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Sanitation In Relation To Prevalence of Waterborne Diseases in Mbeere, Embu County, Kenya

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Abstract: *This study aimed at establishing the linkage between sanitation and the prevalence of the waterborne diseases in Mbeere North, Embu County, Kenya. The accessible population was population within 7,985 households obtained from 12 locations. A sample size of 367 was used. Systematic random sampling was used on the population frame of 7,958. Secondary data constituted waterborne diseases from health facilities, and population statistics. The Acquisition of primary data was done using researcher administered questionnaires and use of Geographical Information System (GPS) instrument for spatial data. The analysis of secondary morbidity data was done using Microsoft office excels 2007 and that of the primary household data was analyzed using statistical package for social sciences (SPSS). SPSS was used to generate descriptive statistics, establish correlation among the variables and to test the hypothesis. Pearson product moment correlation coefficient (r) was used to show both direction and the strength of the relationships. The study data display was done using charts and figures. From the analysis, in addressing the objective, the Pearson correlation coefficient linking waterborne diseases infection with type of excreta disposal methods was 0.348 and a significance level of p<0.005. The link between waterborne diseases infections and those who washed vegetables before cooking and those who washed fruits before eating were correlated by 0.477 and 0.433 respectively. From the hypothesis testing, the study found that Chi-square test for independence indicated a strong significant relationship between those infected with intestinal worms and method used for excreta disposal,* x^2 *(1, n = 267) = 45.231, p = 0.000, phi = 0.412. The study concluded that sanitation which includes hygiene significantly contributed to the prevalence of waterborne diseases. The study therefore recommends provision of adequate and suitable sanitation and capacity building on hygiene practices.*

Keywords: *Waterborne diseases, sanitation, hygiene, Embu.*

I. Introduction

Waterborne diseases are a major cause of illness in developing countries especially Africa and are responsible for sporadic and localized outbreaks of disease in the developed world. Lack of adequate sanitation, adequate and safe water and adequate awareness are major factors contributing to the prevalence of these diseases. Lack of adequate research and ineffective information dissemination hinders the effort to reduce the diseases. The concept behind this study is based on the waterborne diseases burden with the focus on sanitation including hygiene and how it contributes or relates to the prevalence of the common waterborne diseases in Mbeere Embu County.

According to the Centre for Diseases and Prevention [1], improved sanitation facilities usually ensure separation of human excreta from human contact, and these include; flush toilet, piped sewer system, septic tank, ventilated improved pit (VIP) latrine, and pit latrine with slab. Unimproved sanitation facilities do not ensure hygienic separation of human excreta from human contact and include pit latrine without a slab, hanging latrine, bucket latrine, and open defecation in fields, forests, bushes, bodies of water or other open spaces, or disposal of human feaces with solid waste.

Most available studies associate waterborne diseases with lack of clean water and inadequate sanitation. In Africa, it is estimated that only about 22 per cent of the population has adequate sanitation facilities according to Bateman *et al* [4]. Choffnes *et al.* [5] established that, 28 percent of the population of sub-Saharan Africa defecates in the open and an additional 23 percent use "unimproved" sanitation facilities that 'do not ensure hygienic separation of human excreta from human contact'. Moreover, 'even where clean water and flush toilets are available in Africa, lack of hygiene awareness continues to result in outbreaks of water-related diseases according to Choffnes *et al.* [5].

Gunther *et al*. [6] found that sanitary practices for the disposal of sewage and domestic waste water, and treatment of domestic drinking water are associated with the outbreak of waterborne diseases. The most

common symptom is diarrhea. Choffnes *et al*. [5] established that waterborne diseases may result when pathogenic organisms like viruses, parasites and bacteria present in feces or urine from human and animal waste contaminate water supplies, and this water is subsequently used for drinking or food preparation without adequate treatment. The 2008–09 Kenya Demographic and Health Survey (KDHS) estimate that overall, 23% of households use an improved toilet facility and twelve percent of households have no toilet facilities.

Water borne diseases in Kenya is a major concern particularly with children under 5years. A study conducted in Embu County by the Government of Kenya on the top ten causes of morbidity showed that intestinal worms range number three of all medical cases reported in the health facilities [3].

1.1 Interventions to curb spread of water borne diseases

In Cambodia de-worming programmes for school children were started in some provinces with treatment using mebendazole 500 mg coupled with health education. After treatment, the prevalence of intestinal worms dropped to about one-third of the initial level, [7]. In some parts the country which include parts of the study area, the Kenya government has been carrying out de-worming of children between 2-5 years twice per year and also supplying chlorine water treatment tablets (aqua-tabs), applied at one tab per twenty litres or 40mg/10 litres as established by the researcher during the households' survey. The result or the impact showed that the combination of both de-worming and water treatment reduced the prevalence of the waterborne diseases by 80% in the study area.

The Kenyan government is currently spending a lot of public revenue to combat the spread of waterborne diseases in the country. World Health Organization (WHO) [2] observed that waterborne disease remains one of the major health concerns in the world. A study conducted in Embu County by the government on the top ten causes of morbidity showed that intestinal worms range number three of all medical cases reported in the health facilities [3]. The data relating to the level of contamination attributed to sanitation in the country and in particular the study area is not available.

II. Material And Methods

2.1 Study area and population

The study covered Mbeere North Sub-County of Embu County with an estimated population of 89,035 according to the Kenya Housing and Population Census [8]. The area was chosen for the study because of its vulnerability to the waterborne diseases endemic and occasional epidemic associated with poor sanitation facilities. The study area is shown below defined by the bold lines fig 1 below.

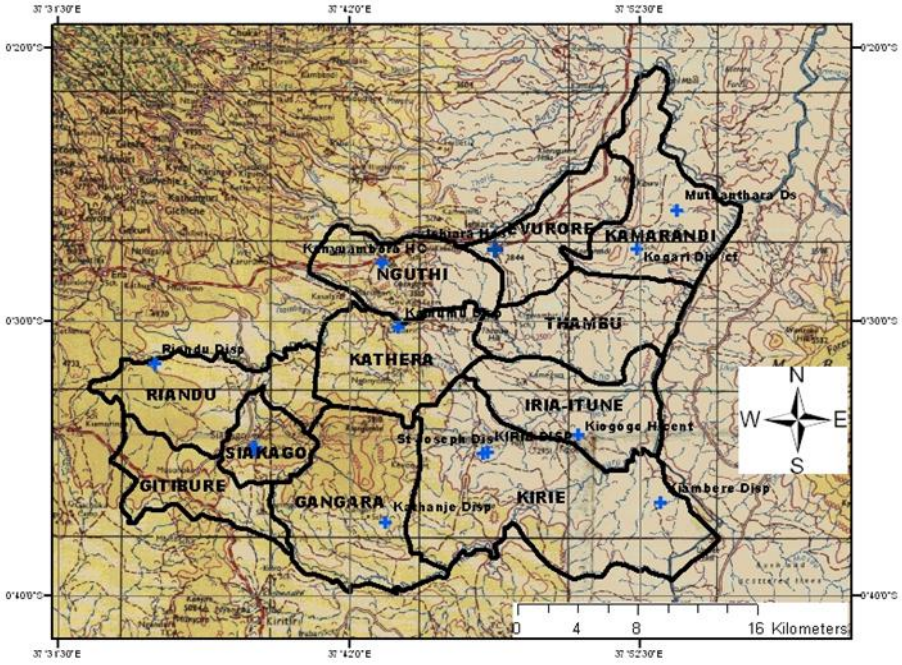

Figure 1: Study area with bold outline showing health facilities marked with blue cross.
Source: Developed from GIS Kenya shape file layers by the Researcher (2014)

2.2 Research Design

In this study, the variables were excreta, solid and liquid waste disposal methods and hygiene practices as independent variables and the waterborne diseases as dependent variable. Since this study was looking at the relationships between variables, correlation and descriptive research design methods were used.

2.3 Sample size and Sampling strategy

The household data of 7,958 formed the population frame. The required sample size of 376 was obtained using Krejcie, Morgan and Daryle [9] chart. The total sample of 376 households was obtained using systematic random sampling method. Although the subjects in this sampling appears to have been the household, only one person either the household owner or an elderly family member represented the household.

2.4 Data collection procedure and instruments

The tools used for primary data were the questionnaire which was administered by the researchers and Geographical Information System (GPS) instrument for spatial data. The secondary data mainly on morbidity from various health facilities and demography were obtained from relevant Government offices.

2.5 Analysis and presentation

Microsoft office Excel 2007 was used to analyze secondary morbidity data and Statistical Package for Social Scientists (SPSS) Version 15.0 was used to analyze primary household data and generate descriptive statistics. The presentation of the data was in the form of charts and digital maps for the spatial data on health facilities collected from the field.

III. Results And Discussion

The researchers issued 367 questionnaires to the respondents in 14 locations within the study area. 267 questionnaires were received back from 12 locations with filled information and the rest were either not filled or were not returned at all translating to 73 % response.

3.1 Sanitation and hygiene in the study area

To address the study objective, the researchers studied various types of human waste and solid waste disposal methods, including the household hygiene practices used in the study area.

The household survey showed different types of human waste or excreta disposal methods were used as shown figure 2 below.

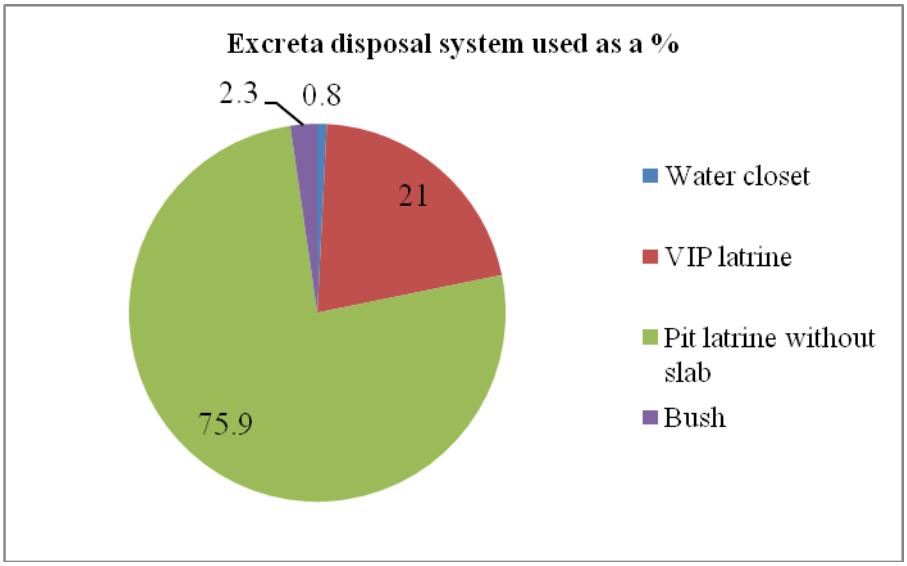

Figure 2: Types of excreta disposal methods

From fig. 2 above, the survey showed that majority, 75.9 % of the respondents used pit latrine without slab which exposed the users to a very high risk of pathogens contaminations. The study also showed that 2.3 % of the respondents used bush, which implies that any surface water runoff within the household range in terms of distance was likely to contaminate any water source including ground water with pathogens. This study showed that only 0.8 % of the respondents used water crochets, a system which has the lowest chance of exposure to pathogens. The types of excreta disposal methods used were a pointer to a high risk of pathogens contamination particularly where good hygiene practices may not have been observed. In this study, those who can be said to have had adequate sanitation were those using water crochets and VIP latrines i.e. 21.8 %. Bateman, *et al.,* [4] estimated that in Africa only 22 per cent of the population had adequate sanitation facilities which compare favorably with this study.

The household survey also established that the community uses various methods of disposing households' domestic solid waste other than excreta as shown fig.2 below. Although fresh domestic solid waste may not be contaminated or containing pathogens, when it is not environmentally handled, it can accumulate and generate pathogens which can be a major course of waterborne disease in an area. The study showed that only 48.9 % of respondents use environmentally acceptable methods i.e. throw in dug pit and also burn waste around the pit. The rest used methods that are not environmentally acceptable (fig. 3) and which can generate waterborne diseases pathogens after decomposing.

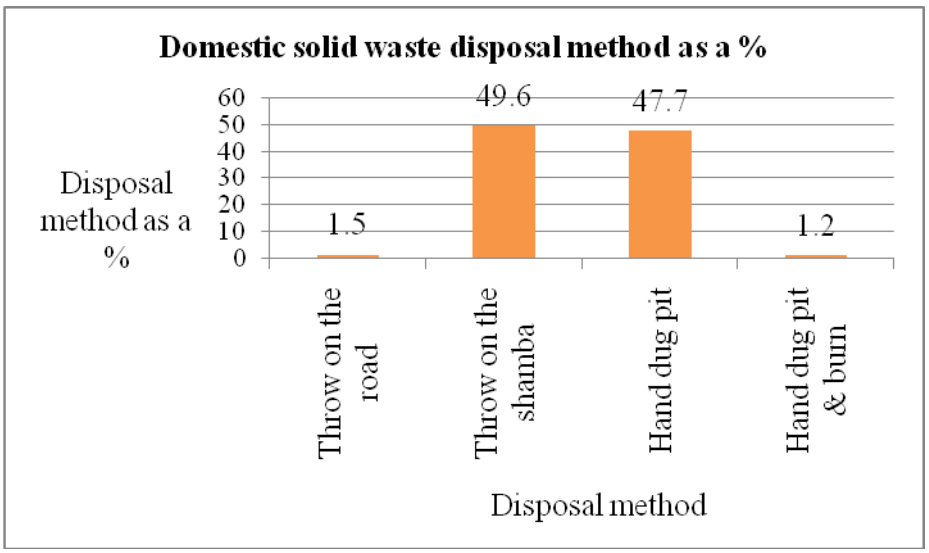

Figure 3: Household solid waste disposal methods

In his study to analyze some of the various factors contributing to the spread of the waterborne diseases, Keith [10] found that improper treatment of domestic sewage and solid wastes, contribute to spread of waterborne diseases. A study by the Kenya Solid waste Management [11] established that solid waste management is a major problem world-over and in Kenya offers several challenges from clogged drainage and sewers, waterborne diseases like typhoid, cholera and diarrhoea, increased upper respiratory diseases from open burning of the garbage to malaria. From this study, it can be seen that the level of solid waste management is still low and therefore a possible source of pathogens causing waterborne diseases.
With regard to the domestic waste water disposal, the survey showed three major methods were used in the area as shown fig. 3 below;-

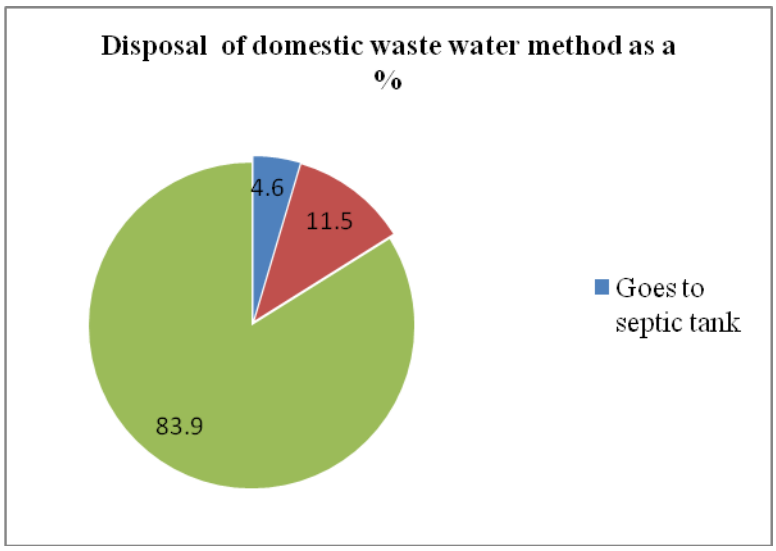

Figure 4: Domestic waste water disposal methods

The survey showed that only 16.1% of the respondents dispose domestic waste water in acceptable ways i.e. use soak pit and septic tank. The rest just throw the waste water around the compound fig. 4 above.

Waste water thrown around the compound is a good habitat for bacteria and other vector organisms. Gunther *et al*. [4] found out that sanitary practices for the disposal of sewage and domestic waste water, and treatment of domestic drinking water are associated with the outbreak of waterborne diseases.

The study therefore indicated that the level of waste water management was low and could be directly associated with the high prevalence of waterborne diseases in the area. The household survey in this study also observed the level of hygienic practices in the study area. The results from the analysis using SPSS were expressed as a % are shown in the Table 1 below.

Table 1: Level of household hygiene

Description	Always (%)	Sometime (%)
Those who washed hands before eating	55.1	44.9
Those who washed hands after visiting toilet	59.2	40.8
Those who washed hands before feeding the baby	67.3	32.7
Those who washed fruit before eating	47.2	52.8
Those who washed vegetables before cooking	89	11
Those who covered good food that remained after eating	70.2	29.8

Source: Researcher (2014)

From Table 1, the study showed that just slightly over 47% of the respondents washed fruits before eating and slightly over 55% washed hands before eating food. The study also indicated that slightly over 40% of the respondents did not wash their hands after visiting toilet. A study by Esrey and Bergeron [12] found that water and sanitation improvements combined with hygiene behavior change, can have significant impact on a population health by reducing a variety of disease conditions such as diarrhea, intestinal helminthes, Guinea worms; respiratory diseases; as well as water wash diseases e.g. Scabies. The low level of household hygiene observed can also be a source of waterborne diseases.

3.2 Waterborne diseases

The analysis of the secondary morbidity data, when analyzed separately for both over five and under five years put waterborne disease as number three among the top ten common diseases in the study area. During the survey, the respondents were asked if they have ever been infected with waterborne diseases and 80% said yes while 20% said no. To assess the Knowledge on waterborne diseases transmission, the question was asked if intestinal worms can be transmitted from one person to another and only 28.6 % responded yes and slightly over 49 % said no and 22.2 % did not know the mode of transmission as shown in fig. 5 below.

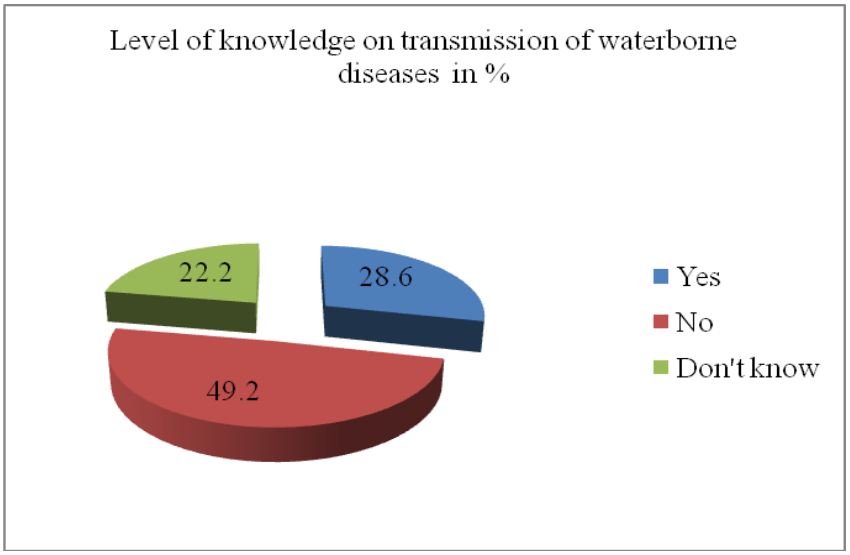

Figure 5: level of knowledge on transmission of waterborne diseases

Source: Researcher (2014)

Among those who acknowledged having had attacks from waterborne disease, 80.9 % had confirmed from laboratory test while 19.1% were treated without being tested in the laboratory.

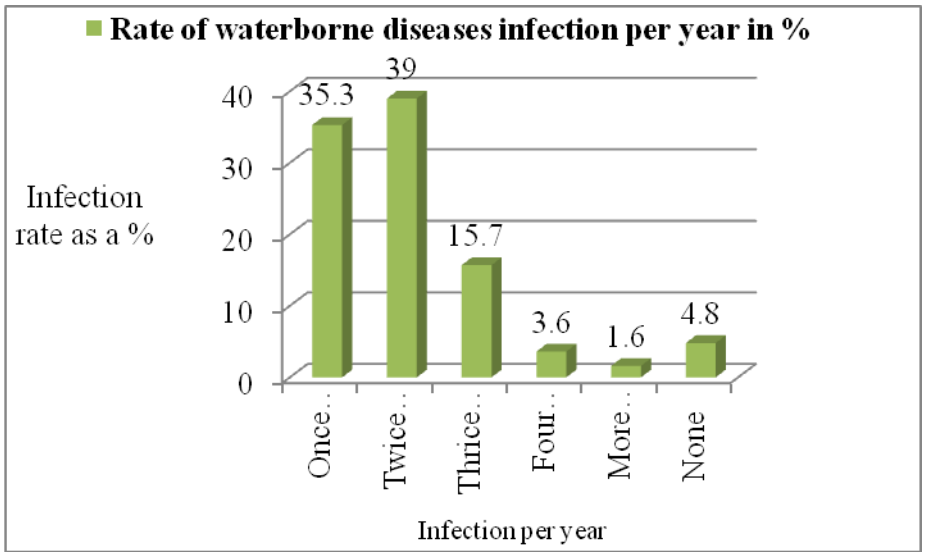

Figure 6: Waterborne infection rate per year

The study showed a slightly higher % of waterborne diseases infections in over five years than that of children under five. However in general, the output of this analysis showed a high prevalence of waterborne disease infection. In his study, Prüss-Üstün *et al*., [13] established that waterborne diseases are largely diarrheal diseases, which as a group cause more than 1.5 million deaths per year, of which more than 90 percent occur in children under the age of 14. The discrepancy with this study where the infections of over five years were found to be more was perhaps because of the interventions to curb spread of water borne diseases in the study area. Luong, T.V. [7] in his study established that in Cambodia de-worming programmes for school children was started in some provinces with treatment using mebendazole 500 mg coupled with health education. After treatment, the prevalence of intestinal worms dropped to about one-third of the initial level. The Kenya government is carrying out interventions to curb spread of waterborne diseases in the study area (see section 1.1 above). Based on these interventions, it is therefore prudent to say that the rate of infection of children under five could have been more than that of over five years. The study also showed that 39% and 35% of the respondents acknowledged having had two and one waterborne infection attacks in a year, respectively (fig. 6). Sharon *et al.* [14] found that the recent estimate suggest that children under 5 years in developing countries have a median of two to three diarrheal episode per person year and children between six and eleven months five diarrheal episode per year. A study conducted in Embu County by the Government of Kenya on the top ten causes of morbidity, showed that intestinal worms range number three of all medical cases reported in the health facilities [3]. The result of this study therefore compare with other studies conducted globally.

3.3 Determining relationship between sanitation and prevalence of waterborne diseases

In this study, hygiene was treated as part of sanitation but analyzed separately.

3.3.1 Sanitation

The relationship between those who had ever been infected by the intestinal worms and excreta disposal method was given by Pearson coefficient 0.348 while the relationship between those who had ever been infected by the waterborne diseases and solid waste disposal methods was given by the Pearson correlation coefficient 0.362 respectively both having a statistical significance level $p < 0.0005$ respectively. Considering also the size of the sample of 267 and the level of confidence, the independent variables uniquely contributed to the dependent variable and therefore it was prudent to take the relationships as significant. Gunther *et al.* [6] found that sanitary practices for the disposal of sewage and domestic waste water and treatment of domestic drinking water are associated with the outbreak of waterborne diseases.

3.3.2 Hygiene

The relationship between those who had ever been infected with intestinal worms and those who washed hands before eating, those who washed hands before feeding the baby and those who washed hands

after visiting the toilet were given by correlation coefficients 0.436, 0.404 and 0.467 respectively. These are relatively large relationships. The model indicated these relationships had statistical significance level of $p < 0.0005$ implying that the relationships were high enough to be relied on. Choffnes *et al.* [5] in his study of sub-Saharan Africa established that even where clean water and flush toilets are available in Africa, lack of hygiene awareness continues to result in outbreaks of water-related diseases. Bloomfield F. Sally *et al* [15] found that whereas improvements in the provision of sanitation and water supply would produce, respectively, a 32% and 25% reduction in diarrhoeal disease burden, improvements in water quality and the promotion of other hygiene interventions including, but not limited to, hand washing in the home and community could produce, respectively, 31% and 37% reduction in diarrhoeal disease burden.

3.3.3 Testing the relationship between sanitation and prevalence of water borne diseases

Chi-square model was used to test if there was a relationship between those infected with intestinal worms and the method of excreta disposal. The interpretation of the above outcome showed that the chi-square test for independence indicated a strong significant association between those who had ever been infected with intestinal worms and method used for of excreta disposal (- x^2 (1, n = 267) = 45.231, p = 0.000, phi = 0.412). This showed a significant relationship and therefore rejected null hypothesis. Gunther *et al*. [6] found that sanitary practices for the disposal of sewage and domestic waste water, and treatment of domestic drinking water are associated with the outbreak of waterborne diseases.

IV. Conclusions and recommendations

This study therefore shows that sanitation including hygiene practices significantly contribute to the prevalence of waterborne diseases in the study area.

This study therefore recommends provision of adequate and suitable sanitation to the community and also continuous health and hygiene education on the community in the study area. There is a need for further research on this area of research covering different localities of the country.

References

[1] CDC. Assessing Access to Water and Sanitation. Global Water, Sanitation, and Hygiene, *Healthy Water*. Retrieved on July 3, 2011.

[2] World Health Organization, Combating Waterborne Disease at the Household Level, *WHO, Switzerland Geneva*, 2007.

[3] Government of Kenya, Data on Top Ten Causes of Outpatient Morbidity Embu District Hospital, Embu, Kenya, 2007.

[4] Batterman, Eisenberg, Hardin, Kruk, Lemos, Michalak, Mukherjee, Renne,Stein, Watkins, Wilson , Sustainable Control of Water-Related Infectious Diseases: A Review and Proposal for Interdisciplinary Health-Based Systems Research; *Environ Health Perspectives*, 2009.

[5] Choffnes, R. & Mark, A.. Global *issues in Water, Sanitation and health: Workshop Summary* (Free Executive Summary), 2009.

[6] Gunther, FC, Rebecca F.C, & Timothy J.W. An introduction: Assessing Water Risks' *Journal of Water and Health*, 04 supplement 2006.

[7] Luong T.V .De-worming school children and hygiene, *International Journal of Environmental Health Research 13, S153 – S159 (June 2003)*, UNICEF East Asia and Pacific Regional Office, Bangkok,Thailand.

[8] Government of Kenya, (2009) '*Kenya Housing and Population Census*, 2009

[9] Krejcie, R., Morgan, V., and Daryle W. Determining Sample Size for Research, Activities, *Educational and Psychological measurement*, 1970

[10] Keith, J., Waterborne Diseases, *Magazine issue* 1994.

[11] Kenya; Solid waste Management, Journal on waterbornediseases/Kenya, Solid waste Management; observed on 25th August 2014 at www.entrepreneurstoolkit.org.htm.

[12] Bergeron G. and Esrey S. A. Baseline survey for the Guatemalan Highlands Rural Water and Sanitation for Health Project, U.S. Agency for Development, Washington DC.1994.

[13] Prüss-Üstün, A.R. Bos, F. Gore, & J. Bartram, (2008). Safer water, better health: costs,

[14] Benefits and sustainability of interventions to protect and promote health, Geneva: *World Health Organization*, 2008.

[15] Sharon, LR, Elaine, S &Michael, JB . 'The rate of gastrointestinal illness in developed Countries' *Journal of water and health*, 04 supplement 2, 2006

[16] Bloomfield F. Sally, Exner Martin, Fara M. Gaetano, Nath J. Kumar, Scotts A. Elizabeth Voorden V. Carolien, The global burden of hygiene-related diseases in relation to the home and community' A report Celebrating 10 Years of the *International Scientific Forum on Home Hygiene*, 2009.