Gastrointestinal Protozoan Infections and Associated Factors among Children under 5 Years with Diarrhea in Kisii County, Kenya

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Abstract

Globally every year, it is projected that approximately two million infections related to diarrhea occur among children who have not reached their fifth birth anniversary. In Kenya, gastro intestinal protozoan infection is a major problem primarily due to fecal contamination of food and water causing high morbidity. The aim of this study was to establish the predisposing factors associated with gastro intestinal protozoan infections in children under five years with diarrhea in Kisii county, Kenya.

Index terms— gastro intestinal protozoans, diarrhea, children under five years

I. Background of the Study lobally every year, it is projected that approximately 2 million illnesses related to diarrhea occur among children who have not reached their fifth birth anniversary from which slightly almost 50% prevalence is recorded in Africa, South Asia (38%), East Asia (9%) and Pacific (7%) respectively. The bulk of gastrointestinal related illnesses are selflimited and very specific, However, certain possible causal factors that include nutritional deficiency, immunity suppression, and early years of age prompt the development of tenacious diarrhea. Diarrhea remains a major problem among the leading causes of death in children who have not reached their fifth birth anniversary globally out of which, Kenya records 27,400 deaths among children under five years associated to diarrhea and other diarrheal illnesses (Bryce, Boschi-Pinto, Shibuya, Black, & Group, 2005).

As much as the gastro intestinal protozoa appear to have less impact on humans than the other diseases like AIDS and tuberculosis, which has been put to priority while neglecting it among many other tropical diseases, they are an immense problem and set back in tropical regions and should be put to consideration in the aid of reducing the child death rate and generally improve child health in the struggle to meet the sustainable development goals. The effects of Intestinal parasites cause noteworthy ill-health and death across the world which has made it a global problem, principally in unindustrialized countries where a larger population has other related ill-health conditions. These effects result to a tremendous effect on socio-economic aspects in terms of high treatment and hospitalization costs (Utzinger, N'goran, Marti, Tanner, & Lengeler, 1999). Recent studies that have been done in the area shows that Entamoeba histolytica and Giardia lamblia are prevalent and are commonly spread through contaminated water, (Nyarango, Aloo, Kabiru, & Nyanchongi, 2008), However, there is not much documentation on the diarrhea and other related diseases in children under five years caused by parasitic infections in Kisii County and the surrounding areas. For this reason, this study was is intended to carry out a study to determine the pre disposing factors G mixed cases of infections relative to single case infections.

1 II. Methodology

The study was carried out at Kisii teaching and referral Hospital, which is the main referral hospital in Kisii county and surrounding counties with the major population being low-income earners. One hundred and twenty children aged five years and below that were presented with diarrheic symptoms seeking medication and subsequent

treatment were included in the study. Fecal samples were collected in clean dry fecal containers from each patient, all the fecal samples were observed macroscopically for color, odor, consistency, presence of mucus and blood stains. Subsequently, a microscopic examination was done to examine the trophozoites/cysts of various gastro intestinal protozoan parasites presumed to be the causal agents for diarrhea in children. Direct wet mount preparation and formolether stool concentration methods were used in the microscopic examination and identity of the suspected organisms in the stool sample within the first 30 minutes to give accurate and reliable results. 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, including the occurrence of gastro intestinal protozoa identified among the study population. Chi-squares test (? 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.

2 III. Results

3 a) Prevalence and distribution of gastro intestinal protozoa per age among children under five years with diarrhea examined at the Kisii County referral hospital (KTRH)

In this study, children aged between 6-11 months had significantly highest proportion (47.6 %) of children infected with gastro intestinal protozoans than other age cohorts, but it generally decreased with the advance in age (p<0.005) (see table 1). © 2020 Global Journals F Additionally, 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 6 cases of mixed infections of E. histolytica and G. lamblia accounting for 5.0% of the infections.

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 120tested positive for either or both Entamoeba histolytica and Giardia lamblia infections, of which 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 (3 organisms per 22 mm square cover slip), few (1 organism per 8 high power fields (40x), moderate (2 organisms per high power field to as few as 1 organism per 2 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 was realised 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.)

4 b) 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 F Additionally, there were 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.

The study found out that households either used one unit of disposal per home 66 (55%) while others shared one disposal unit for many families 54 (45%). We 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 had the highest protozoan infections, with 12 (35%) children infected; others included, borehole 7 (21%) children, rainwater 7 (21%) children, springs 6 (18%) children 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 children (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 / middleincome 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).

5 IV. Discussion a) Prevalence and distribution of gastro intestinal protozoa among children under age five years with diarrhea

Out of a total of 120 screened stool samples, 34 (28.3%) tested positive for gastrointestinal protozoans with Entamoeba histolytica, Giardia lamblia, or both (coinfections) accounting for 18.0 %, 5.0 % and 5.0 % respectively. This prevalence is higher than other sites in Kenya, which include, a study in 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, that reported the infections of protozoa at 25.6%, (Mbae et al, (2013) and in Kitui County 38.6% (Kisavi, 2015). Similarly, our 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% (Ngoso. B.E. et al, **??**2015). The high infections warrant attention and institution of measures to control and treat infected individuals.

We found out that the increase in age was correlated to a decrease in the prevalence of infections, with the peak being at children aged between 6-11 months (47.6 %). Findings in Tanzania differs from this study finding as it showed that the highest infection of gastro intestinal infections was at (34.6%) in the age groups of 12-24 months, followed by 24-36 months (15.6%), 6-12 months (8%) and finally least among children 0-5 months (2.4%), (Ngoso. B.E et al **??**2015). The study carried in south Ethiopia on infectious protozoa diseases of poverty also demonstrated that children of the age group between 2 -3 years were most infected, while the age group of less than one or equal to one year were least infected, (Mulatu, Zeynudin, Zemene, Debalke, & Beyene, 2015). This study also differs from another study done by De Souza et al. **??**2007), who found that "Intestinal parasitism inclines to be less predominant among children under one year of age, afterward reaching a prevalence plateau around 50%. The reason for this age group (less than 12 months old) vulnerability in this study might be explained by milk bottles contamination and crawling on contaminated grounds and accessing filthy material into their mouths (Adnan et al, 2008). Also, these age group children use diaper, which may allow the transmission via hand to mouth contamination if not used properly.

We found that there was a significantly higher number of males infected 23 (67.6%) as compared to females 11 (32.4%). Therefore, a male child was 1.5 times more likely to be infected with GI protozoacompared to a female child. These findings are similar to other studies done in Nakuru Kenya (Chabalala H. P and Mamo H, (2001), Nigeria **??**Anosike et al., 2004; **??**deyeba & 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 © 2020 Global Journals F 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). These disparities usually attributed to ecological factors including differential exposure to pathogens because of sexspecific behavioral or morphological patterns (Stanley, 2003).

6 a) Effect of predisposing factors to gastrointestinal protozoan infections

Various hygienic factors were seen to have contributed to the risk of infections in children under the age of 5 years. These included hand washing before eating meals, finger sucking, waste disposal practices, the main source of drinking water, fruit washing before eating, and economic status of caregivers. There were 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), Benue, Nigeria, (Ojiaku, Pena, Belanger, Chan, & Dennie, 2014),Malawi (Morse et al, 2008) and later in Nigeria **??**Strunz et al., 2013), where all of them showed that hand hygiene greatly reduced the infection by significantly reducing the fecal contamination and improving health. Therefore, the practice of hand washing before eating meals elementarily reducing the infection may be because contaminated hands play a major role in the fecal -oral route of transmissions in humans and therefore we advocate for high standards of hand hygiene for all as a measure of reducing the intestinal protozoa infections. We further found that there were 86(71.7%) children who did not suck the fingers while 34(28 .3%) practiced finger sucking. Interestingly we established that 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 hence indicating that this practice increased risk of infection, P= 0.000.This agrees with the study in Sri Lanka on habits of nail-biting and sucking fingers (Lahiru S. 2016), a study in Nepal that both nail-biting and sucking fingers are significantly associated factors in school children (Sah R.B et al ,2014). However, in Benue, Nigeria, hand eating was negatively associated with diarrhea and intestinal infections (Ojiaku, Pena, Belanger, Chan, & Dennie, 2014). Therefore, health education on the practice of finger sucking aout the risk of intestinal protozoa infections should be embraced among the children in Kisii County.

Water sources for drinking was also a prominent risk with rivers/streams being the greatest 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 (RB.Sah et al 2016).

The study also found out that households that were using a single unit of disposal per household decreased the chances of infections (P = 0.000). This findings are similar to **??**

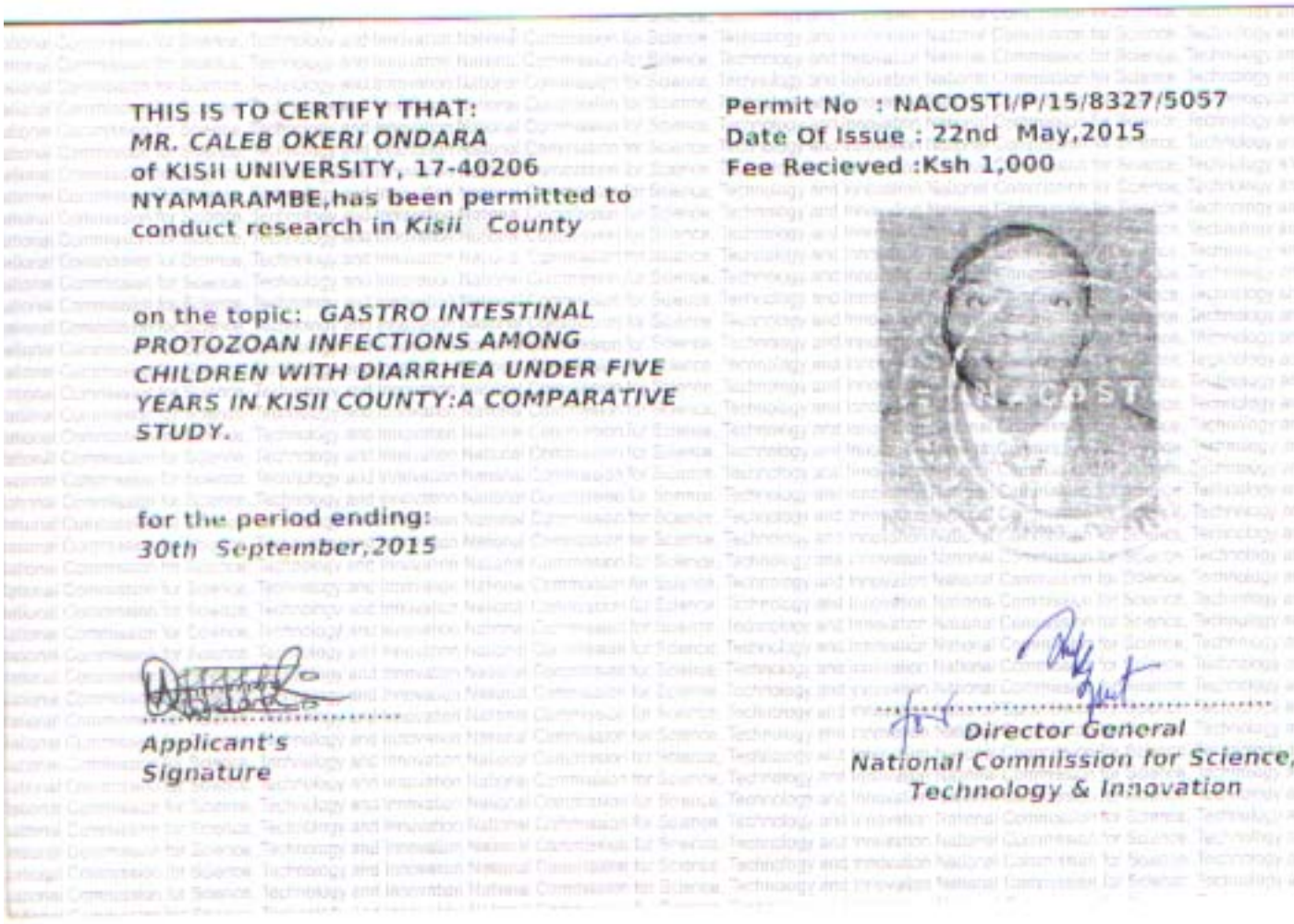
7 V. Conclusion

Gastro intestinal protozoa infections among children under the age five years with diarrhea in Kisii County are high. A male child under age five years in Kisii County is 1.5 times more likely to be infected by gastro intestinal protozoa compared to a female child. The parasite densities for each species was highest in mixed infection cases compared to single infection cases among children of age under five years with diarrhea in Kisii County. Hygienic practices like hand washing before meals and the use of single human waste disposal units 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 the use of water from streams and rivers for drinking was positively correlated with infections.

8 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. Mogoa Nyamwancha Wycliffe assisted in proposal development, research planning and making findings and 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. [1]

[1]Gastrointestinal protozoan infections and associated factors among children under 5 years with diarrhea in Kisii county, Kenya



THIS IS TO CERTIFY THAT:
MR. CALEB OKERI ONDARA
of KISII UNIVERSITY, 17-40206
NYAMARAMBE,has been permitted to
conduct research in *Kisii County*

on the topic: *GASTRO INTESTINAL PROTOZOAN INFECTIONS AMONG CHILDREN WITH DIARRHEA UNDER FIVE YEARS IN KISII COUNTY:A COMPARATIVE STUDY.*

for the period ending:
30th September,2015

.....
Applicant's Signature

Permit No : NACOSTI/P/15/8327/5057
Date Of Issue : 22nd May,2015
Fee Recieved :Ksh 1,000

.....
Director General
National Commission for Science, Technology & Innovation

Figure 1:

1

associated with protozoan infections among children with diarrhea under five years of age brought for medication at the facility (KTRH). The research findings will serve as an imperative tool in allocating limited public health resources, help in achieving government development goals, and the vision 2030 of Kenya.

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	Age in months	Number of patients	Parasite species	Number infected (%) per cohort	P value
Medical Research (	6-11 12-23	21 50	Entamoeba histolytica Giardia lamblia Both (E. histolytica and G. lamblia) Entamoeba histolytica Giardia lamblia Both (E. histolytica and G.	2(9.5) 2(9.5) 10 (47.6)* 10(20) 2(4) 1(2) 6(28.6)	.337
Global Journal of	24-35 36-47	24 12	lamblia) Entamoeba histolytica Giardia lamblia Both (E. histolytica and G. lamblia) Entamoeba histolytica Giardia lamblia Both (E. histolytica and G. lamblia)	13(26) 2(8.3) 0(0.0) 2(8.3) 4(16.7) 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)	

Figure 2: Table 1 :

2

						Year 2020 35
Hygienic practice	Practice presence/absence	Parasite identified Entamoeba histolytica Giardia lamblia Both (E. histolytica and G.lmblia)	Number infected (%)	? 2	P value	Volume XX Issue I Version I
Hand washing before eating meals	No 32		14(44) 5(16) 3(9)			
	Yes 88	Entamoeba histolytica	8(9)	34.789	0.000**	D D D D)
Fruit washing before eating	No 50	Giardia lamblia Both (E. histolytica and G.lmblia) Entamoeba histolytica Giardia lamblia Both (E. histolytica and G.lmblia)	1(1) 3(6)	28.072	2.000**	Global
	Yes 70		11(22)	11.758	8.508	Journal of Medical Research
	Single 66 Multiple		5(10)			
		Entamoeba histolytica Giardia lamblia Both (E. histolytica and G.lmblia)	5(10) 11(16)			
Waste disposal	54	Entamoeba histolytica Giardia lamblia Both (E . histolytica and G.lmblia) Entamoeba histolytica	1(1) 4(6) 1(2) 1(2) 18(33)			
		Giardia lamblia	5(9) 1(1) 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)			
	Yes 34	Entamoeba histolytica	15(44)	47.071	1.000**	
		Giardia lamblia	5(15)			
		Both (E. histolytica and G.lmblia)	5(15)			
Water source for drinking	Streams/rivers 19		12(63)	18.479	9.030*	
	Unprotected springs 19		6(32)			

Figure 3: Table 2 :

2

	Tap	34	1(3)		
	Bore hole	26	10 (38)		
	Others	22	7(32)		
Economic status of	Low income				
caregiver(s).	High or middle	102	27(23%)	3.395	0.758
	income	18	7(39)		

Figure 4: Table 2 .

Figure 5:

.1 Competing interests

The authors declare that they have no competing interests.

.2 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.

.3 Funding

The authors did not receive any funding Appendix I: Research Permit Appendix III: Kisii Teaching and Referral Hospital Authorization Letter Appendix V. Informed Consent form Kisii University, post graduate studies section, school of pure and applied sciences in the department of biological sciences. Title: Prevalence and predisposing factors associated with gastrointestinal protozoa in children under age five with diarrhea, Kisii County.

.4 Patient identity no._____

Consent to participate in this study I greet you, I am ?????????.. Working on this research with an objective of determining the factors associated with gastro intestinal protozoa in diarrheal children under age five. We plan to examine 120 diarrheal children under age five attending outpatient department of Kisii Teaching and Referral Hospital. We are therefore asking you to be part in this study since you are a patient having a visit at this clinic. You have been randomly selected. We would like you to understand the intention of this study and your part so that you may take decision if you would like to join us in this study. If you accept to join, we will then ask you to sign for us this paper (or if you cannot read/ write, make your mark in front of a witness). Please ask us to explain any information that you may have not understood.

.5 Information about the research

If you accept to participate we will interview you. We will ask you about your background and brief history of your illness. The interview will last at maximum 20 minutes. After the interview, we shall collect fresh stool sample from you for examination.

In case of the possible risks, we shall do our best to safeguard your privacy and study records. This interview shall be private. However, it is possible that others may learn that you have joined the research. Because of this, others may treat you dishonorably.

The interview questions may make you have some anxiety. You can reject to answer any question. You may also end the interview at any time without notice.

For the Possible benefits, this study has no one on one benefit but the findings of this study will help to improve interventions against diarrhea, gastro intestinal protozoa infections and other related illnesses. We do not provide any incentive for preventing or curing diarrhea and gastro intestinal protozoa if any but the interview may offer a good advice to you on how you can perhaps live diarrhea and gastro intestinal protozoa infections free life. If you decide not to be in the research. You are free to decide if you want to take part in this research or not.

.6 Confidentiality

We will do our best to protect information about you and your role in this research. We will interview you in a private place. We will not write your name on the interview form. We will use your form number to connect your interview response to our stool testing laboratory. You will not be named in any reports. Only the study staff and investigators will know your responses to the questions.

.7 Compensation

You will not receive any cash by joining this study.

.8 Leaving the research study

You may leave the research at any time. If you leave, it will not change the health attention you receive here. If you choose to take part, you can change your mind at any time and pull out. If so, please tell the research interviewer why you wish to leave.

Your rights as a participant: This research has been reviewed and approved by the Kisii University research and extension unit and NACOSTI.

If in case you have questions about this study, you should contact the Coordinator or the Principal Investigator ONDARA CALEB OKERI, Kisii University School of pure and applied sciences. P.O BOX, 408-40200. Signature: ??????????? Do you agree? Participant Agrees Participants disagree I ————————————-have read and understood the matters in this form. I agree to participate in this study. Participant signature ————————

8 AUTHORS CONTRIBUTIONS

———————-Signature of witness (if can't read) ———————————-Signature of research assistant ———————————Date of signed consent ————-

[Anosike et al.] , J C Anosike , B E Nwoke , C O Onwuliri , C E Obiukwu , A F Duru , M I Nwachukwu .

[Stanley and Jr ()] , S L Stanley , Jr . 10.1016/s0140-6736(03)12830-9. *Amoebiasis. Lancet* 2003. 361 (9362) p. .

[Njuguna et al. ()] 'Enteric pathogens and factors associated with acute bloody diarrhoea'. C Njuguna , I Njeru , E Mgamb , D Langat , A Makokha , D Ongore , . . Kariuki , S . 10.1186/s12879-016-1814-6. *BMC Infect Dis* 2016. 16 p. 477.

[Boschi-Pinto et al. ()] 'Estimating child mortality due to diarrhoea in developing countries'. C Boschi-Pinto , L Velebit , K Shibuya . *Bull World Health Organ* 2008. 86 (9) p. .

[Ojiaku et al. ()] 'Functioning intrapericardial paraganglioma: multimodality imaging findings and pathological correlation'. M Ojiaku , E Pena , E C Belanger , K L Chan , C Dennie . 10.1161/circulationaha.114.012458. *Circulation* 2014. 130 (16) p. .

[Utzinger et al. ()] 'Intestinal amoebiasis, giardiasis and geohelminthiases: their association with other intestinal parasites and reported intestinal symptoms'. J Utzinger , E N'goran , H Marti , M Tanner , C Lengeler . *Trans R Soc Trop Med Hyg* 1999. 93 (2) p. .

[Mulatu et al. ()] *Intestinal parasitic infections among children under five years of age presenting with diarrhoeal diseases to two public health facilities in Hawassa*, G Mulatu , A Zeynudin , E Zemene , S Debalke , G Beyene . 2015. South Ethiopia. 4 p. 49. (Infectious diseases of poverty)

[Coutsoudis et al. ()] 'Method of feeding and transmission of HIV-1 from mothers to children by 15 months of age: prospective cohort study from Durban'. A Coutsoudis , K Pillay , L Kuhn , E Spooner , W.-Y Tsai , H M Coovadia , S A V A S Group . *South Africa. Aids* 2001. 15 (3) p. .

[Kisavi ()] *Prevalence and factors associated with soil transmitted helminth infection among primary school children in Kikumuni sublocation*, P M Kisavi . 2015. Machakos County, Kenya.

[Noor Azian et al. ()] 'Prevalence of intestinal protozoa in an aborigine community in Pahang'. M Noor Azian , Y San , C Gan , M Yusri , Y Nurulsyamzawaty , A Zuhaizam , . . Vythilingam , I . *Malaysia. Trop Biomed* 2007. 24 (1) p. .

[Amajuoy ()] 'Prevalence of parasitic diseases among nomadic Fulanis of south-eastern Nigeria'. O Amajuoy . *Ann Agric Environ Med* 2004. 11 (2) p. .

[Nkengazong et al. ()] 'Reassessment of endemicity level of urinary schistosomiasis in the Kotto-Barombi focus (South West Cameroon) and impact of mass drug administration (MDA) on the parasitic indices'. L Nkengazong , F Njiokou , F Teukeng , P Enyong , S Wanji . *Journal of Cell and Animal Biology* 2009. 3 (9) p. .

[Okpala et al. ()] 'Teaching Neuro Images: internal carotid artery dissection presenting as Villaret syndrome'. O Okpala , A Von Essen , G Cummins , M Manford . 10.1212/wnl.0000000000000266. *Neurology* 2014. 82 (13) p. .

[Chukwuma et al. ()] 'The prevalence and risk factors of Geohelminth infections among primary school children in Ebenebe town'. M Chukwuma , I Ekejindu , N Agbakoba , D Ezeagwuna , I Anaghalu , D Nwosu . *Middle-East Journal of Scientific Research* 2009. 4 (3) p. .

[Adamu et al. ()] 'The prevalence of intestinal parasites in paediatric diarrhoeal and non-diarrhoeal patients in Addis Ababa hospitals, with special emphasis on opportunistic parasitic infections and with insight into the demographic and socioeconomic factors'. H Adamu , T Endeshaw , T Teka , A Kifle , B Petros . *Ethiopian Journal of Health Development* 2006. 20 (1) p. .

[Nyarango et al. ()] *The risk of pathogenic intestinal parasite infections in Kisii Municipality*, R M Nyarango , P A Aloo , E W Kabiru , B O Nyanchongi . 10.1186/1471-2458-8-237. 2008. Kenya: BMC Public Health. 8 p. 237.