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Original Research Article

Risk factors for the prevalence of *Entamoeba histolytica* in children aged under five years in a slum settlement in Nairobi, Kenya

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Abstract

The occurrence of *Entamoeba histolytica* as a human intestinal parasite causing amoebiasis is a serious problem especially in developing countries. *E. histolytica* frequently infests as a commensal within the human large intestines with no overt clinical manifestations. Infection with *E. histolytica* results in 34-50 million symptomatic cases of amoebiasis worldwide each year, causing 100,000 deaths annually. Amoebic infections observed in slum settlements in Kenya such as Mukuru Kwa Reuben are common. This study aimed at determining the prevalence of *E. histolytica* in children aged less than 5 years who were experiencing diarrhea and establish the relationship between the prevalence and demographics and some socio-economic risk factors which were obtained by oral interviews of their parents/guardians. The stool from the children was examined microscopically for cysts and/or trophozoites of *E. histolytica* using formal ether concentration technique and the data was tested by chi-square and ANOVA. The results showed that the overall prevalence of *E. histolytica* infections amongst the children was 24.3%. A significant association was found between *E. histolytica* prevalence and age (P=0.01) with higher levels being observed in children aged 33 – 43 months. There was also a significant association between prevalence and gender (P=0.048) with males having higher rates. However, no significant association was found between the prevalence and types of toilet used (P=0.492), washing of hands after defecation (P=0.845), types of water storage containers (P=0.745), presence of contaminants around water sources (p = 0,893) and boiling of drinking water (P=0.855). In this study there was a clear indication that *E. histolytica* infections was a problem in children less than 5 years and that oral interview is not a reliable technique for obtaining socio-economic information of relevance to *E. histolytica* infections risk. It was therefore recommended that more emphasis should be directed to the male child and all the children aged 33-43 months by prompt diagnosis, treatment and monitoring their hygiene and health behaviors since they are more prone to the infection. It was also recommended that better techniques should be used to obtain reliable socio-economic data.

Keywords: Entamoeba, risk, prevalence, children, slum settlements

INTRODUCTION

Background information

Entamoeba consists of several species of intestinal protozoans that infects humans including: *E.histolytica, E.dispar, E.coli, E.hartmani, E.polecki, E.morskovikii* and *E.gingivalis* (Ash and Orihel, 1980; Ali *et al.,* 2008; Clark and Diamond, 1987). Among these, only *E. histolytica* is considered pathogenic since it invades the lumen epithelium causing amoebic dysentery (Sateriale *et al.,* 2011). A common outcome of invasion of the amoeba into tissues causes liver abscesses which can be fatal (Stanley, 2003).

Ingestion of feacally contaminated food or water containing infectious amoeba cysts leads to the infection (Abate *et al.,* 2013). In those cases where the infection is not self-limiting, amoebic dysentery and liver abscesses can occur (Stanley, 2003, Al-Harthi and Jamjoom, 2007). Ninety percent of infections with *E. histolytica* are

asymptomatic and self-limiting (Clark and Diamond, 1987). However, Sateriale *et al*. (2011) reported that an estimated 50 million cases of invasive infections occur annually worldwide. According to WHO (2010), amoebiasis is ranked the third most important parasitic disease and that 100,000 deaths occur annually due to the disease. The morbidity and mortality due to amoebiasis is primarily seen in the developing countries (Abate *et al.,* 2013). The major cause of transmission is poor sanitation, particularly where food and water are concerned (Benneton *et al*., 2005). According to UNICEF (2009), more than 3 billion people in the world do not have access to proper sanitation.

In Africa and particularly tropical Africa, over half of the population has no access to safe drinking water and the people are constantly faced with food insecurity and shortage, which contributes to infection with *E. histolytica* and other enteric parasites (Brooks, 2009). This food problem, compounded with constant displacement due to civil strife (as in Somalia and Southern Sudan current situations) and frequent floods (as in Nyanza and Coast regions in Kenya during 2015 rainy season) has according to AMREF (2009), adversely contributed to high prevalence of diarrheal diseases including that caused by *E. histolytica*.

The bulk of the population in Kenya like in other developing countries lives in rural areas or in slum dwellings in towns. Sanitary facilities access in such settlements is only about 43% with 57% going without safe water and proper excreta disposal (AMREF, 2009).

Children experiencing diarrhea who were treated at Mukuru Kwa Reuben clinic were mostly found with cysts of *E.histolytica* and *Giardia* but the predisposing factors to these infections have not been exhaustively investigated. There are several ways by which one can contract amoebiasis, including consuming feacally contaminated food and water (Brooks, 2009). In this study, the prevalence of *E. histolytica* was determined in young patients with diarrhea or abdominal discomfort who were below 5 years of age. Details of their age (stratified into six age groups), gender, source and treatment of household water, access to toilets and personal hygiene practices such as washing hands after using toilets was also collected and analyzed to establish the extent and possible risk factors to which *E.histolytica* infection occurs in the children seeking medical treatment in Mukuru Kwa Reuben clinic. The results should facilitate evaluation of the endemic and risk level of amoebiasis, appropriate target group and consequently indicate whether massive or focal measures of the parasite control are required in the settlement.

MATERIALS AND METHOD

The study was conducted at Mukuru Kwa Reuben slum area, a settlement hub with a population of more than 600,000 people situated in the industrial area between Lunga Lunga Road, Enterprise Road, Airport North Road and Mombasa Road in Embakasi Sub-County in Nairobi County. The settlement is characterized by poor quality housing without adequate water supply and improper sanitation with open filthy drainages.

The study participants were children of consenting parents/guardians aged 5 years and below presenting with diarrhea and abdominal pains who were treated as outpatients at Mukuru Kwa Reuben clinic during May – July 2015. The participants were assigned special identification (ID) numbers and their age and gender was recorded during recruitment. Verbal interview concerning source of household water, access to toilets/washrooms, sources of water, washing of hands after defecation, types of water storage containers used, presence of contaminants around water sources and treatment/boiling of drinking water was also administered to their parents/guardians during consent seeking sessions and their responses were coded and recorded.

Stool specimen was collected from each participant. The stool was collected using clean sterile capped containers and initial macroscopic examination was done on fresh stool samples at the collection site, to enhance chances of finding trophozoites (if present) which were easier to detect than the cysts. All the stool samples were thereafter transported to the Center for Microbiology research (CMR) at the Kenya Medical Research Institute (KEMRI) for further examination for the parasite cysts within 24 hours.

Direct Wet Mount and Ethyl Acetate Sedimentation Concentration Techniques were used to examine the stool for *E. histolytica* cysts in the laboratory following the procedures described by Cheesbrough, (1987).

The prevalence of *E. histolytica* in the sampled population was determined and its association with the participants' demographic and socio – economic characteristics was also analyzed using chi – square and analysis of variance (ANOVA). P –values equal or less than 0.05 were considered significant.

RESULTS

The demographic of the study participants are shown in Table 1**.** Out of the 112 children who participated in the study, 55.4% were females and 44.6% were males. Age was stratified into six age groups as follows, 7.1% were aged 0-10 months, 23.2% were aged 11-21 months and 20.5% 22-32 months, 25.9% were aged 33-43 months, 16.1% were 44-54 months and 7.1% were aged 55-56 months.

Stratification by gender indicated a higher number of females than males while by age,
most of the children were within the 33-43 months age group. The over-all prevalence of *E. histolytica* in the children was found to be 24.1%. (Table 2).

About 79.46% of the children's parents/guardians

Table 1. Demographic characteristics of the participants

Variable	Category	Number of Participants	Percentage
Gender	Male	50	44.6
	Female	62	55.4
Age (months)	0-10	8	7.1
	11-21	26	23.2
	22-32	23	20.5
	33-43	29	25.9
	44-54	18	16.1
	55-65	8	7.1
Total		112	100

Table 2. The prevalence of *E. histolytica* by gender (N=112)

Gender	N	Positive (%)	Significance
Male	50	17(34.0)	P = 0.048
Female	62	10(16.1)	
Total	112	27(24.1)	

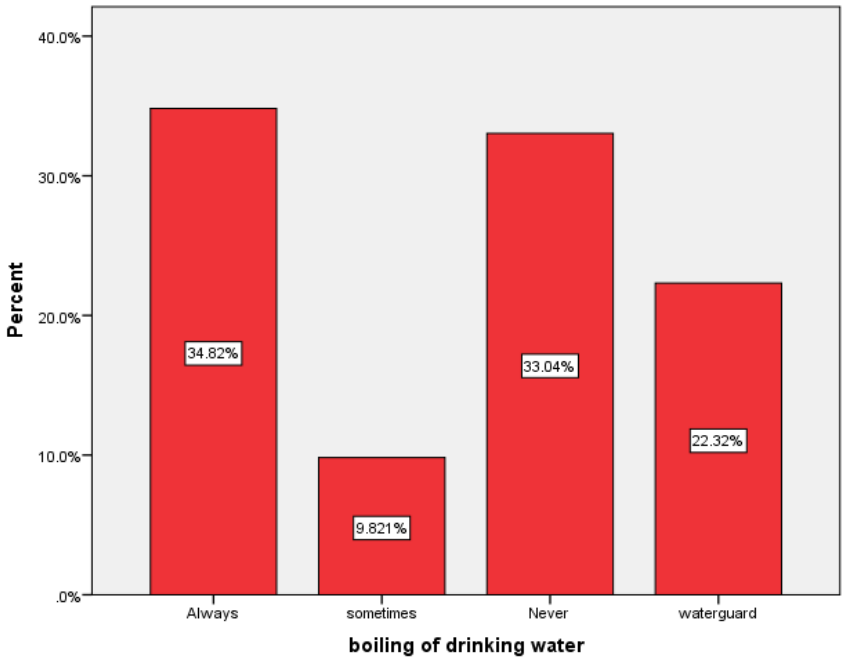

Figure 1. Distribution of participants by water treatment habits

reported the presence of visible contaminants near water sources. Regarding the types of toilet used, 74.11% reportedly used public toilet, 25% used flush toilet and 0.89% used clay made bowls. When Chi-square (χ^2) test was done to determine the difference of *E. histolytica* prevalence between the category who reported presence of visible contaminants around water sources and those without, a computed value of P = 0.893 was obtained against the 0.05 significance cut off level. Hence the *E. histolytica* prevalence was observed to be independent of presence of visible contaminants around water sources. When ANOVA was done to determine the variations between the prevalence of *E. histolytica* and types of toilet used, a computed value of P=0.499 was obtained. Thus, the *E. histolytica* prevalence was also observed to be independent of types of toilet used.

About 74.1% of the participants reportedly always washed their hands after defecation, 25% washed their hands sometimes and 0.89% never washed their hands after defecation. In the treatment of drinking water, 34.82% always boiled their water, 9.821% boiled their water sometimes, 33.04% never boiled water and 22.32% used water guard (Figure 1). Most of the participants (99.1%) reportedly used tap water while 0.9% used river water for

Table 3. Distribution of participants' E histolytica prevalence by types of water storage containers

Containers	Capacity (L)	Percent %	*E. histolytica* prevalence %
Tap	-	1	33.3
Clay pot	20	17.0	26.3
Kentank	2000	0.9	00.0
Jerrican	20	80.4	18.2
Total	112	100.0	24.1

Table 4. The prevalence of *E. histolytica* by age groups

Variable	Category	No. Un-infected (%)	*No. Infected (%)*
Age(months)	0-10	8(100%)	0(0%)
	11-21	23(88.5%)	3(11.5%)
	22-32	17(73.9%)	6(26.0%)
	33-43	19(65.5%)	10(34.5%)
	44-54	12(66.7%)	6(33.3%)
	55-65	5(62.5%)	2(25.0%)
Overall prevalence			24.1%

drinking. When Chi-square (χ^2) test was done to determine the relationship between the prevalence of *E. histolytica* and sources of water, a computed value of P=0.562 was obtained against the 0.05 significance cut off level. Hence the *E. histolytica* prevalence was observed to be independent of sources of water. Analysis of Variance (ANOVA) showed that there was no significant difference in prevalence of *E. histolytica* among those using water with the different treatments. When ANOVA was done to determine the association between the prevalence of *E. histolytica* and the different habits of washing of hands after defecation, a value of P=0.848 was obtained. Hence the *E. histolytica* status was observed to be independent of washing of hands after defecation.

Out of the 112 children, 1.8% of their parents/guardians used water directly from the tap while 17.0% stored water in water pots, 0.9% used a pitcher to store water and 80.9% used Jerricans to store water. However, there was no significant association between *E. histolytica* prevalence and the types of water storage containers.

When Chi-square (χ^2) test was done to determine the association between the prevalence of *E. histolytica* and gender, a computed value of P=0.048 was obtained. Hence the *E. histolytica* prevalence was observed to be dependent on gender with male children being more affected. Similarly, there was significant association between *E. histolytica* prevalence and the age of the children with the 33 – 43 months age group being the most affected (Table 4)

DISCUSSION

This study found an overall *E. histolytica* prevalence of 24.1% which is way above the prevalence reported by Ngonjo *et al* (2012) who found the prevalence of *E. histolytica* amongst school children in Thika District, Kenya to be 14.6% while Mamandou *et al*., (2010) reported an 18.8% prevalence of *E. histolytica* in school children in Agboville area in Côte d'Ivoire. This relatively high prevalence was associated to gender and age in children less than 5 years attending Mukuru Kwa Reuben Clinic while the other studies were based on school aged children. Most children less than five years in slum settlements have not yet started attending school where basic hygiene practices are formally introduced. If the parents/guardians don't teach/instruct the children to practice good hygiene due to their ignorance or because they are too busy to pay full attention to the children, then the children will likely be exposed to contaminated environments where they can contract pathogens including *E. histolytica.* In slum settlements, most parents/guardians are usually struggling to provide food and pay rent for their families and thus they do not have time to take proper care of the children who are often left alone for hours each day. Children above two years are usually very active (playful) and are likely to venture to filthy contaminated grounds around their households where they can get infected.

Environmental, socio-economic, demographic and hygiene-related behavior is known to influence the transmission and distribution of intestinal parasitic infections (Norhayati *et al.,* 2003). A study in Brazil identified place of residence, age, ingestion of raw vegetables and drinking water quality as important risk factors for *E.histolytica* infection (Benetton *et al.,* 2005). Prevalence of *E. histolytica* is related more to inadequate environmental sanitation and personal hygiene than to other factors. Socio-economic factors as well as unpredictable factors such as food insecurity, droughts, and floods contribute to the problem (WHO, 2011). In

this study, the types of toilet used, water sources, presence of contaminants around water sources, washing of hands after defecation, treatment of drinking water and types of
storage containers used had no significant association with the *E. histolytica* prevalence of the infection which was contrary to other studies such as where unavailability of safe domestic water and low education on sanitation was found to contribute to *E.histolytica* transmission (AMREF, 2009).

E.histolytica gains entry into the intestines through the mouth from undercooked food, undercooked or raw vegetables, or contaminated water or hands. Poor personal hygiene, poor garbage disposal and poor disposal of excreta are significant for this oral-faecal infection (Blessman *et al*., 2002). Transmission may also be through mechanical vectors such as flies (Nyarango *et al.,* 2008) whereby flies may carry the infective cysts from contaminated sites or dirty latrines and cause contamination of food and/or water. The surprising findings of this study suggesting that such factors were not associated with *E. histolytica* prevalence may be due to inaccurate information given by the parents/guardians during oral interviews or that the conditions and children's habits in the slum settlement are generally the same for all the participants. During face to face oral interviews, respondents are likely to present what they know to be good habits and not necessarily what they actually practice. Water can be contaminated at source or collection point such as communal tap. The water containers can also be contaminated by the handlers. Even when the water designated for drinking is adequately treated, infections can originate from utensils which are usually washed using water as it is from the source/collection point.

Higher infections in male than female children can be attributed to the fact that due to socio-cultural lifestyle in the slum settlement, boys are more active, have more freedom and are likely to interact more with contaminated environments (contaminated food, water, soil among others while playing outdoors) than girls (Brelet, 2000). Furthermore, children are generally very active in physical play activities and are likely to come in contact with contaminated grounds and fomites in their surroundings. Mukuru Kwa Reuben and other slum areas are generally dirty with no safe playgrounds/facilities for children and the parents/guardians cannot afford decent day care services. These may partly explain the findings of this study.

CONCLUSION

This study therefore recommends that more emphasis should be directed towards the male child's hygiene and all children especially those aged above 33 months since they are more active but often neglected as parents/guardians pay more attention to younger children.

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