Epidemiology of Intestinal Parasitic Infections among Suspected Patients attending a Referral Hospital in, Kenya

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Summary

BACKGROUND

Enteric parasitic diseases constitute a major public health problem in the entire population. This study intended to investigate possible relation in sanitary conditions, hygienic practices and socio-economic status of referred patients at a teaching hospital in Kenya.

MATERIALS AND METHODS

A cross-sectional study was conducted on socio-economic risk factors related to high prevalence of enteric diseases in 185 randomly selected patients from April to December 2015. Data were collected using structured questionnaires and stool samples subjected to routine stool investigations. Descriptive analysis was used for prevalence rates while Chi-square test was used to determine associations with risk factors; P < 0.05 and 95 % confidence level.

RESULTS

The overall prevalence was 46.5 % (86/185) and 6.4 % (12/185) for Polyparasitism. The diseases included; Amoebiasis (63.0%), Cryptosporidiosis (20.0%), Giardiasis (3.7%), Ascariasis (1.6%), Hymenolepsiasis (1.0%), Hookworm disease (1.0%) and Trichuriasis (0.5%). Prevalence of infected cases according to social-economic categories included; permanent housing (60.6%), unemployed (54.4%), urban (51.9%), pit latrine (49.7%), educated (48.8%), untreated water (46.9%), hand washing (46.5%) and pet owners (43.0%). There were no statistically significant differences observed in socio-demographic and risk factors (p < 0.05).

CONCLUSION

Several socio-economic factors contribute enormously to establishment and spread of enteric parasitic diseases. Prevention can be achieved by addressing specific social behavioral changes via public health education. The findings provide useful information on prevention and management of intestinal parasitic infestations at county and national level.

Keywords: *Enteric Parasitic Diseases, Socio-Economic Status, Sanitary Hygiene*

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Introduction

Intestinal parasitic diseases constitute a global health burden in developing countries due to several factors including fecal contamination of water sources, environmental and socio-cultural transmissions. Approximately two billion people are affected worldwide majority in developing countries, of whom 300 million suffer from severe morbidity.[1] Gastrointestinal parasitic diseases have socio-economic relevance affecting the poorest in deprived tropical regions.[2] Morbidity in children with enteric parasitic diseases (EPDs) is characterized by complications in malnutrition, anaemia, growth retardation, cognitive impairment and low immunity.[3] In endemic areas, sources of infection include; improper disposal of human and animal waste, contaminated water sources and recreational waters.[4] Socio-environmental vulnerability of EPDs are associated with precarious sanitation and quality of water..[5]

Water serves as a medium for pathogen dissemination,[6] and waterborne parasite are commonly distributed through treated and untreated water.[7] Previous studies in Yemen confirmed ineffectiveness in conventional water and sewage treatments in destroying protozoan and helminthic parasites .[8] Amoebiasis, balantidiosis among others have been associated with outbreaks worldwide.[9] Giardiasis and cryptosporidiosis are waterborne diseases causing gastrointestinal illnesses.[10] Sewer overflows and floods cause contamination of surface water and agricultural lands,[11,12] leading to multiple infections / re-infections.[13]

Global epidemiological studies regard social cultural and socio-economic aspects as indicators of health.[14,15] Follow-up studies reported effective hand washing to be cost-effective in preventing fecal-oral transmission of EPDs in developing and developed countries.[16] Further, Curtis and others reported 47% reduction in diarrhea-related infections by hand washing with soap.[17] In developing countries, poverty make control strategies difficult to implement.[18] Intervention against EPDs is basically on improved water supply /sanitation, health education and regular deworming.[19]

Pathogenic protozoans include *Entamoeba histolytica* and *Giardia lamblia* which cause gastrointestinal morbidity and mortality worldwide, particularly young children in developing countries.[20] Amoebiasis, kills between 40,000 - 100,000 people yearly and is among the deadliest parasitic infection worldwide.[21] *Cryptosporidium parvum* has a wide host range including humans and mammalian species.[22] Infestations of *Toxoplasma gondii* and *Toxocara canis/catis* in dogs or cats infects humans when in close contact.[23] Zoonotic transmission can occur through direct contact with infected animals or indirectly through consumption of contaminated water, [24,25] and reservoir hosts.[26-28]

Geohelminthes pose serious consequences on human health including hepatosplenomegaly, esophageal varices and bleeding.[29] In Kenya hookworm disease is prevalent in the coastal region and most counties in western Kenya.[30,31] Epidemiological survey on EPDs and associated factors are important in identifying, designing and implementing effective community-based interventions.[32] The role and possible interaction of each of these factors in endemic regions has been inadequately addressed and no intervention strategies, thus remains a major public health problem.[33] Currently, there is scarcity of available literature regarding the association between prevalence of EPDs and socio-economic status in the endemic regions. The aim of this study was to determine the number of patients infected with EPDs attended at the referral hospital. The explored socio-economic factors and demographic variables in disease burden were assessed in gender and age groups.

Materials and Methods

Study site and setting

The study was conducted at Moi Teaching and Referral Hospital (MTRH) which is the second largest National Referral Hospital in Kenya. It is located in Uasin Gishu County in the North Rift region of Western Kenya. The Hospital has an 800 bed capacity and receives patients from Western Kenya, Eastern Uganda, and the Southern Sudan and offers a wide range of services out-patient and in-patient. The services are supported by modern clinical and diagnostic equipment manned by qualified medical staff from the hospital and the College of Health Sciences, Moi University.

Study design, population and sample size

A cross sectional hospital-based study design was adopted and consecutive sampling was used to recruit participants who met inclusion criteria. The study was conducted between April and December 2015 among patients referred to MTRH for specialized management of EPDs. The study population consisted of all age groups and sexes and pre-designed questionnaire was used to collect data on socio-demographic and selected risk factors. Participant's age categories were; < 9 years, 10-19 years, 20-29 years, 30-39 years, 40-49 years, and above 50 years.

Sample size determination and Inclusion criteria

The sample size was calculated based on a related study by Wekesa *et al*., 2014, [34] which reported prevalence of 13.8% at 95% confidence level and 5% marginal error. The sample size (n) was estimated using modified Fischer's formula as used by Mugenda and Mugenda, [35]

$n=z^2pq/d^2$

n=desired sample size

z= standard normal deviate (1.96)

p= Prevalence from previous study rounded to 14%.

q=1.0-p

d= degree of accuracy

$n = (1.96)^2 (0.14) (1.0-0.14) / (0.05)^2$

n=185 patients.

Therefore, the minimum sample size aimed at was 185 patients.

All patients sent to the laboratory for stool analysis and consented were included in the study.

Patients of unsound mind and those whose parents/guardians did not consent were excluded.

Ethical considerations

The study was approved by the Institutional Research and Ethics Committee (IREC) of MTRH and Moi University-School of Medicine (Approval number: FAN: IREC 16011). Study participants were provided with consent forms to sign before sample collection. Informed consent was obtained from parents or guardians for participants under 18 years. Participants' identity was coded for confidentiality and had the freedom to decline, and any refusal would not affect any medication in the institution. There was no monetary benefit or coercion for participating and any positive case for intestinal parasites were treated.

Collection and processing of stool specimen

Clean screw capped Polypots were used for collecting fresh stool samples from consenting patients under instructions.

The stool samples were macroscopically examined before separating for wet mounts and fixing in 10% formalin. Saline and iodine wet mounts were prepared and examined for protozoan cysts/ trophozoites and helminthes eggs using 100 × and 400 × magnification.

Formal - ether concentration technique was performed on (1) g of stool fixed in 7 ml of 10% formal saline and kept for 10 mins before filtering into a centrifuge tube. Three milliliters of ether was added and mixed for 1 min before centrifugation at 2,000 rpm for 2 min. The supernatant was decanted, and one drop of the deposit was poured onto a glass slide and examined microscopically.

Smears made from the deposits were stained by Modified Ziehl–Neelsen staining technique for detection of protozoal oocysts according to Cheesbrough (2005) [36] and examined under x1000 magnification. A known positive control was included in every batch for staining and the results were entered in MS Excel software and released to participants.

Identification of Intestinal parasites

Intestinal parasites species were identified based on their morphological features using binocular microscope under x10 and confirmed using x40 magnification. The colored charts published by Cheesbrough (2005), [36] were employed for identification.

Quality assurance and data analysis

Coded questionnaires were administered by the technologist to consenting patients at the reception in the language they understood best. Appropriate samples were checked during collection and all reagents were freshly prepared and subjected to control samples before use. Standard operating manuals were used and results were verified by two technologists. Data entry was checked for accuracy before uploading to Excel spread sheets ® 2007 template, coded and exported to statistical package for social sciences (SPSS) software program version 16 SE. (Chicago, USA) for analysis.

Prevalence was calculated directly for each identified parasites species and association between categorical variables such as gender, age group and the socio economic risk factors was assessed using Pearson's Chi-Square test. Descriptive and inferential statistics were carried out for continuous data while frequency listing and percentages were used to explore categorical data. In all analyses, a p-value > 0.05 were considered statistically significant and presented in tables.

Results

Participant characteristics and prevalence of parasitic species

In this study, 185 participants enrolled and their age ranged between 2 and 70 years with a mean age of 24. The gender representation was 104 (56.2%) females and 81 (43.8%) males. The overall prevalence was 86 (46.5%) and 6.4% (12/185) had Polyparasitism with combinations reported in *E histolytica* and *E. coli*, *E. histolytica* and *I. butschlii* and *A. duodenale* and *I. butschlii*.

High prevalence was observed among protozoan species *Entamoeba histolytica* (23.9%) and *Cryptosporidium parvum* (13.0%) while the helminthes had low prevalence > 3 % for all identified species. Identified enteric parasite species prevalence is depicted in Table1.

Parasitic disease distribution r

Amoebiasis was the most common disease affecting both genders; 67(36.2%) males and 51(27.6%) females, and across all age groups recorded (3.7%-25.0%).Cryptosporidiosis recorded moderate prevalence in females 27(14.6%) than males 10(5.4%). Helminthic diseases were low in all age groups and both genders 1(0.5%).

Distribution of age groups and gender is depicted in **Table 2.**

Table 1: Prevalence of Identified Enteric Parasitic Species

Parasite spp.	Ass. Disease	Technique used	Id. Stage	(+ve) n=185 / %
Protozoans				
Entamoeba histolytica	Amoebiasis	Formal ether	Cysts	43(23.9%)
Cryptosporidium parvum	Cryptosporidiosis	Mod. Z-N	Oocysts	24 (13%)
Entamoeba coli	Amoebiasis	Formal ether	Cysts	12 (6.5)
Giardia lamblia	Giardiasis	Formal ether	Cysts	12 (6.5%)
Iodamoeba butschlii	Amoebiasis	Formal ether	Cysts	12 (6.5%)
Helminthes				
Ascaris lumbricoides	Ascariasis	Formal ether	Ova	3 (1.6%)
Hymenolepis nana	Hymenolepsiasis	Formal ether	Ova	1 (0.5%)
Trichuris trichiura	Trichuriasis	Formal ether	Ova	1 (0.5%)
Ancylostoma duodenale	HWD	Formal ether	Ova	2 (1.1%)

Mod. Z-N: Modified Zielh Neelzen method, spp.: species, Ass: Associated, Id: Identified, (+ve): number of positive cases, HWD: Hookworm disease

Table 2: Age Group and Gender Based Prevalence of Enteric Parasitic Diseases Prevalence of Enteric Diseases in age Groups (years) and Gender (%)

	<9yrs	10-19yrs	20-29yrs	30-39yrs	40-49yrs	>50yrs	Males	Females
Protozoal diseases								
Am.	24(12.9)	22(11.8)	24(12.9)	21(11.4)	7(3.7)	20(10.8)	67(36.2)	51(27.6)
Cr.	10(5.4)	6(3.2)	9(4.8)	3(1.6)	8(4.3)	0	10(5.4)	27(14.6)
Gi.	1(1.8)	1(1.8)	2(3.7)	2(3.7)	1(1.8)	0	3(1.6)	4(2.2)
Helminthic diseases								
As.	0	1(1.8)	1(1.8)	1(1.8)	0	0	1(0.5)	2(1.1)
HWD	0	1(1.8)	1(1.8)	1(1.8)	0	0	1(0.5)	1(0.5)
Tr.	0	0	0	1(1.8)	0	0	0	1(0.5)
Hym	0	1(1.8)	0	0	0	0	0	0
Total.	35	32	37	29	16	20	82	86

Am.- Amoebiasis, Cr- Crytosporidiosis, Gi.-Giardiasis, As.- Ascariasis, HWD- Hookworm disease, Tri.- Trichuriasis, Hym.- Hymenolepsiasis

Enteric parasitic diseases in relation to variable risk factors

Enteric diseases were higher in Urban 41(51.9%) than rural areas 45(42.5%). Unemployed participants recorded 56(54.4%) while employed 30(36.6%). Pre- school children reported higher prevalence 8(34.8%) while high school reported low 25(22.5%). Participants occupying permanent houses reported 43(60.6%) while in semi-permanent 43(37.7%). However, there was no statistically significant difference in prevalence between the housing status (P = .177). Distribution of enteric diseases in relation to variable risk factors is presented in **Table 3.**

Discussion

Enteric parasitic diseases present a major public health problem in developing countries including Kenya. Several studies on control, prevention and management of these diseases are widely reported in varied settings. This is contrasting with our present study that focused on prevalence of EPDs and the role of specific socio-economic factors, their establishment and spread. In the current study, intestinal protozoal diseases presented a higher prevalence (55.1%) than helminthes (3.8%). This was in agreement with a previous similar study in Iran which achieved (33%) and (4.8%) for protozoa and helminthic diseases respectively. [37] In contrast, it wasn't in agreement with a related study in Ethiopia recording (13.2% & 26.9%) in protozoa and helminthes, respectively. [38] The high prevalence of protozoan diseases may be attributed to tough double-walled cysts of *Entamoeba histolytica* which resist harsh environment including chlorinated water. [39.

Overall prevalence of EPDs in this study (46.5%) was lower than a similar study in Pakistan (52.8%) and higher than other studies in Nigeria (34.6%) and (30.6%) respectively. [40] This difference could be attributed to the type of participants used whereby, the current study recruited from the in / out-patients and tertiary hospitals while in the cited studies recruitment was from the general population. Consequently, participants in the current study may have been treated clinically at primary healthcare where diagnostic facilities are inadequate. [41, 42]

Table 3: Association between Risk Factors and Prevalence of Enteric Parasitic Diseases

Socio-demographic factors	**Overall enteric diseases**		
Characteristics n=185	**Frequency (%)**	**Infected cases (%)**	**p-value**
Gender			
Males n=81	43.8	39(48.1)	
Females n=104	56.2	42(40.4)	.535
Residence			
Rural n=106	57.3	45 (42.5)	
Urban n=79	42.7	41 (51.9)	.621
Employment			
Employed n=82	44.3	30 (36.6)	
Unemployed n=103	55.7	56 (54.4)	.150
Education			
Pre-school n=23	12.4	8 (34.8)	
Primary n=51	27.6	16 (31.4)	
High school n=111	60.0	25 (22.5)	.180
Housing condition			
Permanent n=71	38.5	43 (60.6)	
Semi-permanent n=114	61.6	43 (37.7)	.177
Drinking water			
Treated n=136	73.5	63 (46.3)	
Untreated n=49	26.5	23 (46.9)	.829
Toilet type			
Pit latrine > 5 (n=147)	79.4	73 (49.7)	
Flash toilet <5 (n=38)	20.5	13 (34.2)	.445
Hygienic habits			
Hand washing n=155	83.8	86 (46.5)	
Water only n=95	51.4	61(64.2)	
Soap and water n=60	32.4	25(41.6)	
Possession of pets n=119	64.7	52 (43.7)	.257

Amoebiasis recorded a higher prevalence in males (36.2%) than females (27.6%). This was higher than related studies in Thailand 18.5% (males), 16.1% (females) and in Italy 17.1% (males), 12.7% (females) respectively. [43,44] On the contrary, it was lower than similar study in Nairobi, Kenya 51.6% (males) and 48.4% (females).[45] The low prevalence in Thailand and Italy could be attributed to improved socio-economic standards as compared to Kenya. In regards to African context, farming activities were done by men while the domestic chores, care of children and the sick were undertaken by women indicating shared responsibilities.

The participants of ages below 9 and 20-29 years both recorded (12.9%) in amoebiasis. Since age has a profound effect on infections, children < 9 years most often have a tendency of eating without hand washing or may lick contaminated fingers. The ages 10-19 years falls within the period when children are increasingly involved with outdoor activities, including handling fecal contaminated materials which predispose them to enteric diseases. The moderate disease rate affecting age 20-29 years and over could be attributed to negligence in hand washing, poor personal hygiene, attitude and habit of sharing materials which facilitates enteric diseases.

The low rate in helminthiases in the study was an indication of effective regular mass treatment as reported in a previous study. [46] Infected participants' from rural and urban areas recorded (42.5%) and (51.9%) respectively and was lower than related study in Eastern Nigeria (80.9%) rural and (51.4%) urban. [47] Rural-urban migration may be attributed to unemployment and low wages/salary. Consequently, low socio-economic status increases the likelihood to continuous infection enhancing Polyparasitism (6.4%) as reported in our study. Employment factor reported higher prevalence (54.4%) in unemployed as compared to (36.6%) in employed participants. Regular odd jobs in the informal settlements expose casual laborers to enteric diseases. Hand washing with water only reported (64.2%) while (41.6%) washed with soap and water. Our findings did not agree with similar studies in Asia and Africa, that recorded (3% - 42%) and (1% - 16%) respectively. [48] However; our results on hand washing may have been affected by self-reported as opposed to observation.

Education levels recorded rate ranges from (22.5% - 34.8%). The moderate prevalence in pre-school (34.8%) could be attributed to frequent contacts, playing with soil, water bodies and over-crowding in day-care centers while tertiary level (22.5%) could be attributed to asymptomatic cases and a likelihood of self-treatment on over the counter drugs. Participants living in permanent houses reported (60.6%) and (37.7%) in semi-permanent which suggested that cleanliness and health habits of families contributed to the diseases. Access to treated tap water recorded (46.3%) while river and borehole water (46.9%) infection rate which may be attributed to trusted water sources which were not boiled before drinking. This was in agreement with a similar study in Argentina, which reported association of intestinal parasites with contaminated water sources and insufficient health conditions. [49] In contrast, a similar study in Mexico reported no correlation between reliable drinking water and parasitic diseases. [50] Pit latrine users reported higher prevalence (49.7%) compared to flash toilets users (34.2%) which may be attributed to communal sharing and improper hygienic conditions.

Infected participants' cohabitating with pets reported (43.7%) and dogs were owned by

70% of which may have served as guards for livestock and homes. The limitation of the study was low number of stool samples and studied parasite species. Considering all the factors, and the identified fecal-oral transmitted enteric parasites, it suggested that the infections constitute a major public health problem.

Conclusion

This study demonstrates enteric parasitic diseases as a major public health problem in counties of Western Kenya. The prevalent EPDs were amoebiasis, cryptosporidiosis, giardiasis, ascariasis, hookworm disease and trichuriasis. All age groups and both genders were susceptible to enteric diseases but at different rates. Polyparasitism was observed among the protozoan species but rare with helminthes.

Our study investigated transmissions of enteric diseases in complex interactions between human and animal hosts, enhanced by effects of socio-economic aspects and urbanization. It was concluded that faecally polluted environment, poor sanitary conditions, personal hygiene and lack of safe water leads to continuous infections.

To reduce such a high burden of EPDs, effective strategies should be designed and implemented. The epidemiological data generated in this study may help local and regional health authorities and decision makers to optimize resources to improve the quality of life in rural and urban areas and combat EPDs.

Recommendations

We recommend that the ministry of health services under the devolved function within County Governments to consider specific local socio-economic factors when developing prevention, control management policy on EPDs in the regions.

Local government authorities must implement preventive strategies for schoolchildren, households, and communities to reduce incidence of EPDs by establishing access to safe drinking water, continuous health education to improve personal and environmental hygiene habits.

That the ministry of health services should use data from this study to form a baseline for future evaluation of control measures.

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Conflicts Of Interest

The authors have no conflict of interest.

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