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Prevalence of Intestinal Parasitic Infections and Transmission Risk Factors in Primary School Children in Mbeere North Sub-County, Embu County, Kenya

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Authors' contributions

This work was carried out in collaboration among all authors. Author SK designed the study, wrote the protocol, collected data and performed the statistical analysis and wrote the first draft of the manuscript. Authors LK and NM reviewed the concept, supervised the research data collection and statistical analysis, did literature searches and reviewed the draft manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Intestinal parasitic infections (IPI) such as soil transmitted helminths (STH) and protozoa can cause diverse negative effects on human health. The prevalence of IPI in primary school children in Mbeere North sub-county in Embu County is not documented, though there are many cases reported in health centers in the area. The aim of this study was to establish the current prevalence of IPIs in primary school children in Mbeere North sub-county and the factors that perpetuate

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transmission which is necessary for implementation of suitable control programs in the study area. The study was done among primary school children from nine public schools. Three schools per administrative ward were randomly selected to represent each of the three administrative wards. A total of 414 pupils whose parents/guardians gave informed consent participated in the study, 46 pupils per school. Each participant provided a thumb size of early morning stool. The stool samples were processed by Formol-ether concentration technique and direct wet preparation methods for microscopic identification of intestinal parasites. A structured questionnaire was used to collect data on age, sex, sanitation and hygiene practices. The overall point prevalence of intestinal parasitic infections amongst the pupils was 43%. Chi-square (χ^2) test was done to determine the relationship between prevalence and the pupils' age and sex. There was no significant association between prevalence and sex ($\chi^2 = 0.184$, $P = 0.668$, $df = 1$) but a significant association was found between prevalence and age where children 11 years and below were more pre-disposed than those above 11 years old ($\chi^2 = 4.770$, $P=0.043$, $df = 1$). Similarly, a significant association was found between water source and prevalence of IPI; the parasites infection prevalence decreased when tap water was used and increased when open surface water was used ($F = 6.15$, $P = 0.006$). From this study, it is clear that IPIs particularly *E. histolytica* are a problem in primary school children in Mbeere North Sub-County. There is an urgent need for provision of safe domestic water in the county. Additionally, community education on sanitation and IPI transmission risk factors is urgently required. The information generated in this study is beneficial to the public health service in designing control strategies for areas of high transmission.

Keywords: Intestinal Parasitic Infections (IPI); Soil Transmitted Helminths (STH); children; Kenya.

ABBREVIATIONS

GBD : Global Burden of Disease;
IPI : Intestinal parasitic infections;
STH : Soil transmitted helminths

1. INTRODUCTION

Intestinal parasites are mainly protozoa or helminths inhabiting the gastrointestinal tract (GIT). Generally, these intestinal parasites are more prevalent in the tropics and subtropics than any other part of the world. The four major species of intestinal helminthic parasites, also known as geohelminths/soil-transmitted helminths (STH) are *Trichiuris trichiura* (whipworm), *Ascaris lumbricoides* (roundworm), *Ancylostoma duodenale* and *Necator americanicus* (hookworms) [1]. About one billion people in the world are suffering from *A. lumbricoides* infection [2]. The eggs of *A. lumbricoides* are very resistant to desiccation [3], strong chemicals and low temperatures [4]. World Health organization (WHO) estimates suggest that hookworms and *T. trichiura* infect 740 million people and 795 million people respectively [5]. Whipworm commonly occurs as a co-infection in people infected with *Ascaris lumbricoides*, hookworms, *Entamoeba histolytica* and *Giardia lamblia* [6]. Intestinal helminths infections are less related to death than to the harmful gradual effects on the nutritional status and health of the host [7]. Additionally, helminthiasis impairs mental and physical growth and development of children [8].

The most prevalent intestinal protozoan parasites are: *Entamoeba histolytica, Giardia lamblia* and *Cryptosporidium* spp, and their infections are characterized by diarrhoea [9]. The World Health Organization approximates that about 50 million people in the world suffer from invasive amoebic disease annually, leading to 40-100 thousand fatalities [10]. Intestinal parasitic infections are widespread with high prevalence rate among the socio-economically disadvantaged communities where poor environmental sanitation, overcrowding, lack of access to safe/ clean water and low level of education are prevalent [11], resulting in perpetual cycle of destitution [12]. Soil transmitted helminths are the most predominant of IPIs due to continuous contact with soil in daily activities [13,14]. Within this context, this study has provided comprehensive data on the current prevalence of IPIs and their transmission risk factors among primary school children in Mbeere North Sub County in Embu County, which is a rural area in Kenya. This information is helpful for the public health sector and other stakeholders in designing control strategies in the study area and other areas of high transmission.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

The study was done in Mbeere North sub-county within Embu County in Kenya. According to 2009 population census, Mbeere North sub county had a population of 103,483 and an area of 1,046 km² [15]. Mbeere North has three administrative wards; Evurore, Nthawa and Muminji. The altitude ranges from approximately 500m above sea level to 1200m. The rainfall has a bimodal pattern with the moderate rains falling between April and June while the light rains are experienced from October to December. The annual rainfall ranges between 640mm to 1100mm with most parts receiving 550mm. Most soils in the area are sandy and clay, few areas have loam soil [15]. The average annual temperature in Mbeere North is 24.9 degrees Celsius and humidity is low with average evaporation of 2020 mm [16]. The area is served by two public hospitals and few private clinics. The residents get water from canals, piped water, Ena River, dry riverbeds, seasonal streams and open wells.

2.2 Study Design

A cross-sectional descriptive study involving pupils from nine randomly selected public primary schools, three schools in each of the three administrative wards constituting Mbeere North Sub-County, was undertaken. Stratified sampling technique was used where each ward formed a stratum. Balloting was done to select three schools per stratum. Systematic sampling was done to sample students per class using the class register where the n^{th} individual after the starting point was selected. The minimum sample size was determined using the formula $n = Z^2pq/d^2$ [17], Where p = estimated prevalence of intestinal parasitic infections in the study area, q = 1-p, d = level of statistical significance (0.05), Z= standard normal deviation which corresponds to 95% confidence interval (1.96). The minimum sample size for this study was 385 pupils but it was raised to 414 pupils to cater for eventualities such as failure to sign informed consent form and data loss. Each participant was given a clean, dry, leak-proof, well labeled specimen container and instructed to scoop a thumb size of early morning stool sample into the container. The specimens were collected the first thing in the morning and transported immediately to laboratory for processing and microscopic examination. Formol ether concentration technique and direct wet mounts were undertaken to examine for eggs or larvae of helminths and cysts and oocysts of protozoan parasites. The protozoa and helminths were identified using identification key [18]. The participants also filled a questionnaire designed to collect data on the knowledge and practices on personal hygiene, parents' education level, and water handling and consumption habits and to assess latrine availability and utilization. Data analysis was carried out using SPSS 10 for windows. Percentages were used to describe the characteristics of the studied population. Chi-square (χ^2) on proportion was used to test the associations between variables. The level of statistical significance was $P < 0.05$.

3. RESULTS

Out of the 414 pupils studied were 52.9% females and 47.1% males. The participants were divided into two age sets; those 11 years and below and those above 11 years old. The minimum age was 8 years and the maximum age was 15 years.

3.1 Prevalence of IPI by Demographic Characteristics of Participants

The types of parasites observed in the stool specimens were *A. lumbricoides*, hookworms, *T. trichiura*, *E. histolytica* and *G. lamblia.* Commensals such as *Entamoeba coli*, *Endolimax nana* and *Iodamoeba butschlii* were also observed. The overall prevalence of IPI in the studied pupils was 43.0% (Table 1). Out of the total 414 pupils, 178 were infected, out of whom 17.4% were infected by more than one type of parasite. Another 3% had three types of IPIs. Among the 219 female pupils, 92 (42%) were infected with intestinal parasites while 86 out of 195 males (44.1%) were infected with intestinal parasites (Table 1). Intestinal parasitic infections were independent of sex ($\chi^2 = 0.184$, $P = 0.668$, $df = 1$). Further analysis revealed that children 11 years and below had a 48% prevalence which was higher than 37.6% for children above 11 years old (Table 1). Intestinal parasitic infection was observed to be dependent on age ($\chi^2 = 4.770$, $P = 0.043$, $df = 1$).

3.2 Factors that Contribute to the Transmission of Intestinal Parasites in Pupils in Mbeere North Sub-County

Children of families using ponds, earth dams, dry river bed wells, canals and rivers

Table 1. Prevalence of IPI by demographic characteristics of participants (n=414)

Variable	Category	Uninfected	Infected / Prevalence	χ^2	df	P-Value
Sex	Female	127 (58%)	92 (42%)			
	Male	109 (55.95%)	86 (44.1%)			
	Subtotals	236	178	0.184	1	0.668
Age	11 years and below	110 (51.9%)	102 (48.1%)			
	Above 11 years	126 (62.4%)	76 (37.6%)			
	Subtotals	236	178	4.770	1	0.043
Overall prevalence			43.0%			

The overall prevalence of IPI was 43% and infections were dependent on age (χ^2 = 4.770, P = 0.043, df = 1), while both sexes were infected at comparable levels

had the highest infection rates amongst the water sources (F = 6.15, P = 0.006) (Table 2). However, no significant association was observed between protection of water sources and prevalence of intestinal parasites (OR = 0.620, CI = 95%) (χ^2 = 2.673, df = 1, P = 0.102). Those who did not treat or boil drinking water were significantly more infected than those who treated/boiled (OR = 0.288, CI = 95%), (χ^2 = 16.667, df = 1, P = 0.000). Use / type of toilet facilities at home had a significant effect on intestinal parasites infections (F = 4.802, P = 0.029). Sharing or not sharing toilet facilities with other households in the neighborhood did not affect IPI status (χ^2 = 0.689, df = 1, P = 0.407, OR = 0.815), however, a significant association was noted between overflow of flood water in toilets/ latrines and infection with intestinal parasites (χ^2 = 13.636, df = 1, P = 0.000). Having siblings less than 5 years old at home did not affect prevalence of intestinal parasites (OR = 1.225, CI = 95%), (χ^2 = 1.040, df = 1, P = 0.308). ANOVA test revealed a significant association between child's waste disposal method and the prevalence of the infections (F = 5.24, P = 0.037). Prevalence of intestinal parasites decreased in children whose parents had higher education level (F = 7.39, P = 0.002) for mother and (F = 7.92, P = 0.001) for father's highest education level being post-secondary.

4. DISCUSSION

This study showed an overall prevalence of IPI at 43% among the primary school pupils aged 8-15 years studied in Mbeere North, which was way above the prevalence of 20.83% reported in other parts of Kenya [19]. A similar study in an Ecuadorian highland community in Ecuador recorded a prevalence of IPI at 46.6% and attributed this to failure to treat drinking water and failure to wash hands before eating [20]. Male pupils recorded a slightly higher percentage infection (44.1%) than the females (42%). Similar studies in Jeddah Saudi Arabia reported a higher prevalence in males compared to females and associated it with the higher risks for infection in males due to daily activities carried out. Most boys do manual jobs far from their homesteads where they are more likely to ingest contaminated food and water [21]. It was found that prevalence of IPI was dependent on age. Younger pupils (11 years and below) had a higher infection rate (48.1%) than the older ones (37.6%). A study carried out in Iraq amongst children aged 11 years and below recorded a prevalence of 30.8% and associated this with low immunity, poor hygiene and toilet training, and low socioeconomic status, in addition to playing anywhere irrespective of the cleanliness or dustiness of play grounds [22]. The present study found that water that is likely to be contaminated by human and animal excreta such as dry river bed wells, rivers and canals were the main water sources in Mbeere North. There was a significant association between source of water and prevalence (F = 6.15, P = 0.006). Similar studies to establish the factors associated with high prevalence of intestinal parasites in Yemen identified the use of well water as a predictor of intestinal parasitic infections [23]. Children without access to toilet facilities were more predisposed to IPI. Those without toilets often defecated in the bushes and this could have led to contamination of soil, water sources and foodstuffs such as vegetables. Prevalence of intestinal parasites decreased in children whose parents had higher education level, similar to studies in the villages of Panipat of Haryana State, India [24].

Table 2. Risk factors contributing to transmission of intestinal parasites in school children in Mbeere North Sub-County (n=414)

Risk factor	Variable	No. of respondents	Number infected (%)	O.R	χ^2	F-value	P-value
Main water source at home	Bore hole	21	7 (33.3%)	-			
	Tap	39	11 (28.2%)	-			
	Spring	6	2(33.3%)	-			
	Canals	80	36(45%)	-			
	River	100	39 (39%)	-			
	Earth dam	25	14(56%)	-			
	Dry riverbed wells	136	66(48.5%)	-	-	6.15	0.006
	Rainwater	4	0 (0%)	-			
	Bottled water	0	0 (0%)	-			
	Pond /lake	3	3(100%)	-			
Water source protected/covered	Yes	60	20(33.3%)				
	No	354	158(44.6%)	0.620	2.673	-	0.102
Water treated/boiled	Yes	68	14(20.6%)				
	No	346	164 (47.4%)	0.288	16.667	-	0.000
Toilet facility at home	Flush toilet	10	2(20%)	-			
	Traditional pit latrine	355	161(45.4%)	-			
	Ventilated improved pit	42	10(23.8%)	-	-	4.802	0.029
	No facility	7	5(71.4%)	-			
Sharing toilet with other households	Yes	87	39(45%)				
	No	320	134(41.9%)	0.815	0.689	-	0.407
Rain water overflow in toilets / pit latrines	Yes	261	129 (49.6%)	2.211	13.636		0.000
	No	146	45 (30.8%)			-	
Siblings less than 5 years	Yes	216	98(45.4%)	1.225	1.040		0.308
	No	198	80 (40.4%)			-	
Disposal of child waste	Thrown outside house	48	30(62.5%)	-			
	Buried in the yard	1	1(100%)	-			
	Rinsed away	142	78(55.2%)	-	-	5.24	0.037
	Not disposed off	25	15(60%)	-			
Mother's highest education level	No education	60	35(58.3%)	-			
	Primary education	247	115(46.6%)	-			
	Secondary education	77	22(28.6%)	-	-	7.39	0.002
	Post- secondary	30	6(20%)	-			
Father's highest education level	No education	70	45(64.2%)	-			
	Primary education	218	106(48.6%)	-			
	Secondary education	84	21(25%)	-	-	7.92	0.001
	Post- secondary	42	6(14.3%)	-			

5. CONCLUSIONS

The findings of this study show that the prevalence of IPI among primary school pupils in Mbeere North Sub County is 43%. Children 11 years old and below were more infected than those above 11 years. Some minor variations occurred in infections between the sexes, where males were slightly more infected. Inaccessibility to safe water was a significant factor in transmission of IPI. Most households used potentially contaminated water from dry river bed wells, canals, earth dams and rivers. Other transmission risk factors included low level of toilet use, failure to treat or boil drinking water and low education level.

6. RECOMMENDATIONS

There is need for the national government and the county government to provide public health education to parents and pupils on transmission risk factors for IPIs, provide safe domestic water and broaden the Mbeere water and sanitation piped water project to reach all the homesteads.

The general population should be encouraged to construct and use toilets or latrines properly. Since IPIs are prevalent in children, there is need to extend the school-based deworming program to reach children who do not attend school which would reduce contamination of the environment hence lower IPI prevalence.

CONSENT AND ETHICAL APPROVAL

Approval to carry out the study was obtained from Kenyatta University Graduate School, the Ministry of Health and Sub-county Education Office-Mbeere North. Ethical clearance was obtained from Kenyatta University ethical review committee. Research permit was issued by the National Council for Science, Technology and Innovation (NACOSTI). Informed signed consent was obtained from parent / guardian of each participant. Confidentiality was maintained and feedback on infection status provided to the study participants and their parents / guardians at the end of the study. All participants whose stools contained intestinal parasites were referred to hospital for treatment.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ahmed HAH. Prevalence rate of intestinal parasites among schools children in Al-kalakla locality - Khartoum state, Doctoral dissertation, Sudan University of Science & Technology; 2017.
2. Pullan RL, Smith JL, Jasrasaria R, Brooker SJ. Global numbers of infection and disease burden of soil transmitted helminth infections in 2010" Parasites & Vectors. 2014;7:37.
3. Gerba CP. Environmentally transmitted pathogens In Environmental Microbiology. 2009;2:445-484.
4. Faulkner CT, Reinhard KJ. A retrospective examination of paleoparasitology and its establishment in the Journal of Parasitology. The Journal of Parasitology. 2014;3:253-259.
5. Pham-Duc P, Nguyen-Viet H, Hattendorf J, Zinsstag J, Phung-Dac, Zurbrügg C, et al. Ascaris lumbricoides and *Trichuris trichiura* infections associated with wastewater and human excreta use in agriculture in Vietnam. Parasitology International. 2013;2:172-180.
6. Cimino RO, Jeun R, Juarez M, Cajal PS, Vargas P, Echazú A, et al. Identification of human intestinal parasites affecting an asymptomatic peri-urban Argentinian population using multi-parallel quantitative real-time polymerase chain reaction. Parasites & Vectors. 2015;1: 380.
7. Bethony J, Brooker S, Albonico M, Geiger SM, Loukas A, Diemert D, et al. Soil-transmitted helminth infections: Ascariasis, trichuriasis, and hookworm. The Lancet. 2006;9521:1521-1532.
8. Taricone AAA. Comparative study of the nutritional status of school aged children enrolled on the Ghana school feeding programme: A case of Kwabre East and the Tolon Districts of Ghana" Doctoral dissertation, University of Ghana; 2017.
9. McHardy IH, Wu M, Shimizu-Cohen R, Couturier MR, Humphries RM. Detection of intestinal protozoa in the clinical laboratory. Journal of Clinical Microbiology. 2014;3:712-720.
10. Ng'ang'a GW. Bacterial, Parasitic Co-Infections, Antimicrobial Susceptibility and ESBL Genes Carriage in Bacteria Isolated from Children below 5 Years with Diarrhea Attending Mukuru Slum Health Clinic, Doctoral dissertation, JKUAT-COHES; 2018.
11. Mohd-Shaharuddin N, Lim YAL, Hassan NA, Nathan S, Ngui R. Soil-transmitted helminthiasis among indigenous communities in Malaysia: Is this the endless malady with no solution? Tropical Biomedicine. 2018;1:168-180.
12. Yahaya A, Yakubu B, Tyav Aisha I. Prevalence of intestinal parasitic helminths from fingernails of "Almajiris" in Birnin Kudu Local Government Area, Jigawa State, Nigeria. International Journal of

Tropical Disease and Health. 2015;2:66-74.
13. Ali Y. Intestinal parasitic Infections among School-age children in Mekaneselam Health Center, Borena, Northeast Ethiopia" Doctoral dissertation, Addis Ababa University; 2016.
14. Jourdan PM, Lamberton PH, Fenwick A, Addiss DG. Soil-transmitted helminth infections. The Lancet. 2018;10117:252-265.
15. Republic of Kenya, Population census; 2009.
16. Mwaniki KH. The living history of Embu and Mbeere to 1906." Kenya Literature Bureau, Nairobi; 1973.
17. Mugenda OM, Mugenda AG. Research methods: Quantitative and qualitative approaches. African Centre for Technology Studies, Nairobi; 2003.
18. WHO. Bench Aids for the Diagnosis of Intestinal Parasites. WHO, Geneva. 1994;10-15.
19. Kinuthia G, Afolayan F, Ngure V, Anjili C. Selected practices among rural residents versus the prevalence of Amoebisis and Giardiasis in Njoro District, Kenya. African Journal of Health Sciences. 2012;20:11-20.
20. Rinnes S, Rodas E, Galer-Unti R, Glickman N. Prevalence and risk factors for protozoan and nematode infections among children in an Ecuadorian highland community. Transactions of the Royal Society of Tropical Medicine and Hygiene. 2005;8:585–592.
21. Al-Malki J. Factors associated with high prevalence of *Entamoeba histolytica/* dispar infection among children in Jeddah, KSA. American-Eurasian Journal of Agricultural and Environmental Science. 2014;1:50-56.
22. Kau AL, Ahern PP, Griffin NW, Goodman AL, Gordon JI. Human nutrition, the gut microbiome and the immune system. Nature. 2011;7351:327.
23. Speich B, Croll D, Fürst T, Utzinger J, Keiser J. Effect of sanitation and water treatment on intestinal protozoa infection: A systematic review and meta-analysis. The Lancet Infectious Diseases. 2016;1: 87-99.
24. Abossie A, Seid M. Assessment of the prevalence of intestinal parasitosis and associated risk factors among primary school children in Chencha town, Southern Ethiopia. BMC Public Health. 2014;1:166.

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