Arts and Design Studies
ISSN 2224-6061 (Paper) ISSN 2225-059X (Online)
Vol.27, 2015 www.iiste.org

A Cross Sectional Survey of Soil Transmitted Helminthes in Preschool Children in Mrani, a Rural Settlement, Kenya.

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ABSTRACT
Soil transmitted helminthes infections constitute one of the major obstacles to survival of children below the age of five years in many developing countries apart from other factors such as malnutrition and inaccessibility to safe water. This Crossectional survey conducted in Marani district, a rural setting was aimed at determining the presence of prevalence rates of various STH among preschool children usually aged below five years and the influence of demographic and socio-economic factors. Single stool specimen were collected from 106 children for the detection and identification of worm eggs using MiniParasep, a concentration technique. A structured questionnaire was used to identify demographic and socio-economic factors which impact on infection rates. Statistical software SPSS version was used to analyze the data. The overall prevalence of STH in the sample was 35.8%, with single infection of 30.2% and co-infection 5.6%. *Ascaris lumbricoides* accounted for a prevalence rate of 19.8% followed by hookworm infection at 7.5% and *Trichuris trichiura* infection at 2.8%. Male children had a higher infection rate of 43.6% compared to girl children at 27.5%.The levels of education of the parents had an influence on infection rates with higher education standards having lower infection rates. Water sources had some influence on prevalence rates with wells/rain combination having high infection rates of 25%, while river water had 22%.
Key words: soil transmitted helminthes, preschool children, rural setting.

1.0 INTRODUCTION

Soil transmitted helminthes (STH) infections such as ascariasis caused by roundworm *Ascaris lumbricoides*, trichuriasis caused by roundworm *Trichuris trichiura* and hookworm infection also caused by roundworms *Necator americanus* and *Ancylostoma duodenale* are a major health problem of children in rural areas of developing countries (Knopp *et al*., 2008) including Kenya. Such infections impose an enormous public health burden in developing countries and are among the most widespread infectious agents that affect humans particularly in marginalized, low-income and resource constrained regions of the world (Lustigman *et al*., 2012, Wang *et al*., 2012).

STH infections are associated with high prevalence rates especially in children from low socio-economic background thus are considered one of the principal factors contributing to childhood morbidity and mortality in tropical countries (Boschi-Pinto *et al*., 2008). Systematic studies show that at great risk of morbidity are high risk group which includes preschool, school aged children and pregnant women (Matthys *et al*., 2011).

Generally, STH cause malnutrition, intestinal obstruction, lack of appetite, slow growth, weakened general physical fitness, fever, diarrhea, vomiting and impaired cognitive development especially in children whose immunity is still developing (Ahmed *et al*., 2012). Trichuriasis causes inflammation at the site of attachment and when in high intensity it results in colitis (a clinical disorder that resembles inflammatory bowel disease, including chronic abdominal pain and diarrhea, as well as the sequelae of impaired growth and finger clubbing). In intense trichuriasis, dysentery and rectal prolapse occurs especially in children.

In young children, adult worms of *Ascaris lumbricoides* can accumulate in the ileum causing partial obstruction because the lumen is small. High intensity of adult *Ascaris lumbricoides* worms in the small intestine may cause abdominal distension. Pain is experienced; lactose intolerance as well as malabsorption of vitamin A. Absorption of other nutrients may also be impaired leading to poor nutritional and growth failure. When the infective filariform larvae of hookworm penetrates the soft skin between toes, it causes an irritation on the penetrated skin area leading to pruritis that produces a ‘ground itch’, an inflammation that leads to local intense itching, where the filariform larvae penetrated (Arora *et al*., 2004).

Although direct mortality that may result from helminthes infection is low, its morbidity is high. Numerical threshold at which worms cause disease in children has not been established, because its highly dependent on the underlying nutritional status of the host that is, if the host is malnourished, then the worm burden may be high as compared to an individual who doesn’t have nutritional deficiencies (Arora *et al*., 2004). Morbidity from STH infections and the rate of transmission are directly related to the number of worms harbored in the host, it is for this reason the intensity of infection is the main epidemiological index for STH (Lynne; 2007).

Contrary to WHO guidelines on deworming of high risk groups where preschool children fall (WHO; 2013), Kenyan health policy continues to ineffectively manage the issue of STH infection prevention and control. In rural Kenya, deworming is still performed at the individual level rather than community level, this does not take charge of the preschool children in the community who are considered a high risk group and may harbor the STH infections in high intensity. Such children end up contaminating the environment which makes other members of the community vulnerable to such infections or become reinfected if such children practice open defecation or unsanitary disposal of stool. Such practice propagates the spread of STH infections (Boschi-Pinto *et al*., 2008) because contaminated stool undergo environmental exposure and growth thus eggs become infective and may end up contaminating water in rivers, streams or dams that the community regularly use. In this regard therefore, epidemiologic tools are needed to identify and prioritize preschool children for mass treatment programs (Parker *et al*., 2011).

Infections are disproportionately high among preschool school children because policies are not implemented in the government sponsored mass drug administration (MDA) program (Parker *et al*., 2011) and it is unlikely that their parents would buy anthelminthic drugs as a control measure due to either lack of appropriate health knowledge or poverty. As a result, untreated preschool children live with chronic infections that may make them stunted leading to delayed joining school (Bethony *et al*., 2006). Regardless of the health risks associated with STH infections, sufficient attention has not been given to Marani district (Figure 7); a remote, rural community where health, environmental facilities and infrastructure are poor, inadequate or lacking altogether. This community mirrors the situation of most remote communities in developing countries where lack of regular and sustained intervention could be detrimental to the well being of growing children.

To control the morbidity which is associated with STH infections for preschool children living in endemic communities, government of Kenya programs under ministry of public health and sanitation has focused on deworming through school programs. Such efforts have showed a reduction in the transmission of STH in that group of children (Obala *et al*., 2013). It is therefore particularly important to cater for preschool children who are untreated portions of the population to ensure control of infections given the impact of STH on early growth and development. This present study is therefore aimed at studying the risk factors in preschool children that are associated with STH in an impoverished indigenous setting in rural Marani that will include treatment for the infected preschool children. This study will enhance growing pool of vital baseline data on the prevalence of STH infection in Kenya.

2.0 MATERIAL AND METHODS

2.1 Study area

This study was conducted in Kisii County which is located in Nyanza, Kenya, a highland at an altitude of 1660 m above sea level. It receives average rainfall of 1500 mm per annum that is distributed almost throughout the year although there are two rainy seasons (March to May and October to November). The county is densely populated with a population of 37,531 people and a density of 1295 people/km^2. Marani district is located in Kisii and covers approximately 3873km^2. Temperatures range from 10°C to 30°C with relative humidity of 88% (Central Bureau of Statistics/GOK 1999). The soils around the homes in Kisii are mostly damp and warm, providing ideal conditions for hatching of helminthes.

2.2 Study Design

This was a cross-sectional survey that involved administration of structured questionnaire and laboratory analysis. To establish the factors influencing the prevalence rates of soil transmitted helminthes amongst preschool children of Marani district a questionnaire were administered to the household parents/caretakers. The questionnaires were formulated into three categories, for parents, clinician and nongovernmental organizations. Parents were interviewed in their household settings and were required to fill in a pre-tested questionnaire for their family background and socioeconomic information. The questions were designed to generate information about age, sex, parents educational and employment status, source of drinking water, presence of toilet facilities as well knowledge about worms and personal hygiene practices. The questionnaire helped in determining household and individual risk factors that influence soil transmitted helminthes infection dynamics in preschool children aged 0-5 years and to establish the effect of water, sanitation and hygiene on soil transmitted helminthes infection in rural Marani community.

2.3 Specimen Collection

Consent was sought from the parents who were required to sign it, thereafter; a polypot container for stool collection was given to them. Instructions of stool collection were given to the parents. Only one stool sample was submitted per participant. A total of 106 stool samples were collected and analyzed using MiniParasep concentration microscopic technique for the identification and quantification of parasitic eggs in accordance to WRP-K Microbiology Hub- Kericho microscopy Standard Operating Procedures. Accurate diagnosis of STH in both child and caregivers stool was determined by the observation of the STH eggs in defined quantities of stool using the new MiniParasep technique. Fresh stool samples were collected and preserved using 10 percent formalin with Triton X before transportation to WRP-K for further analysis. For quality control, one hundred percent of the samples were verified by a second technologist for the initial results.

2.4 MiniParasep technique.

This is a concentration technique that uses 3ml formain and trixton X as preservatives in a kit. This technique allows for the quantification and identification of helminthes eggs. A pea size stool sample was put in the kit and mixed to form a homogeneous solution. After 24hours, this kit was then centrifuged at 1500 r.p.m for two minutes, supernatant poured off and sediment resuspended. A drop of the sediment was put in a glass slide; cover slipped and examined under both ×10 and ×40 objective lenses microscopically for quantification of helminthes egg.

2.5 Ethical Clearance

Review and clearance for this study was given by Egerton University and Walter Reed Project-Microbiology Hub, Kericho administration. The consent of each participant was obtained and recorded on signed consent forms. To guarantee anonymity, each study participant was accorded a unique identification number. After conclusion of this study, the participants who tested positive for STH were treated with 200 mg of albendazole as per Ministry of Health Kenya deworming guidelines.

2.6 Data analysis

Data for this study was initially stored in Microsoft excel spreadsheet 2007 and later imported to SPSS software (SPSS version 16.0) for statistical analysis. When significant values were found, a correlation of the variables was then done still using the SPSS software. A p-value that was less than 0.05 using chi square on SPSS, was considered statistically significant and vice versa.

RESULTS

This was a Crossectional survey that enrolled 106 preschool children living in rural Marani and who were below the ages of five. Single species and co-infection prevalence rates tended to have a higher rate in males than in female preschool children. Even though the variation between male and female was statistically insignificant, more male 43.6% preschool children were more infected than the female 27.5% as shown in table 1. Out of a total of 106 preschool children enrolled for this study, 30.1% were positive for either *Ascaris lumbricoides*, *Trichuris trichiura* or the hookworm as a single helminth infection. Co-infection of the helminthes was observed with *Ascaris lumbrocoides*/*Trichuris trichiura* having a prevalence rate of 4.7% followed by *Ascaris lumbricoides*/hookworm 0.9%. The distribution of helminth infection tended to decrease with increasing education standards amongst parents, from none educated parents to parents who had post secondary education. It was noted that, infection with *Ascaris lumbricoides* had a predominant prevalence rate of 19.8% in preschool children in Marani district followed by hookworm infection with a prevalence rate of 7.8% and the least prevalent soil transmitted helminth being *Trichuris trichiura* 2.8% .

DISCUSSION

Three species of soil transmitted helminthes were identified from the stool samples of the preschool children that were included in this study namely, *Ascaris lumbricoides, Trichuris trichiura* and hookworms. Of these, *Ascaris lumbricoides* had the highest of frequency 19.8% followed by hookworm 7.5% then *Trichuris trichiura* which was detected the least in frequency 2.8%. This infection pattern is attributed to the fact that the spread of infection of these worms is entirely through fecal pollution of soil, thus, infection is concurrent with the extent of soil contamination by fecal matter (Smith *et al*., 2001). *Ascaris lumbricoides* and hookworm showed a high prevalence in sampled preschool children who used environment as a defecation area thus supporting this position. It has been suggested that in many tropical countries, soil transmitted helminthes is an occupational disease of the farming community (Giles; 1964). In Marani district, most parents interviewed were farmers and STH were isolated from their children.

Single infection prevalence rate was relatively high especially in preschool children of the ages four and five who showed a high infection rate to *Ascaris lumbricoides* and hookworm infection as compared to co–infection. *Ascaris lumbricoides* and *Trichuris trichiura* co-infection showed a high prevalence unlike hookworm and *Trichuris trichiura* co-infection which was not observed because the frequency of infection with hookworms was a little bit lower therefore this observation was anticipated. Most research especially those conducted in rural areas around the country and in endemic areas show that co-infection is common (Bethony *et al*., 2006).

Marani district is a typical rural area with no taped water, poor housing and a naïve area in association with soil transmitted helminthes study, because to the best of the researchers' knowledge, this is the first study being conducted in this area. Therefore key environmental factors linked with STH infection which are amenable for intervention were identified. The findings of this study provide some evidence for environmental and public health measures to counter STH infection.

This study reaffirms that there still exists a high prevalence of STH in rural areas especially *Ascaris lumbricoides* with a high prevalence rate across all gender. Because most of the helminthes detected in the preschool children in this study are feco-orally transmitted, improved environmental hygiene would highly reduce this transmission. Occupation of parents, type of water and levels of sanitations were the major factors that contributed to the high prevalence rates of soil transmitted helmithes in Marani district.

A lot has been documented about soil transmitted helminthes in school going children but less has been explored about preschool children especially in Marani area where this is the first study, therefore more research is needed for national data. Among the factors involved, community based mass drug administration administered to the preschool going children would be very effective in controlling soil transmitted helminthes as well as the provision of clean and safe water for drinking. Educated parents are key to control of STH especially to the mothers who play a vital role in the day to day growth of a child. Non governmental organization in partnership with the government should be encouraged to carry out helminthes eradication programmes especially in the rural setting of Marani which mirrors other rural areas in Kenya.high levels of both personal hygiene and community hygiene would help id reducing and eradicating helminthes infection. This maybe be done through radio programmes,local health centres by the ministry of sanitation and hygiene.

TABLES

Table 1. Soil transmitted helminthes distribution across gender.

			Gender		Total
			Female	Male	
Helminth	None	Count	37	31	68
		%	72.5%	56.4%	64.2%
	Ascaris lumbricodes	Count	8	13	21
		%	15.7%	23.6%	19.8%
	Trichuris trichiura	Count	1	2	3
		%	2.0%	3.6%	2.8%
	Hook worms	Count	3	5	8
		%	5.9%	9.1%	7.5%
	Asacris lumbricoides/	Count	2	3	5
	Trichuris trichiura	%	3.9%	5.5%	4.7%
	Ascaris lumbricoides/ Hookworm	Count	0	1	1
		%	.0%	1.8%	.9%
Total		Count	51	55	106

$\chi^2 = 3.607$ df = 5 $p = 0.607$

Table 2: Distribution of helminth among the sampled children

Helminth	Frequency	Percentage (%)
None	68	64.2
Ascaris lumbricodes	21	19.8
Hook worms	8	7.5
Trichuris trichiura	3	2.8
Asacris lumbricoides/Trichuris trichiura	5	4.7
*Ascaris lumbricoides/*Hookworm	1	0.9
Total	106	100.0

Table 3. Helminth distribution across level of education of the parents

			Levels of education				Total
			None	Primary	Secondary	Post secondary	
Helminth	None	Count	5	19	26	18	68
		%	27.8%	57.6%	72.2%	94.7%	64.2%
	Ascaris lumbricodes	Count	6	6	8	1	21
		%	33.3%	18.2%	22.2%	5.3%	19.8%
	Trichuris trichiura	Count	0	3	0	0	3
		%	.0%	9.1%	.0%	.0%	2.8%
	Hook worms	Count	5	2	1	0	8
		%	27.8%	6.1%	2.8%	.0%	7.5%
	Ascaris lumbricoides/ Trichuris trichiura	Count	2	2	1	0	5
		%	11.1%	6.1%	2.8%	.0%	4.7%
	Ascaris lumbricoides/ hookworm	Count	0	1	0	0	1
		%	.0%	3.0%	.0%	.0%	.9%
Total		Count	18	33	36	19	106

$\chi^2 = 35.007$ df = 15 $p = 0.002$

FIGURES

Figure 1. Distibution of Helminth infection in Marani preschool children