Selected practices among rural residents versus the prevalence of Amoebiasis and Giardiasis in Njoro Distrct, Kenya.

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SUMMARY

The study was designed to investigate on selected practices among rural population, and their likely contribution to the spread of amoebiasis (*E. histolytica*) and giardiasis (*G. lamblia*). A cross sectional study was carried out in three villages, namely Kikapu, Piave and Belbar in Njoro District, Kenya. Questionnaire, interviews and personal observations were used to obtain data from 336 randomly selected consenting individuals in homesteads in the three villages. A retrospective study was further carried out to establish the prevalence of *E. histolytica* and *G. lamblia* among outpatients attending two randomly selected health centers in the study area. Majority of the respondents' highest education level was basic primary school education (61%), unemployment (98%) and with a monthly expenditure of less than 2200 Kenya Shillings or 28 US Dollars (81%). Eighty percent of the respondents were classified under low economic status. Eighty two percent reported lack of piped water and boiling of drinking water was less likely to occur among the low economic status respondents (Odds ratio (OR) = 0.423, χ^2 = 9.88; 95% CI of -5.74 to 6.58). However, washing of hands with soap after using a latrine seemingly was not influenced by economic status of the respondents (OR = 1; χ^2 = 0; 95% CI = 0). The level of education seemed to influence on the adoption of risky practices, such as, failure to boil drinking water was more likely to occur among respondents who had a low academic level (OR = 0.84, χ^2 = 0.04, 95% CI of -2.27 to 3.95). The stool tests records at Njoro PCEA health center showed that the prevalence of *E. histolytica* (20.83%) and *G. lamblia* (20.32%) were higher than the corresponding prevalence at Njoro County Council health center which were 1.34% and 0.00% respectively. Concurrent infections of *E. histolytica* and *G. lamblia* were absent in the two health centers. The trend of *E. histolytica* and *G. lamblia* followed an alternating pattern, in which an increase in one directly corresponded to a decrease in the other and vice versa in the two health centers. It was concluded that poverty and low education levels were significant factors that influenced on the adoption of risky lifestyles that were likely to enhance parasitic infections. There is a need for reliable diagnostic methods other than direct microscopy for *E. histolytica* and *G. lamblia* stool tests in order to minimize the wide variation of the results in the two health centers. Public health education should also be enhanced to discourage the adoption of risky practices.

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Introduction

According to WHO [1], health is a state of complete physical, mental and social well being. The 'Alma-Ata Declaration' postulated that an acceptable level of health for all people in the world should have been achieved by year 2000 [2]. Many developing countries may not have achieved this target. In Kenya, provision of health has been influenced by factors like the level of education, social stratification among others. People with higher levels of educations tend to be healthier than those of similar income who are less well educated and that those in 'upper' social strata tend to show low mortality rate and less morbidity rate due to infections because they seek medical attention early [3]. In addition, rural populations in developing countries tend to face problems of unhygienic practices, which may contribute to the transmission of parasitic diseases [4]. Infectious parasitic diseases remain the primary cause of morbidity and mortality in tropical countries where, being in contact with microorganisms and transmission of microorganisms is higher [5]. The prevalence of intestinal parasite infection is influenced by factors like poor sanitation and hygiene, age of the individuals, the type of parasites, the climate and the presence of animals known to be involved in the transmission of the parasites [6].

Amoebiasis and giardiasis are intestinal protozoa infectious diseases usually contracted by ingesting food or water contaminated with cysts. Auto infection also plays a key role in the transmission of giardiasis [7]. The causative agents for amoebiasis and giadiasis are *E. histolytica* and *G. lamblia* respectively. The *E. histolytica*, whose occurrence is highest in the tropics, is thought to be carried in the intestine of one-tenth of the world's population and it kills around 100,000 people per year [8]. Amoebiasis exists in intestinal and extra-intestinal forms characterized by dysentery, abdominal pain, fever, diarrhoea, weight loss, amebic hepatitis and pulmonary amoebiasis [8]. On the other hand, *G. lamblia,* has an incidence of between 100,000 to 1 million cases per year [8]. Giardiasis leads to symptoms ranging from mild diarrhoea, flatulence, vague abdominal pain, acute and/or severe diarrhoea to steatorrhea and a typical mal-absorption syndrome [9]. Diarrhoea is a condition which increases the stool weight in excess of 200g per 24 hours with increased water content leading to lose of water and electrolytes from the body [10]. Some of the clinical features associated with amoebiasis include hyponatremia and hypokalemia [11]. A drop in electrolytes can lead to a drop in the blood volume which may affect the blood pressure among other conditions. Concurrent giardiasis and amoebiasis infections have been associated with delayed recovery from childhood malaria especially in the tropics [12]. The current research was aimed at establishing the prevalence of amoebiasis and giardiasis among patients residing in rural areas and the predisposing practices that have been adopted by these rural residents.

Materials and methods

Study area:

The study was carried out in Njoro District, Kenya. Njoro is 20 km southwest of Nakuru town, in the Rift Valley Province. The residents of Njoro are mainly subsistence farmers, small traders and civil servants. The data was collected from three villages, namely Kikapu, Piave and Belbar and from two randomly selected health centers where the residents of these villages sort treatment. These health facilities included Njoro PCEA and Njoro County Council health centers.

Study design:

A cross-sectional study that involved observational approach and use of questionnaires to determine the frequency of socio-economic, socio-demographic and parasitic disease control practices was carried out. The target group comprised of 336 respondents in randomly selected homesteads from the study area. Preference was given to the owners of the homesteads visited. A retrospective study in which health records were retrieved from two randomly selected health centers in the study area was also done. The frequencies or prevalence of amoebiasis and giardiasis among patients seeking treatment at Njoro PCEA (private) and Njoro County Council (government) health centers which are located in the study area were investigated. The laboratory diagnostic method used in the two health centers for both the amoebiasis and giardiasis involved observation of iodine stained fresh stool samples using a light microscope.

Ethical issues:

Permission to carry out the study was obtained from the Department of Research, Publication and Consultancy at Daystar University. The Chief, the

District officer, and the area Member of Parliament in the study area were consulted and their written approval was granted. In addition, the local churches and schools were informed about the research and their readiness to cooperate was granted. Written permit to enable us retrieve data from the health centers was provided by the District medical officers.

Data collected, data analysis and presentation:

Socio-demographic and socio-economic variables that included, the age, sex, marital status, family size, education level, occupation, and indicators of economic status of the respondents were recorded. In addition, aspects of lifestyle or daily practices that may have enhanced the transmission of amoebiasis and giardiasis were recorded. Prevalence of amoebiasis and giardiasis among the patients residing in the study area (villages) and seeking treatment from the selected heath centers from 2004 to 2009 were noted in a standard form. Statistical analysis included computing percentages, means, odd ratios and chi square tests. The chi square test was used to establish relationship between variables in a 2 × 2 contingency table.

Results

Socio - demographic and socio - economic variables:

Table 1: Showing the educational level, occupation and of the economic status of the respondents (n = 336).

Variable	Category	Respondents	Percent (%)
Respondent's gender:	Male	128	38.10
	Female	208	61.90
Education Level:	None	62	18.45
	Primary school	199	59.23
	Secondary school	67	19.94
	College	6	1.79
	University	2	0.60
Employment/Occupation:	Unemployed	328	97.62
	Employed	8	2.38
	Small scale farmer	323	96.13
	Large scale farmer	1	0.30
	Small scale traders	12	3.57
Average monthly spending in Kshs [a]:	Less than 1000	158	47.02
	1000 to 2200	114	33.93
	2201 to 3401	30	8.93
	3402 to 4602	6	1.79
	4603 to 5803	1	0.30
	5805 to 7004	4	1.19
	More than 7005	1	0.30
	Opted not to disclose	22	6.55
Economic status [b]:	Low	268	79.8
	Medium	67	19.9
	High	1	0.3

[a] The average income per month = Total money spent per month divided by the number of individuals using the money in that homestead every month [Exchange Rate: 1 US Dollar = 80 Kenya Shillings (Kshs)].

[b] A respondent must have scored 78% (7/9 variables) to qualify for being in a specific category. Note: the type of the house; car or tractor ownership, size & ownership of the land and average income per month, were the compulsory aspects that were included in the 7 variables used to compute the 78 %. [13]

Selected lifestyles and practices:

Table 2: Showing some selected practices adopted by the respondents (n = 336).

Variable	Category	Respondents	Percent
Water source:	Piped water present in the homestead	59	17.56
	Piped water absent in the homestead	277	82.44
	Protected rain water tank present	150	44.64
	Non-protected rain water tank present	45	13.39
	Rain water tank absent	141	41.96
	Centralized community watering point	277	82.44
	Domestic dams	76	22.62
	Rivers	26	7.73
Drinking water:	Boil drinking water always	130	38.69
	Do not boil drinking water always	206	61.30
Pit Latrine [a]:	Clean pit latrines	269	80.06
	Dirty pit latrines	58	17.36
	Latrines absent	9	2.68
Washing hands after using a latrine:	Do not wash hands	26	7.74
	Do not always wash hands	28	8.33
	Always wash hands in a basin	266	79.16
	Always wash hands in running tap water	16	4.76
Washing hands with soap after using a latrine:	Use soap	291	86.60
	Do not use soap	45	13.39
Toiletries:	Use toilet papers always	227	67.55
	Do not use toilet paper always	109	32.44

[a] Features of a clean latrine were: washed with clean water; a dry clean floor; no flies; no cobwebs; and no evidence of feacal materials or urine on the floor.

Statistical comparison of selected practices versus economic levels of the respondents:

Table 3: Shows a 2 × 2 contingency table used to compute Odds Ratio (OR) for the aspect of boiling drinking water among the low and medium economic cadres; n = 335.

Economic status	Respondents who boil drinking water	Respondents who do not boil drinking water	Total
Low	92	176	268
Medium	37	30	67
Total	129	206	335[a]

Odds ratio (OR) computation = 92x30/176x37 = 0.423, (therefore, OR< 1)

[a] The total number of respondents was 335 because 1 respondent was classified as high economic status (Table 1).

Table 4: Summary of the ORs for the selected practices calculated using 2×2 contingency tables, for the low economic cadre; n = 335.

Economic status	Total number	Boil drinking water	Use soap to wash hands after latrine	Always use a toilet paper
Low:	268	92(34 %)	232(87 %)	171(64 %)
Medium:	67	37(55 %)	58(87 %)	55(82 %)
OR:		0.42	1	0.38
Chi Square (χ^2):		9.88	0	8.16
95% Confidence Interval (CI):		-5.74 to 6.58	0	-5.22 to 5.98

Tables 3 and 4 show that boiling drinking water and always using toilet papers were practices that were non-significantly less likely to occur in the low economic group of respondents. The statistical evidence to support this was that, Odds Ratio (OR) < 1, Chi Square (χ^2) > 1, and 95% confidence interval (CI) was inclusive of 1. Washing hands with a soap after using a pit latrine had an equal probability of occurring in both the low and medium economic cadres of the respondents (ORs = 1, χ^2 = 0, and 95% CI = 0).

Statistical comparison of selected practices versus education levels of the respondents:

Table 5: Showing the computed ORs for the selected practices when different education levels of the respondents were compared; n = 336.

Academic level	Total number	Boil drinking water	Use a soap to wash hands after latrine
≤ Primary level:	261	94(36 %)	214(82 %)
≥ Secondary level:	75	30(40 %)	68(90 %)
OR:		0.84	0.47
Chi Square (χ^2):		0.40	3.25
95% Confidence Interval (CI):		- 2.27 to 3.95	- 0.62 to1.56

Table 5 shows that the aspect of boiling water was non-significantly less likely to occur among respondents who had an academic level of primary school and below (OR = 0.84, $\chi^2 = 0.04$, 95% CI of -2.27 to 3.95). Similarly, use of soap to wash the hands after using a latrine was also non-significantly less likely to occur among those with lower education level (OR = 0.47, $\chi^2 = 3.25$, 95% CI of -0.62 to 1.56).

Retrospective studies: Prevalence of E. histolytica and G. lamblia based on laboratory stool tests, in the selected health centers:
Out of 3059 stool tests from the study area carried out between 2004 and 2009 at Njoro County Council Health Center, 1.34% of the tests were positive for *E. histolytica*; 0.00% for *G. lamblia* and 0.75% for intestinal worms (Table 6). Similarly out of a total of 984 stool tests carried out between 2004 and 2009 at Njoro PCEA health center, 21% were positive for *E. histolytica*; 20% for *G. lamblia* and 5% for intestinal worms (Table 7). The total stool tests at Njoro PCEA health center indicated that the prevalence of *E. histolytica* and *G. lamblia* tended to be equal in adult males and adult females with a ratio of 1:1 (Table 7). The stool tests at Njoro County Council Health center gave a ratio of 7: 2: 1 adult females, adult males and children respectively (Table 6), implying that more adult females were referred for the stool tests.

Table 6: Stool tests results for gut parasites at Njoro County Council Health Center from 2004 to 2009.

Year	Total tests (F/M/C) [a]	Stool Tests *E. histolytica*	*G. lamblia*	Intestinal worms
2004	316 (245/40/31)	6	0	0
2005	496 (373/85/38)	6	0	6
2006	466 (339/101/26)	8	0	3
2007	581 (376/144/61)	8	0	2
2008	605 (430/115/60)	1	0	12
2009	595 (389/110/96)	12	0	0
Total	3059 (2152/595/312)	41	0	23
Average/year	510 (359/99/52)	7	0	4
Ratio	7: 2: 1			
Prevalence (%)		1.34	0.00	0.75

(F/M/C) [a] = adult females/adult males/children

Table 7: Shows the positive stool tests for gut parasites at Njoro PCEA health center for the years 2004 to 2009.

Year	Total patients	Positive (+ve) Tests E. histolytica (F/M) [b]	G. lamblia (F/M)	Intestinal worms (F/M)
2004	168	31(14/17)	29(14/15)	2(2/0)
2005	148	33(14/19)	32(21/11)	7(5/2)
2006	228	50(25/25)	32(18/14)	9(8/1)
2007[c]	142	33(13/20)	35(17/18)	14(4/10)
2008[c]	118	28(12/16)	22(11/11)	9(4/5)
2009	180	30(14/16)	50(27/23)	4(2/2)
Total	984	205(92/113)	200(108/92)	45(25/20)
Average/year	164	34(15/18)	33(18/15)	7(4/3)
Ratio		1:1	1:1	1:1
Prevalence (%)		20.83	20.32	4.57

(F/M) [b] = Adult females/adult males; [c] Data for December 2007 and April 2008 was not available.

It was further noted that all the positive tests at Njoro County health center were significantly lower than those of Njoro PCEA despite the former having a larger number of patients.

Concurrent infections of E. histolytica and G. lamblia:

The stool samples that were positive for both *E. histolytica* and *G. lamblia* (concurrent infections) were conspicuously absent in the two health centers studied. Out of 984 stool tests carried out, from 2004 to 2009, there were 0 amoebiasis/giardiasis co-infections recorded at Njoro PCEA health center. Similarly, out of 3059 stool tests, there were 0 amoebiasis/giardiasis co-infections cases recorded at Njoro County Council Health Center in the same period.

The yearly trend of E. histolytica and G. lamblia cases at Njoro PCEA health center:

Figures 1 and 2 shows that the cases of amoebiasis and giardiasis at Njoro PCEA health center had a typical alternating pattern in which an increase in amoebiasis at a particular time tended to correspond to a decrease in giardiasis at the same time and vice versa.

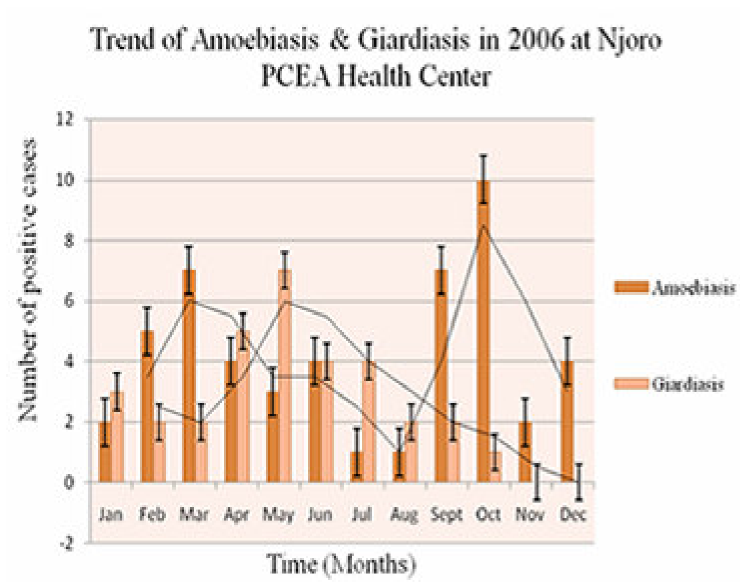

Fig 1: Trend of amoebiasis and giardiasis cases at Njoro PCEA Health Center in the year 2006.

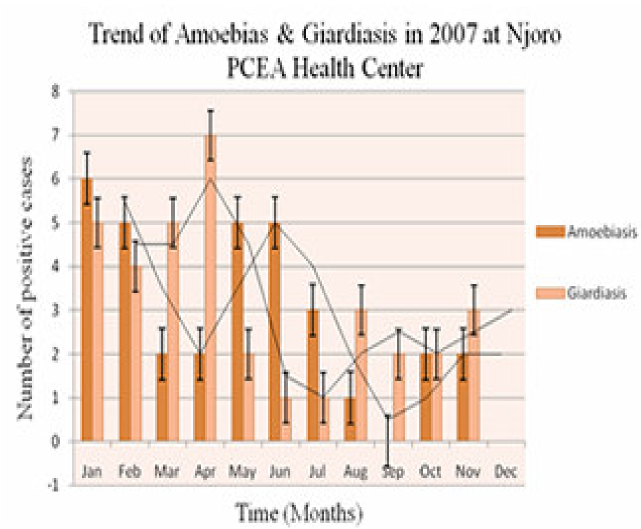

Fig 2: Trend of amoebiasis and giardiasis cases at Njoro PCEA Health Center in the year 2007 [data for the month of December was missing in the records availed].

Discussion

The combination of illiteracy and increased unemployment (Table 1) must have contributed to a relatively higher rate of poverty in the study area. The current research established that 80% of those interviewed were spending less than a dollar per day and therefore a large number of those interviewed must be spending little for their health care (Table 1). This observation is in line with Stanhope and Lancaster [14], who concludes that poverty affects directly the persons' health wellbeing and that poor persons tend to be associated with more complex health problems. Some of the health risks associated with poverty includes unemployment, poor academic achievement, and unaffordable or inaccessible health care [15].

Adoption of practices that may predispose an individual to infectious agents can promote the spread of parasitic infections among humans. This research identified such practices to be common among the rural residents in the study area and they corresponded to increased prevalence of some parasitic diseases in the local health center where the residents sought their treatment. Table 2 shows the various practices among the residents in the study area which might be contributing to the spread of amoebiasis and giardiasis. These practices and their prevalence include; not boiling drinking water (61%); using water that was likely to be contaminated for instance, rivers (8%), public dams and domestic dams that trapped surface runoffs after the rains (23%) and communal water collecting points (82%); inadequate and inappropriate washing of hands after using the latrines (16%), washing of hands in a basin of water (79%) instead of running tap water; dirty latrines with flies and being located near the houses (17%) and in some cases absence of latrines (3%); inadequate and inappropriate use of toiletries in the latrines hence increasing the chance of fecal contamination (36%); and failure to use soap when washing hands after utilizing a latrine (13%).

The failure to boil drinking water seemed to be influenced by factors like economic status and the level of education. Boiling of drinking water was less likely to occur among the low economic status respondents (Odds ratio (OR) = 0.423, χ^2 = 9.88; 95% CI of -5.74 to 6.58) (Table 3). Probably this was due to lack of enough money to buy the fuels. Similarly, the aspect of boiling water was less likely to occur among respondents who had an academic level of primary school or below (OR = 0.84, χ^2 = 0.04, 95% CI of -2.27 to 3.95). This therefore implies that health education in rural areas is necessary in order to enhance the adoption of hygienic practices and appropriate lifestyles. A study carried out in the villages of Panipat of Haryana State, India on a sample of 60 rural school going children aged 8 -10 years concluded that if a need based school health education program is developed for different age groups, it leads to improvement and practices regarding personal hygiene [16].

These unhygienic practices among the residents in the study area can lead to feacal contamination of the hands and predisposing the residents to infections. According to Radford [17] more than half of the people in the world carry around inside them an 'intestinal zoo' of parasites, majority of which are transmitted to human by swallowing the egg or the cyst forms of the parasite in contaminated food, water or through contamination of the hands by infected feaces or feacally contaminated soils. Furthermore, the economic status and the level of education tend to influence the adoption of risky health practices. For instance, washing hands with a soap after using a pit latrine had an equal probability of occurring in both the low and medium economic cadres of the respondents (ORs = 1, $\chi^2 = 0$, and 95% CI = 0). It therefore follows that having or not having money seems not to influence the behavior of using a soap to wash hands after latrine. However, use of a soap to wash the hands after using a latrine was less likely to occur among those with low education level (OR = 0.47, $\chi^2 = 3.25$, 95% CI of -0.62 to 1.56) (Table 5). Utilizing a toilet paper seems to be enhanced by economic status and education level (OR = 0.38, $\chi^2 = 8.16$, 95% CI of -5.22 to 5.98) (Table 4). Low educational status has earlier been associated with spread of infectious agents [3] and also with spread of giardiasis in Hamadan province, Iran [18]

The stool tests indicated that the most common intestinal parasites treated at Njoro PCEA health center were amoebiasis (21%), giardiasis (20%), and intestinal worms (5%), while at Njoro County Council Health Center, the intestinal parasitic infections were amoebiasis (1%), giardiasis (0%), and intestinal worms (1%) as indicated in Tables 6 & 7. This observation agrees with that made by Kean *et al*. [19] in which the prevalence of *E histolytica* tend to be significantly higher than that of *G. lamblia* among homosexuals in New York City. Taherkhani *et al*. [18], established that the overall prevalence rate of *G. lamblia* was 20% in Hamadan province, Iran. The prevalence rate of giardiasis at Hamadan was identical to that of giardiasis at Njoro PCEA health center as indicated in the current research. This is a further confirmation that probably adoption of unhygienic practices among people living in the study area and seeking treatment at Njoro PCEA health center, could be contributing to increased chances of getting infected with *E. histolytica* or *G. lamblia* bearing in mind that both are transmitted through consumption of water contaminated with cysts.

It is worth noting that the amoebiasis and giardiasis cases at Njoro PCEA health center were much higher than those at Njoro County Council health center. This was probably because the high number of children seeking treatment at Njoro County Council health center, were rarely referred for stool tests in the laboratory. Also being a cheaper government health center, the low economically endowed patients tend to prefer Njoro County Council health center since most of them may not have enough money to pay for the laboratory tests in other hospitals. According to Uzochukwu and Onwujekwe [20], the poor and underprivileged people in the tropics are at great risk of contracting tropical diseases because of their precarious living conditions and inadequate health services. The economic status of an individual has an influence on which treatment source, one will seek, when symptoms occur [21].

The laboratory records for stool tests at Njoro PCEA health center indicated that increases in amoebiasis corresponded to decreases in giardiasis and vise versa (Figures 1 & 2). Studies carried in animals, have shown that *Giardia* cysts are shed intermittently [22] and in addition, Tomkins [23] observes that usually, a negative stool test of giardiasis does not exclude the existence of *Giardia* infection since the parasites may be passed only intermittently. Probably this intermittent shedding of cysts explains the upsurge of giardiasis cases in the health center at certain times of the year. Further research is required to establish whether the intermittent shedding of cysts occurs in humans and also whether such a phenomenon applies for amoebiasis too. Alternatively, could it be due to unreliable diagnosis that leads to the stool examination for giardia cysts being often negative? Misdiagnoses for giardiasis have been common and the actual prevalence may be underestimated [24]. It has also been reported that diagnosis of giardia infections using fecal smear is considered difficult because the cysts are small and similar in appearance to many pseudoparasites such as yeasts [25]. According to Kapoor [26], many patients who are treated for amoebiasis are actually suffering from giardiasis. Probably this would also explain why the positive *G. lamblia* cases were relatively lower than those of *E. histolytica* in both the health centers. Kapoor recommends serological tests for *Giardia* serum antibodies (IgM) as a more reliable procedure for confirmation.

Concurrent infections of amoebiasis and giardiasis were totally absent from the records retrieved in the two health centers. This was in line with several studies that have recorded a lower prevalence of amoebiasis/giardiasis concurrent infections. In a study that involved screening of 89 high risk stool specimens from sexually active homosexual men, 20% were infected with amoebiasis, 12% with giardiasis and 7% with concurrent amoebiasis and giardiasis infections [27]. Similarly, a study carried out in Nigeria showed a lower amoebiasis/giardiasis concurrent infection (15.2%) as compared to the prevalence of amoebiasis alone (27.6%) in children infected with *Plasmodium falciparum* [12].

Conclusion

These findings suggest that amoebiasis and giardiasis are relatively common phenomena whenever a stool test is carried out especially at Njoro PCEA health center. There is need for further investigation on the sources and quality of water for the residents in the study area. Previous studies in Njoro watersheds have raised health concerns [28]. Control of water borne diseases requires adoption of hygienic practices and appropriate lifestyles which can be made popular through health education programs in the study area.

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