Prevalence and pre-disposing factors associated to gastro intestinal protozoan infections among diarrheal children under 5 years in kisii county, kenya.

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Research note

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Abstract

ABSTRACT. Objectives: Mortality and morbidity due to diarrheal diseases among children below the age of five has been increasing especially in the developing countries. This infection has not got attention like other health issues at national or regional levels. Documenting the risk prevalence and factors that influence the occurrence of the diarrheal diseases help to inform the and to develop preventive strategies for the county of study and the country at large. Results: There was high prevalence of gastro intestinal protozoan infection with 34(28.3%) children infected with either Entamoeba histolytica, Giardia lamblia or both (co infections). Female children were 2.1 times less likely to be infected with gastro intestinal protozoa than their male counterparts, though not statistic ally different (P=0.392).

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Introduction

About 3.5 billion people are affected with gastro intestinal parasites with the proportion of the infected individuals rising over time, (Organization, 2004). Diarrheal diseases on average accounts for 1/5 of all child deaths in which about 78% of the deaths are record mostly in the African and South East Asian regions where many areas are poverty stricken. Kenya records 27,400 deaths among children under 5 years associated to diarrhea and other diarrheal illnesses (Boschi-Pinto et al., 2008).

Studies show that *Entamoeba histolytica* and *Giardia lamblia* are prevalent and are commonly spread through contaminated water, *(Nyarango, Aloo, Kabiru, & Nyanchongi, 2008),* however, there is no documentation on the diarrhea cases in children under five years caused by parasitic infections in Kisii County. This study therefore intended to document the pre disposing factors associated with protozoan infections among children with diarrhea under 5 years of age, findings that will serve as an imperative tool in allocating limited public health resources, aid in government development goals and the vision 2030 of Kenya.

Methods

The study was carried out at Kisii teaching and referral Hospital, the main referral hospital in Kisii county with the major population being low income patients. One hundred and twenty children aged five years and below that presented diarrheic symptoms seeking medication and subsequent treatment were included in the study. Fecal samples were collected in clean dry fecal containers from each patient, observed macroscopically then microscopic examination was done to examine the trophozoites/cysts of various gastro intestinal protozoan. Socioeconomic factors were assessed using a structured questionnaire that was filled by the caregiver guided by the research assistant.

Percentages were used to describe the characteristics of the study population, whereas Chi-squares test (χ^2) was used to check on the associations between the variables. All variables that were significantly associated with the profile of *E. histolytica* and *Giardia lamblia* or both were included in a logistic

regression analysis to ascertain the predisposing causal factors for *E. histolytica* and *Giardia lamblia* infections. For each statistically significant factor, 95% confidence interval (CI) was computed by the univariate and multinomial logistic regression analyses and level of statistical significance determined at $P<0.05$.

Results

Prevalence and distribution of gastro intestinal protozoa per age

Children aged between 6–11 months had significantly higher proportion (47.6 %) of children infected with gastro intestinal protozoans than other age cohorts, but it generally decreased with advance in age ($p<0.005$) (see table 1).

Entamoeba histolytica was the most prevalent among the patients accounting for 64.7 % of the parasite infections in the children, while the rest were *G. lamblia* infections. Remarkably, there were 5% cases of mixed infections of *E. histolytica* and *G. lamblia.*

Out of the 120 sampled tested for protozoal infections 71 (59.1%) were males while 49 (40.1%) were females. Thirty-four cases out of the 120 tested positive for either or both *Entamoeba histolytica* and *Giardia lamblia* infections, where 23 (67.6%) males and 11 (32.4 %) female.

Twenty-two of the positive cases (64.7%) were *Entamoeba histolytica,* 6 (17.6 %) *Giardia lamblia,* while 6 (17.6%) cases had mixed infections of *G. lamblia* and *E. histolytica* infections. The densities were classified as: rare (2–5 organisms per 22 mm square cover slip), few (1 organism per 5–10 high power fields (40x), moderate (1–2 organisms per high power field to as few as 1 organism per 2–3 high power fields.) and many (over 3 organisms in every high power field.) in that order.

The distribution of the parasite densities for *Entamoeba histolytica* was significantly higher by proportion in a category identified as few (38.2 %) as compared to rare (14.8 %), moderate (11.8 %) and finally many (0.0%) being the lowest. The same trend wasseen in *Giardia lamblia* where few had the highest frequency,followed by rare, moderate and eventually many with the following percentage proportion, 8.8 %, 5.9 %, 2.9 % and 0.0% respectively. Nonetheless in mixed infections, all cases had very high numbers of each parasite species that were categorized as many. The gastro intestinal protozoal densities for all single case infections and mixed infections were significantly lower ($P = 0.000$.)

Predisposing factors to gastrointestinal protozoan infections

In this study 25 (74%) of children who had a habit of sucking the fingers were infected by gastro intestinal protozoan infections while only 9 (10%) of the children who did not suck fingers were infected $P = 0.000$, therefore indicating that this practice increased risk of infection see Table 2.

Additionally, 32 out of 120 children who did not regularly practice hand washing before eating meals, out of which 22(67%) were found to be infected by gastrointestinal protozoans while for the 88 children that

regularly washed their hands before eating meals only 12(14%) were infected (see Table 2). Therefore, hand washing before meals significantly reduced the risk of infection P = 0.000.

Some households used one unit of disposal per household 66 (55%) while others shared one disposal unit by many households 54 (45%). The study found out that 28 (52%) children of those who shared a single disposal unit per multiple households were infected while only 6 (9%) of the children from households that did not share disposal units were infected (see Table 2). Therefore, the use of a single unit per household significantly reduced the risk of infection, (P = 0.000).

Water from rivers/streams was the highest source of protozoan infections with 12(35%) infections, others were borehole 7 (21%), rainwater 7 (21%), springs 6 (18%) and tap water with 1 (3%) child. Fruit washing was also seen to be a factor in the infections with fifty children (42%) not regularly practicing fruit washing before eating and 70 (58%) often washed the fruits before eating. Among the 34 children that were infected with gastro intestinal protozoa 21(62%) who did not regularly wash the fruits before eating were infected while 12(35%) who always practiced fruit washing before eating tested positive, though this factor was not seen to statistically significant.

The study also found out that 102(85%) of the caregiver(s) were in low income level and 18(15%) of those caregiver(s) that were classified as high / middle income level. Out of the 34 children that tested positive of gastro intestinal protozoa, 27(79%) of the infected children came from households where caregivers were of low income while only 7 (21%) came from homes where caregiver(s) belonged to high /middle level of income (P = 0.758).

Discussion

Prevalence and distribution of gastro intestinal protozoa

Out of a total of 120 screened stool samples, 34 (28.3%) tested positive for gastrointestinal protozoans with *Entamoeba histolytica, Giardia lamblia or* both (co- infections) accounting for 18.0 %, 5.0 % and 5.0 % respectively. This prevalence is higher than Kitui County, that reported a prevalence 12.6%, of intestinal protozoa (Nguhiu et al., 2009). The high rates observed were comparable to other findings in Mukuru informal settlement in Nairobi with 25.6%, (Mbae *et al,* (2013). Similarly, these findings showed a relatively higher numbers than other countries including Mozambique 16% (Kneel. J*. et al,* 2018) but were comparable to those in Nigeria 36.52% (Firdu *et al,* 2014) and Tanzania 29.6% (Ngosso.B. E. *et al,* (2015).

Increase in age was correlated to decrease in the prevalence of infections, with the peak being at children aged between 6–11 months (47.6 %). Findings in Tanzania differs with this study finding as it showing highest infection at 34.6% in the age groups of 12–24 months, followed by 24–36 months (15.6%) and least among 0–5 months (2.4%), (Ngoso. B.E *et al (2015).* A study in south Ethiopia demonstrated that children of the age group between 2 –3 years were most infected, while the age group of less than 1 or equal to 1 year were least infected, (Mulatu, Zeynudin, Zemene, Debalke, & Beyene, 2015). The reason for

this age group (less than 12 months old) vulnerability in this study may be due to milk bottles contamination and crawling on a contaminated grounds and accessing filthy material into their mouths.

The study found that there was a significantly higher number of males infected (67.6%) as compared to females (32.4%), therefore a male child was 2.1 times more likely to be infected compared to a female child. These findings are similar to a study in Nakuru Kenya (Firdul 2014), Nigeria (Anosike et al., 2004; Adeyeba & Akinlabi, 2002) and South Korea (Nkengazong, Njiokou, Teukeng, Enyong, & Wanji, 2009). However some studies have reported higher infections in females than males(Chukwuma et al., 2009). Higher infection rates in males could be due to differences in behavioral factors (Coutsoudis et al., 2001), males in general show reduced immune responses and increased intensity of infection compared to females (Stanley, 2003). Other proximate cause of sex differences in infection is differences in endocrine-immune interactions in which Sex steroids alters genes and behaviors that influence susceptibility and resistance to infection (Stanley, 2003).

Effect of predisposing factors to gastrointestinal protozoan infections

The study found that 32 (26.7%) out of 120 children in the study who did not regularly practice hand washing before eating meals, out of which 22(67%) were found to be infected by gastrointestinal protozoans while for the 88 children that regularly washed their hands before eating meals only 12(14%) were infected. Hand washing before meals was found to significantly reduce the infection of gastro intestinal protozoa infections among the study population, P = 0. 000. This finding is similar to other studies in Kilifi, Kenya, (Njuguna et al., 2016), Nigeria, (Ojiaku, Pena, Belanger, Chan, & Dennie, 2014) and later in Nigeria (Strunz *et al.*,, 2013). The study further found out that there were 86(71.7%) children who did not suck the fingers while 34(28.3%) practiced finger sucking. Interestingly, 25 (74%) of children who had a habit of sucking the fingers were infected while only 9 (10%) of the children who did not suck fingers were infected hence indicating that this practice increased risk of infection, P = 0.000. This agrees with a study in Sri Lanka on habits of nail biting and sucking fingers (Lahiru S. 2016). However in Nigeria, hand eating was negatively associated with diarrhea and the intestinal infections, (Ojiaku, Pena, Belanger, Chan, & Dennie, 2014).

Water sources for drinking was also seen as a prominent risk factor with rivers/streams being the greatest risk with 12(35%) children out of the 34 infected, others included borehole 7 (21%) children, rain water 7 (21%), springs 6 (18%) and tap water1 (3%) child was infected. These findings are similar to one done in Nepal Nigeria, where water from the river/streams had higher infections compared to other water sources (Strunz *et al*2014).

The study also found out that households that were using a single unit of disposal per household decreased chances of infections (P = 0.000). This findings are similar to (Adamu, Endeshaw, Teka, Kifle, & Petros, 2006);Noor Azian et al., 2007; Atukorala & Lanerolle, 1999) who found that intestinal parasitic infections have a global distribution with high prevalence registered in people with poor living conditions characterized by over-crowding,poor environmental sanitation, inappropriate waste disposal and unhealthy usage of pit/latrine.

Conclusions

Gastro intestinal protozoa infections among diarrheal children under the age 5 years in Kisii County are high. A male children is 2.1 times more likely to be infected by gastro intestinal protozoa compared to a female child. The rate of parasite densities for each species was highest in mixed infection cases compared to single infection, which may lead to disease severity. Hygienic practices like hand washing before meals and use of single human waste disposal unit per household highly reduced the risk of infection while unhygienic practices like finger sucking increased the risk of infection. The source of water for drinking was a major determinant of risks of infections where treated tap water highly reduced probability of infection but use of water from streams and rivers for drinking was positively correlated with infections.

Limitations

The major limitations in the study included:

- Participants not open to sharing their private issues.
- Inability to obtain immediate samples from some participants
- Contamination of some specimens

Declarations

Authors Contributions

Caleb Okeri Ondara designed, performed sampling, data collection, data analysis and participated in manuscript preparation. Benson Omweri Nyanchongi did the research planning, data analysis and preparation of the manuscript. Vincent Obino Orucho, participated in data analysis, discussion of the results and development of the manuscript. All the authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

Ethical Approval and consent to participate

The study obtained approval from the Kisii teaching and referral hospital ethical committee (KTRH) and the National Commission for Science and technology (NACOSTI). Parents/caregivers of all the participants in the study signed a written consent before being incorporated in the study.

Consent to publish

Consent to publish has been sought from the parents/guardians /caregivers of the participants in the study

Availability of data and materials

The datasets for the current study are available from the corresponding author on request.

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Tables

Table 1: prevalence and distribution of gastro intestinal protozoa in children under age 5 in Kisii County.

Age in months	Number of patients	Parasite species	Number infected (%) per cohort	P value
6-11	21	*Entamoeba histolytica* *Giardia lamblia* Both *(E. histolytica and G. lamblia)*	6(28.6) 2(9.5) 2(9.5)	
			10 (47.6) *	
12-23	50	*Entamoeba histolytica* *Giardia lamblia* Both (*E. histolytica and G. lamblia*)	10(20) 2(4) 1(2)	.337
			13(26)	
24-35	24	*Entamoeba histolytica* *Giardia lamblia* Both *(E. histolytica and G. lamblia)*	2(8.3) 0(0.0) 2(8.3)	
			4(16.7)	
36-47	12	*Entamoeba histolytica* *Giardia lamblia* Both *(E. histolytica and G. lamblia)*	2(16.7) 0(0.0) 1(8.3)	
			3(25)	
48-60	13	*Entamoeba histolytica* *Giardia lamblia* Both (*E. histolytica and G. lamblia)*	2(15.4) 2(15.4) 0(0.0)	
			4(30.8)	
Sub total	120	*Entamoeba histolytica* *Giardia lamblia* Both *(E. histolytica and G. lamblia)*	22(18.4) 6(5) 6(5)	
Total	**120**		**34(28.3)**	

Table 2: Effect of hygienic practices on gastro intestinal protozoan infections among diarrheal children under age 5 years in Kisii County Kenya.

Hygienic practice	Practice presence/absence	Parasite identified	Number infected (%)	χ^2	P value
Hand washing before eating meals	No 32	*Entamoeba histolytica*	14(44)		
		Giardia lamblia	5(16)		
		Both (*E. histolytica and G.lmblia*)	3(9)		
	Yes 88		8(9)	34.789	0.000**
		Entamoeba histolytica	1(1)		
		Giardia lamblia	3(6)		
		Both *(E. histolytica and G.lmblia*)			
Fruit washing before eating	No 50	*Entamoeba histolytica*	11(22)		
		Giardia lamblia	5(10)		
		Both (E. *histolytica and G.lmblia*)	5(10)		
	Yes 70		11(16)	11.758	0.508
		Entamoeba histolytica	1(1)		
		Giardia lamblia	1(1)		
		Both (E. *histolytica and G.lmblia*)			
Waste disposal	Single 66	*Entamoeba histolytica*	4(6)		
		Giardia lamblia	1(2)		
		Both (*E . histolytica and G.lmblia*)	1(2)		
	Multiple 54		18(33)	28.072	0.000**
		Entamoeba histolytica	5(9)		
		Giardia lamblia	5(9)		
		Both(*E. histolytica and G.lmblia*)			
Finger sucking	No 86	*Entamoeba histolytica*	7(8)		
		Giardia lamblia	1(1)		
		Both (*E. histolytica and G.lmblia*)	1(1)	47.071	0.000**
	Yes 34		15(44)		
		Entamoeba histolytica	5(15)		
		Giardia lamblia	5(15)		
		Both *(E. histolytica and G.lmblia)*			
Water source for drinking	Streams/rivers	19	12(63)	18.479	0.030*
	Unprotected springs	19	6(32)		
	Tap	34	1(3)		
	Bore hole	26	10 (38)		
	Others	22	7(32)		
Economic status of caregiver(s).	Low income				
	High or middle income	102	27(23%)	3.395	0.758
		18	7(39)		