 137 boys and 19 721 girls) [14].

Education zones in each sub - County were then selected by cluster sampling technique based on number of students and type of school. Six zones (30% of 21 zones in the three sub – Counties) were then selected by the highest coefficient of variation. Schools in each zone were then arranged by type (Boys only, Girls only and mixed (boys and girls) schools). Thirty percent of schools, 38 out of the total 129 schools were then selected based on coefficient of variation by school type (30 Boys and Girls/Mixed schools, 5 Boys only schools and 3 Girls only schools). Out of the 38 schools, 15 were urban schools while 23 were rural schools.

Data collection

Informed consent was sought before commencement of any data collection, and the respondents were assured of confidentiality and also informed of the purpose of the research. The respondents were required to affirm their consent verbally or by signing the consent form. Data were collected by direct observation, surveys, interviews and medical examination. Research authorization was sought from the School of Graduate Studies at Masinde Muliro University of Science and Technology and the administration of Kisumu County, Kenya.

Data on the state of facilities used for communicable disease intervention was collected using interview guide. Issues it addressed were on ambient (outdoor/indoor) air quality, provision of safe drinking water, water storage facilities and spill prevention, waste management system, and food storage. More data on intervention programs were collected by an observation checklist. Evaluation questionnaire was used to assess public health intervention programs in place in schools. The house Masters and Mistresses in schools were given opportunity to comment on open ended questions in the questionnaire, in order to explore some of the intervening mechanisms contributing to the impact of each intervention.

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 was 60 and in one question 40 respondents understood it correctly, then the coefficient of variation in that question was $\frac{40}{60}$ x100% = 66.7%. The question was reliable and taken for actual research.

Students filled a questionnaire on their morbidity status in the last two weeks from the date of the research. Those who did not self-report clinically confirmed illnesses in the questionnaire were taken to the nearest health facility for medical examination by medical professionals. The observed medical examination results of interest were:

(a) Blood slides testing positive for the malaria parasite; (b) Positive culture for Mycrobacterium tuberculosis confirming tuberculosis infection. An acceptable sputum specimen had more than 25 leukocytes and fewer than 10 epithelial cells per lower field. The most common pathogens detected were bacteria such as Streptococcus pneumoniae, Staphylococcus aureus and Klebsiella species. Sensitivity testing was done for positive results; (c) Positive rapid urine antigen testing for Streptococcus pneumonia; (d) Positive stool tests for Clostridium difficile for respondents having diarrhea or watery stools. Other tests done were an antigen test for notavirus, ova and parasite examinations and antigen tests specific for the parasites Giardia lambia, Entamoeba, histolyca, Crystosporidium and Parvum.

Data analysis and presentation

Chi Square was computed for association between public

health interventions (the independent variable) and prevalence rates of communicable diseases among students (the dependent variable). In addition, normative research analysis was adopted to explore the environment in which the program is delivered, considering, for example participants, implementers, partner organizations and mode of delivery.

Results and Discussion

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 of 20.7%.

Use of Insecticide Treated Mosquito Nets (ITNs): Prevalence of malaria was highest (11.09%) among students who did not sleep under insecticide treated nets (Figure 1). On further analysis using ANOVA (Table 1), there was not strong evidence that use of insecticide treated mosquito net has effect.

Prevalence of malaria varies widely from area to area as has been shown by several studies in Uganda [15-17]. The findings of these studies showed 14-64% of school- age children in Uganda were parasitaemia at any one time; this concurs with the determined prevalence rate of malaria (20.7%) in this study. It was also not different from results of a study on prevalence of malaria parasitaema by [18,19] in 480 Kenyan schools between September 2008 and March 2010 that found an overall prevalence rate of 4%, in the range 0-71%. It also agrees with the findings of a study by [20,21], and others for Senegal, The Gambia, and Mauritania showing prevalence of malaria infection between 5-50% among school-age children.

It is of great concern that high malaria prevalence among secondary school students may interfere with their educational development. The effect of malaria infection on school absenteeism has been observed in several studies and it contributes to between 17% and 54% on school absenteeism per year [22].

Studies by [23,24] have shown there is 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. This may be attributed to by 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 1) by a large proportion of respondents (11.5% out of 46.3%)

Table 1: ANOVA for public health intervention programs among secondary schools.

Intervention Program	df	F	p
Safe water provision	2	1.031	0.368 (ns)
ITN Use	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 Handwashing before eating	2 3	0.074 0.839	0.929 (ns) 0.482 (ns)
Water only at handwashing area	2	0.214	0.809 (ns)
Water and soap at handwashing area	2	0.402	0.672 (ns)
Water + soap+ disposal towel at handwashing 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)
Handwashing 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)

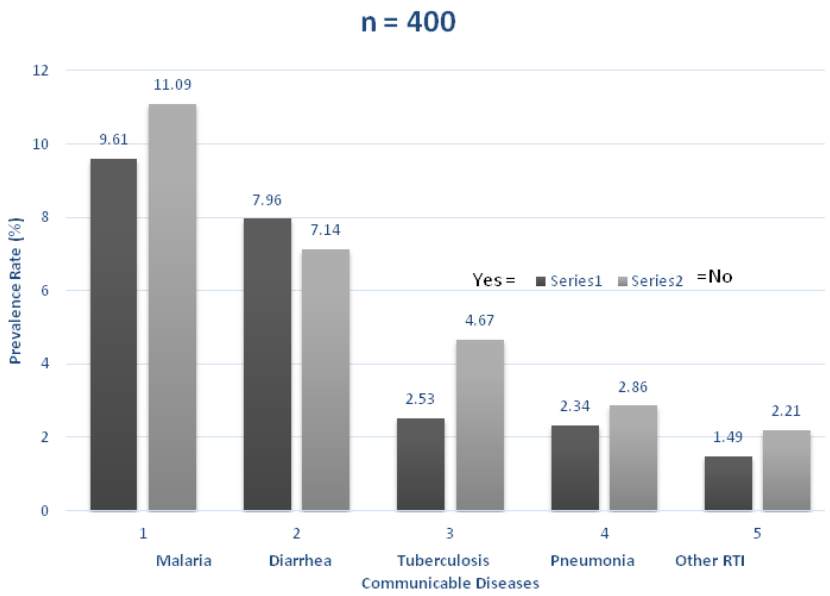

Figure 1. Prevalence rates of communicable diseases against use of insecticide treated bed nets (ITNs) among secondary school students in Kisumu County, Kenya.

of those who did not use insecticide treated nets, and reported confirmed incidences of malaria.

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) [25]. Global health agenda is shifting from disease specific approaches to strengthening of health systems [26]. One way of doing this is to advocate for establishment of health promoting schools.

Mosquito greeding control among secondary schools: Prevalence rate of malaria was higher in schools where mosquito breeding control was not observed (Figure 2) and lower in schools where mosquito breeding control was observed to a high degree. There was no significant ($X^2_{3, 0.05}$ =3.154) association between Mosquito Breeding Control and malaria prevalence rate among secondary schools. There was not strong evidence that the intervention had effect (Table 1).

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.

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.

During focus group discussion, the consensus was that schools and communities where schools stand rarely work together to improve their health status. Environmental components are linked to each other and significantly influence the health status of a school and students [27].

The findings of this study agree with the finding of a study by [28] 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.

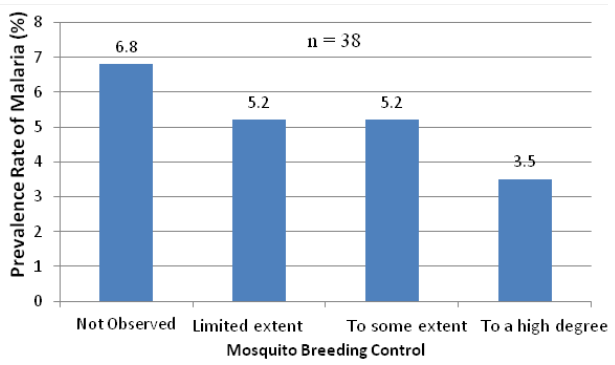

Figure 2. Malaria prevalence rate against Mosquito Breeding Control among Secondary Schools in Kisumu County, Kenya.

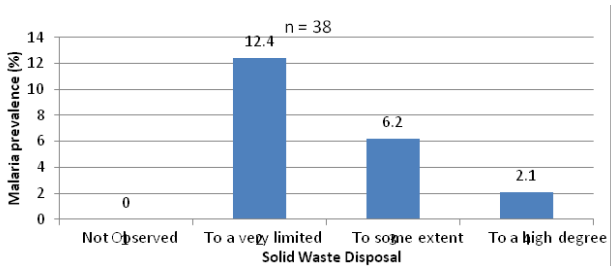

Figure 3. Malaria prevalence rate against Solid Waste Disposal among secondary schools in Kisumu County, Kenya.

Plate 1. A photograph showing state of solid and liquid wastes among secondary schools in Kisumu County, Kenya.

Solid waste disposal among secondary schools: Malaria prevalence was 12.4% in 47.3% of schools that observed solid waste disposal to a very limited extent. 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 3; Plate 1).

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 which were not secured and unattended.

There was no significant association ($X^2_{2, 0.05}$=9.692) between Solid Waste Disposal and malaria prevalence rates. There was not strong evidence that the intervention had effect (Table 1).

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.

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 waste 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 cause water-borne diseases to the surrounding communities.

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%. Some of the findings causing the high prevalence rate are safe water provision, hand washing processes, personal hygiene, student – toilet ratio, and waste disposal among others.

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 (Figure 4; Plate 2). There was significant association ($X^2_{2, 0.05}$=16.769) between provision of safe water and prevalence of diarrhea among secondary schools in Kisumu County.

Contaminated water cause diarrhea. Food is the main source of pathogens causing diarrhea. Safe water provision is important to control 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 (Figure 4). Studies by and [29,30] had similar findings [31] in their study also observed that the major contributing factor to burden of communicable diseases is inadequate access to safe water and sanitation infrastructure. Water storage tanks should be accessed only through a water tap. This would reduce rate of contamination at storage.

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 5).

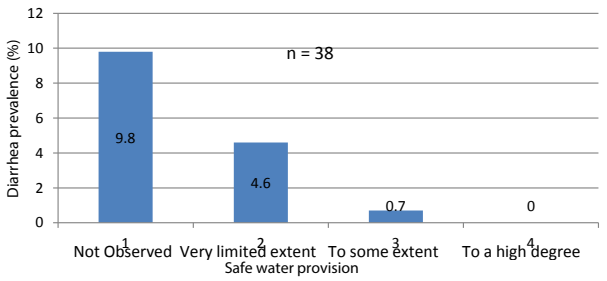

Figure 4. Diarrhea prevalence rate against unsafe water provision among secondary schools in Kisumu County, Kenya.

Plate 2. Photograph showing state of unsafe water in containers without taps in many secondary schools in Kisumu County, Kenya.

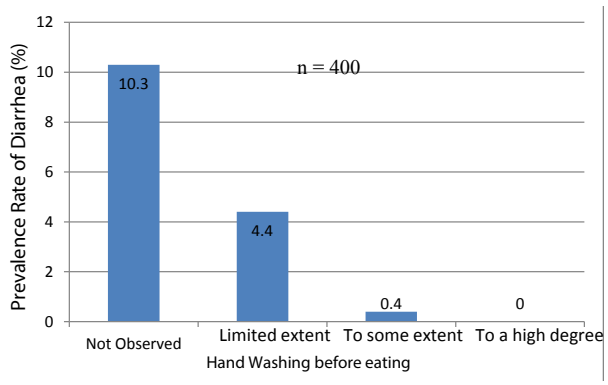

Figure 5. Prevalence of Diarrhea against Hand Washing before eating among secondary students in Kisumu County, Kenya.

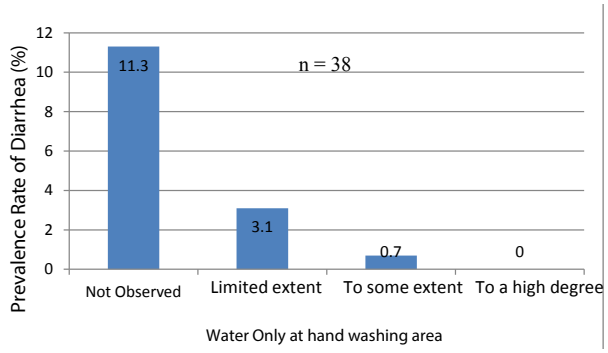

Figure 6. Diarrhea prevalence rates against provision of Water only at hand washing area among secondary schools in Kisumu County, Kenya.

Of the 84.7% schools that observed hand washing 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. There was not strong evidence that the intervention had effect (Table 1).

Provision of water only at hand washing place among secondary schools

Prevalence rate of diarrhea was 11.3% in schools where provision of 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 6).

There was a significant ($X^2_{2, 0.05}$=44.42) association between provision of water only at hand washing area and prevalence of

diarrhea among secondary schools in Kisumu County; there was not strong evidence that the intervention had effect (Table 1).

Provision of water and soap at hand washing 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 to some extent, and 0% in schools where the intervention was observed to a high degree (Figure 7).

There was a significant association ($X^2_{2, 0.05}$=10.158) between provision of soap and water at hand washing area, and prevalence of diarrhea among secondary schools in Kisumu County; there was not strong evidence that the intervention had effect (Table 1).

Provision of water, soap and disposable towel at Hand washing 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 disposal towel at hand washing area was observed to a high degree (Figure 8).

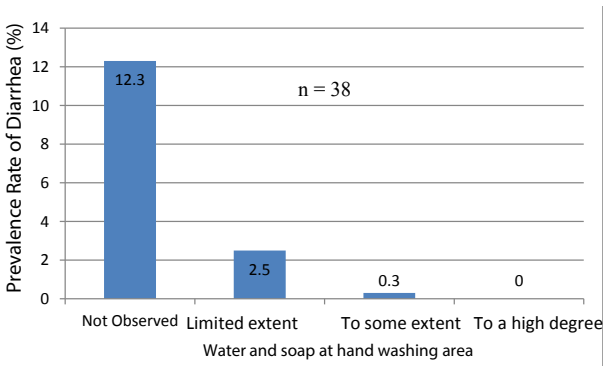

Figure 7. Diarrhea prevalence rate against provision of Water and soap at hand washing area among secondary schools in Kisumu County, Kenya.

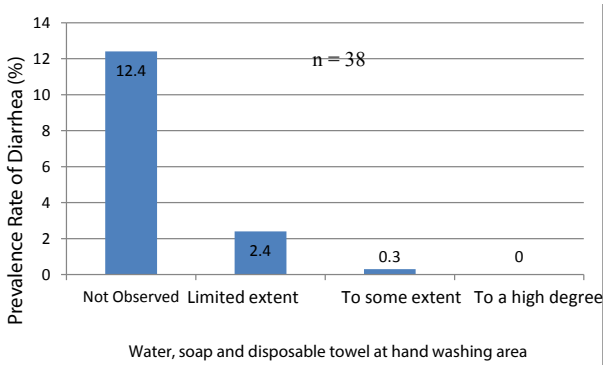

Figure 8. Diarrhea prevalence rates against provision of Water, Soap and disposable Towel at Hand washing area among secondary schools in Kisumu County, Kenya.

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 and prevalence rate of diarrhea among secondary schools in Kisumu County; there was not strong evidence that the intervention had effect (Table 1).

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 diarrhea and respiratory tract infections. "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 have not seen a food kiosk or grocery in this area where some kind of hand sanitizer is placed in an area of reach for use."

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 or ecosystem approaches bridge scientists, policy makers, activists, and citizens. This agrees with the results of the focus group discussion 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. Provision of running water at hand washing area is the hallmark intervention strategy to reversing infection rates of diarrhea and respiratory tract.

Hand washing after defecation among secondary students

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

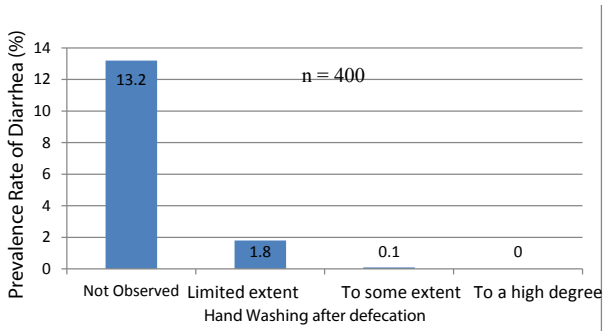

Figure 9. Diarrhea prevalence rates against Hand washing after Defecation among secondary students in Kisumu County, Kenya.

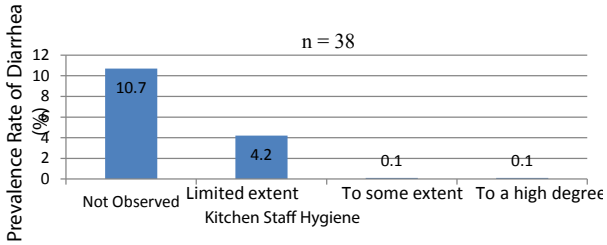

Figure. 10 Diarrhea prevalence rates against Kitchen Staff Hygiene among secondary schools in Kisumu County, Kenya.

extent, and 0% in schools where hand washing after defecation was observed to a high degree (Figure 9).

There was a significant association ($X^2_{2, 0.05}$=16.158) between Hand washing after Defecation and prevalence of diarrhea among secondary school students in Kisumu County; there was not strong evidence that the intervention had effect (Table 1).

The most common route of transmission of diarrheal agents is the fecal-oral route, within and between populations [32]. This finding concurs with the results of this study (Figure 9) revealing high prevalence rate of diarrhea among students 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 [33,34]. Safe water, good sanitation, waste management and food safety are vital community interventions to prevent diarrhea.

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 10).

There was 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 was not strong evidence that the intervention had effect (Table 1).

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

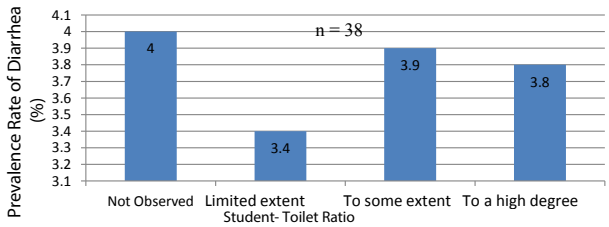

Figure 11. Diarrhea prevalence rates against Student-Toilet ratio among secondary schools in Kisumu County, Kenya.

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 [35].

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 disease burden [10,35]. 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 [10]. Results of this study reveal the prevalence of diarrhea is high among students in schools where Kitchen Staff hygiene was not observed (Figure 10).

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 11). 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 was not strong evidence that the intervention had effect (Table 1).

Prevalence of intestinal parasite infections may be attributed to poor environmental conditions and personal hygiene, and inadequate supply of safe water and waste disposal [36]. 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 11). Where there is low Student – Toilet ratio, hygienic conditions of the toilets are poor.

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 12,13; Plate 3,4).

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 was not strong evidence that the intervention had effect (Table 1).

Many diarrheal agents thrive in organic matter and can

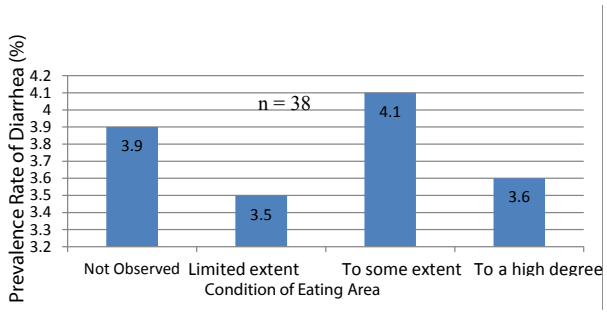

Figure 12. Diarrhea prevalence rates against Condition of Eating Area among secondary schools in Kisumu County, Kenya.

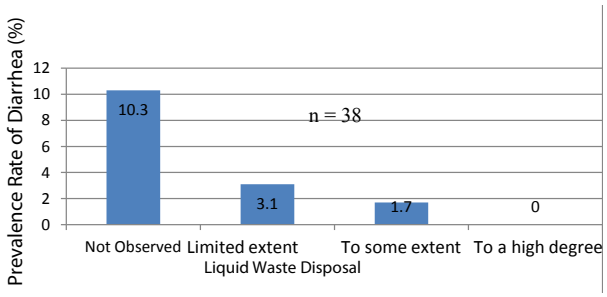

Figure 13. Diarrhea prevalence rates against Liquid Waste Disposal among secondary schools in Kisumu County, Kenya.

Plate 3. A photograph showing a smoky kitchen area among secondary schools in Kisumu County, Kenya.

Plate 4. A photograph showing cooked foods kept uncovered in most secondary school kitchens in Kisumu County, Kenya.

therefore multiply rapidly in cooking areas with poor floors and walls and therefore in food kept in such places [37]. Figure 12 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.

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 13).

There was a significant ($X^2_{2, 0.05}$=11.692) association between Liquid Waste Disposal and prevalence of diarrhea among secondary schools in Kisumu County; there was not strong evidence that the intervention has effect (Table 1).

Tuberculosis and Pneumonia Infection in Secondary Schools

Tuberculosis and Pneumonia are the third and fourth most important communicable diseases among secondary students in Kisumu County, with prevalence rates of 7.2% and 5.2% respectively.

Ventilation in Hostels among secondary schools

Prevalence rate of Tuberculosis and Pneumonia were7.2% and 5.2% in schools where ventilation in hostels was observed to some extent, and 0% for other observations (Figure 14).

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

Bed Spacing in hostels and 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 15).

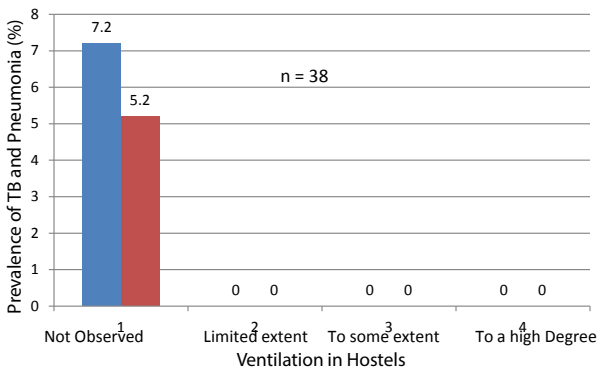

Figure 14. Tuberculosis and Pneumonia prevalence rates against Ventilation in Hostels among secondary schools in Kisumu County, Kenya.

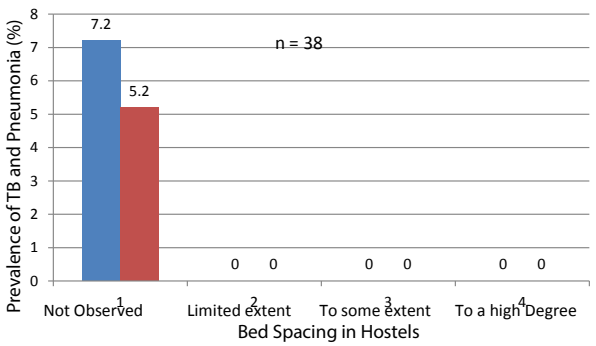

Figure 15. TB and Pneumonia prevalence rates against Bed Spacing in Hostels among secondary schools in Kisumu County, Kenya.

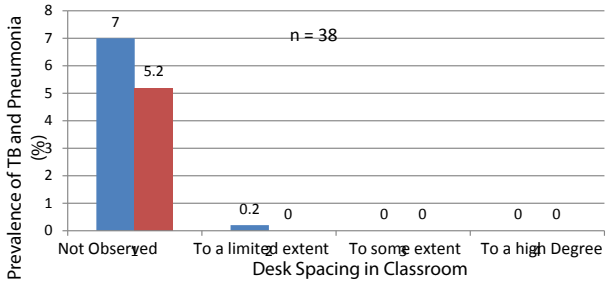

Figure 16. TB and Pneumonia prevalence rates against Desk Spacing in classrooms among secondary schools in Kisumu County, Kenya.

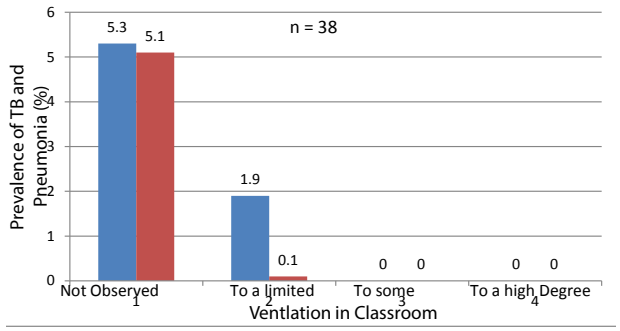

Figure 17. Prevalence rates of Tuberculosis and Pneumonia against Ventilation in Classrooms among secondary schools in Kisumu County, Kenya.

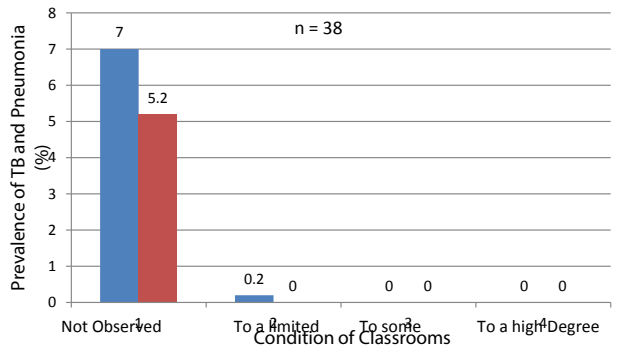

Figure 18. TB and Pneumonia Prevalence rates against condition of classroom among secondary schools in Kisumu County, Kenya.

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 was no strong evidence that the intervention had effect (Table 1).

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 16). 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 was no strong evidence that the intervention has effect (Table 1).

Transmission of infections in students can easily occur due to large concentration of students in a school [38]. This is supported by the findings in Figures 15 and 16).

Ventilation in classrooms among secondary schools

Prevalence rate of Tuberculosis and Pneumonia were 5.3% and 5.1% respectively in schools where ventilation in classrooms was not observed; 1.9% and 0.1% respectively in schools where ventilation was observed to a very limited extent, and 0% for other observations (Figure 17).

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 was no strong evidence that the intervention had effect (Table 1).

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 18).

The findings of this study agree with the findings of [39] 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.

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.

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.

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 19).

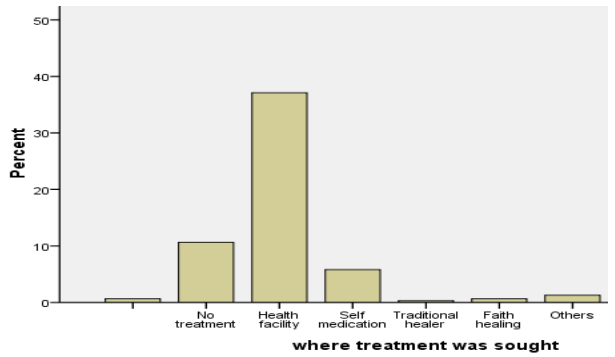

Figure 19. Proportion of secondary Students in Kisumu County against place where treatment was sought.

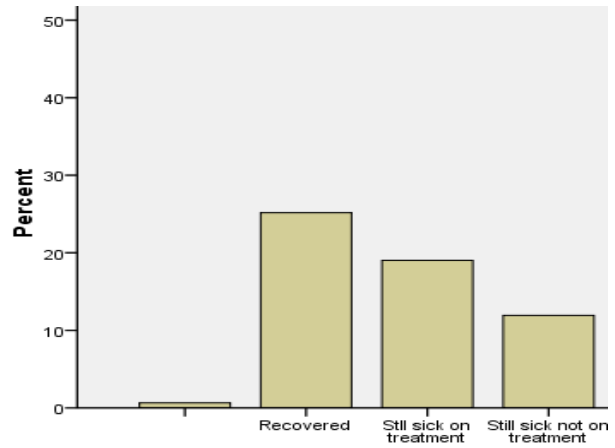

Figure 20. Proportion of secondary Students in Kisumu County against Outcome of treatment.

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 recover but were still on treatment.

Thirty seven (37) out of 310 (11.9%) of those who were ill and did not seek treatment were still sick (Figure 20). There was a significant ($X^2_{4,\ 0.05}$=184.374) association between communicable disease prevalence rates and health seeking behavior in schools; there was strong evidence that the intervention had effect (Table 1).

Health unit status among secondary schools in Kisumu County

Only 4 out of 38 (10.0%) schools had health units with trained nurses, compared to 31 out of 38 (82.0%) schools that had no health units. Schools without health units engaged school matrons or school secretaries to dispense drugs to students (Figure 21).

There are important gender differences related to health seeking behavior and access to health care. In some societies there are differences in the utilization of health care facilities

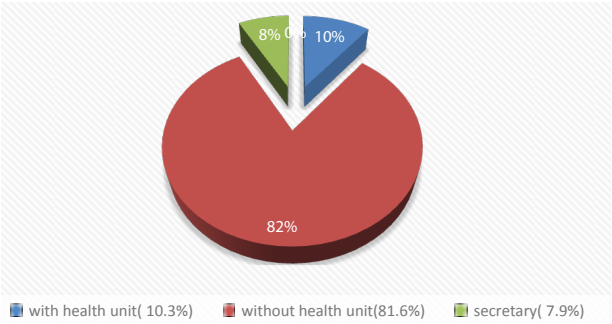

Figure 21. Proportion of Secondary schools with Health Units in Schools.

and in the level and type of care given to males and females, for example, [40] in their follow up observational study in Calcutta, 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 [41] 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 1).

Health care system is an environmental factor of relevance to the occurrence of diarrhea [42].

Analysis of Variance for Public Health Intervention Programs among Secondary Schools

On analysis of variance (ANOVA), the results are shown in Table 1. This study revealed that health seeking behavior is an important public health intervention program that should be enforced in all schools.

Key: ns-intervention has no effect; ss-strong evidence that intervention has effect.

Conclusion

Provision of water for hand washing as a public health intervention strategy has strong evidence that the intervention strategy has effect in reduction of prevalence rates of diarrhea, tuberculosis and pneumonia. Use of insecticide treated mosquito nets for malaria prevention and health seeking behavior were best practices among students and within schools.

Our conclusions need to be qualified of course. This is an introductory study. We hope it will stimulate some much needed research on the relationship between political forces and health. Also, further study is required on the possible impact of a public health intervention programs and improvements in health. Also requiring further study are "mixed cases" in which the balance of forces within government may have had different effects on implementation policies

Comparative policy studies, such as the one reported here, also need to be complemented by more traditional and equally informative case studies analyzing experiences and making evaluations country by country. These further areas

of investigation could overcome some of the limitations of the present study.

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