



Prevalence and Associated Risk Factors of Soil-Transmitted Helminthiases among Primary School-going Children in Rarieda, Siaya County-Kenya

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Authors' contributions

This work was carried out in collaboration among all authors. Author ASO conceived and designed the analysis, collected the data, contributed data or analysis tools, performed the analysis, wrote the draft and the final manuscript. Authors M. Dominic and M. David supervised and approved the study at any given stage. They also participated during data collection and analysis and approved this final manuscript for publication. All authors read and approved the final manuscript.

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ABSTRACT

Soil Transmitted Helminthiases (STH) are a group of chronic infections, typically very common or endemic in low income countries and are classified as Neglected Tropical Diseases (NTD). Despite the World Health Organization (WHO) laid down control strategies and goal to eradicate these infections by the year 2020, these infections continue to dominate in Sub-Saharan countries; this problem necessitated the need for this study. The primary objective of this study was to assess prevalence of, and risk factors of STH among primary school children in Rarieda, a sub-county in Siaya County of Kenya. The study contributed to the overall theme of "Research for Better Health in East African Region". The study population comprised of primary school children, aged between seven and fifteen years. A total sample size of 300 pupils was randomly sampled from five primary schools across Rarieda. Data were collected between September and October 2018 and cross

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sectional study design was used. Ethical approvals were obtained from all the relevant authorities and pre-testing was done at Ruma primary school. Data was collected using structured questionnaires, Key Performance Indicators (KII) and Focused Group Discussions (FGD). The study established that there was high prevalence of STH among the primary school children in Rarieda, with prevalence rate of 27.3 percent. The prevalence rate varied with socio-demographic characteristics of the pupils. Knowledge level of the pupils on STH was 38.9, and the pupils were 45.9 percent at risk of STH with a great variance noted between health practices at schools verses at homes. Integrated STH control approach, which would incorporate regular deworming, health education and promotion, hygiene and sanitation, and appropriate health policies formulation and implementations, was therefore seen to be very necessary in controlling and prevention of STH in Rarieda.

Keywords: Prevalence; risk factors; STH; primary school children; Kenya.

1. INTRODUCTION AND STUDY BACKGROUND

Soil-Transmitted Helminthiasis (STH) refer to the intestinal worms infecting humans and are usually transmitted through contaminated soil, and, this type of helminth infection or helminthiasis is caused by different species of roundworms [1,2]. It is usually referred to as Soil-Transmitted Helminthiasis because it is caused specifically by those worms which are transmitted through soil contaminated with faecal matter [1]. The main types of STH include *ascariasis*, *hookworm*, *whipworm* and *threadworm*, with the first three types being the most distinguished. STH is categorized as a Neglected Tropical Diseases (NTD) which was launched in 2012 to be eradicated by 2020 in the world [1]. Epidemiological distribution of STH is worldwide with approximately a third of the global population infected with STH [1]. This means that about two billion people of the world total population are infected, and about another four billion are at risk of being infected [1]. Infections are widely distributed in tropical and subtropical areas, with the greatest numbers usually occurring in China, America, East Asia, and sub-Saharan Africa, Kenya inclusive [3]. Over 267 million preschool-age children and over 568 million school-age children live in areas where these parasites are intensively transmitted, and are in need of treatment and preventive interventions [2]. Generally, these infections are endemic in developing and low income countries [1]. Soil-Transmitted Helminthiasis may cause several health issues such as abdominal pains, diarrheal, physical and cognitive growth retardation and protein loss to the infected [2]. Hookworms are major cause of chronic intestinal blood loss which causes anaemia in most cases. Soil-Transmitted Helminthiasis also cause appetite loss leading to reduction of nutritional

intake in the body and physical unfitnes in human beings and in particular, *T. trichiura* mainly cause diarrheal and dysentery. They also contribute and prevent affected children and/or persons from going to school, work, or fully participating in community development activities, thereby contributing to stigma and poverty [1,2]. For basic diagnosis, specific helminths can generally be identified from the faeces, and their eggs microscopically examined and enumerated using faecal egg count method [3]. Control and prevention strategies involve regular treatments, improving of sanitation, and health education and promotion [1,2].

This study was necessitated by high prevalence of STH among the primary school children, and the burden caused by these worms among the pupils. The primary purpose of this research project was to provide statistical and epidemiological understanding of the prevalence and risk factors of STH in Rarieda, Siaya County. In justifying the need for the study, the researcher noted that there was a serious need to carry out a study on STH with the primary school children as the study population because of the public health effects associated with these infections, especially in children [1,2], the vulnerability of pupils to STH infections [2], and also because of the fact that these infections have been neglected [1]. In this study, new data were generated on the prevalence and risk factors of STH in Rarieda. This in turn helped in better understating and decision making on the most appropriate prevention and control strategies of Soil-Transmitted Helminthiasis. The primary objective of the study was to assess prevalence and associated risk factors of Soil Transmitted Helminthiasis among primary school going pupils in Rarieda, Siaya.

2. METHODOLOGY

2.1 Study Area

This study was carried out in Rarieda. Rarieda is one of the six sub-counties of Siaya County, in the former Nyanza province in the southwest part of Kenya [4,5]. Siaya County covers a total area of 2,496.1 km² with a total population of 842,304 as per the 2009 Kenya population census [6]. Siaya county borders Busia, Kakamega, Vihiga, Kisumu and Homabay counties. Apart from Rarieda, the other five sub-counties in Siaya include Bondo, Ugenya, Alego, Gem and Ugunja [7]. The main economic activities in the area include food and cash crop farming, cattle rearing mostly in small scales, and fishing [8]. Rarieda Sub-County is made up of two communities namely Uyoma and Asembo. The sub-county is sub-divided into five administrative areas, referred to as “wards” under the new Kenyan constitution promulgated in 2010 [7]. During the time of the study, Rarieda had approximately one hundred and thirteen primary schools with a total pupil’s population of about thirty-four thousand. Rarieda sub-county is located in the Kenyan plateaus where the temperature is generally mild and pleasant warm. Rainfall in this area is received mainly between March and May and between October and December. In this study, data was collected between September and October, 2018. It therefore means that data collection started during dry season (September) and proceeded till rainy season (October) with temperature range of between 28 degrees Celsius to 31 degrees Celsius.

2.2 Study Population

The study population comprised of primary school children in Rarieda. The pupils were between the ages of seven and fifteen years old. Minimum age of seven was considered because at this age, the pupils could speak and answer some questions correctly even without assistance, while fifteen years was considered as the average maximum age a pupil takes to complete primary education. It might not have been easy to interview pupils less than seven years, and it would not be easy to find pupils above sixteen years of age in primary schools. Primary school children were also considered because they tend to bear the heaviest burden of STH [1]. A research done in Nigeria had also included school children between the ages of five to fourteen years [4]. A similar study also done in

India had also examined the prevalence and risk factors of STH among the school children aged between nine and ten years old [9].

2.3 Study Design

This was a descriptive cross-sectional study. This study design was preferred because it captured the data on prevalence and risk factors of STH at one point in time. It was also cheap and required less time to perform.

2.4 Sample Collection

Sample size was determined and calculated using the Fisher’s Formula (1998). Three hundred primary school children, comprising of one hundred and fifty boys and a similar number of girls were sampled for the study. During the sampling, the study site (Rarieda) was first divided into five strata. These five strata were the five administrative wards, three in Uyoma and two in Asembo [7,10]. One school was then sampled randomly from each of the five wards. Sixty pupils in total, twelve per class, were then sampled from each of the five sampled schools.

2.5 Stool Examination

Single stool samples were collected from each of the sampled pupils and analysed for STH eggs and larvae by wet mounts [11]. Kato-Katz technique was used for quantification of the worms. The selected pupils were given a screw capped plastic sterile container bearing an inscription with name and age of child. They collected two grams of the early morning stool on the day of selection into the study. The stool sample collected was then subjected to microscopic evaluation [12,13,14]. The direct wet smear was prepared by mixing a small amount of stool (about 2 mg) with a drop of 0.85% NaCl; this mixture was to provide a uniform suspension under a 22- by 22-mm cover slip [13]. This was the cost effective routine microscopy examination of stool undertaken in the study in the community. The laboratory analysis of the stools was done at Pap-Kodero Health Centre. The health centre is owned and managed by the county government of Siaya.

2.6 Pre-testing

Pre-testing of the data collection tools was done at Ruma Primary school one week prior to the actual data collection exercise. Data collection tools included the structured questionnaires for the primary school children, Focused Group

Discussions (FGD) and Key Informant Interviews (KII). FGD were useful to obtain detailed and broader range of information about personal and group feelings, perceptions and opinions as far as STH in the area was concerned. They saved time and money compared to individual interviews. KII was purposely used to collect information from a wide range of people—including health professionals, chiefs, teachers or residents—who had first-hand knowledge about Rarieda community. Pre-testing also involved sample stool collection, examination and analysis.

Data collected were entered into an excess sheet for analysis and correction of any errors. The first step in quantitative data analysis was to identify the levels or scales of measurement as nominal, ordinal, interval or ratio. This was to help determine how best to organize the data. The data was typically entered into a spread sheet to check for the accuracy and any errors, and organized or “coded” in some way that gave meaning to the data. Data was summarized and analyzed by use Statistical Package for Social Science (SPSS- Version 20) [15,16].

2.7 Assent, Consent and Ethical Approval

The researcher sought approval to carry out this research project from all the relevant authorities. Upon being cleared by the Mount Kenya University Schools of Public Health and Postgraduate studies; ethical approvals were also sought and obtained from the Mount Kenya University Ethical and Research Committee (MKU-ERC), the National Commission for Science, Technology and Innovation (NACOSTI) and the County government of Siaya [6,10]. The school heads of the selected schools, the area local Public Health and education officers and the area local chiefs had to be officially informed and their approvals sought before the start of the research. Since the study involved minors, that is, pupils below eighteen years of age, their respective head teachers, parents or guardians signed a minor’s assent form on their behalf after the pupils were fully informed of the all the information pertaining to the research, what was required or expected of them and any potential risk the research may have posed to them.

2.8 Operational Definition of Key Terms

Deworming: Refers to giving of an anthelmintic drug to a human or animal to rid them of helminths parasites, such as roundworm, flukes and tapeworm [17].

Health promotion: Refers to the activities of enabling people to take control and increase control over their health and the health determinant.

Hygiene and sanitation: Refers to a set of personal practices and activities that contribute and promote good health. It includes hand-washing, bathing and cutting hair and nails.

Neglected Tropical Diseases: Refers to a diverse group of tropical infections which are common in low-income countries of Africa, Asia, and the Americas [18].

Knowledge: Refers to the facts, information, and skills acquired through experience or education; the theoretical or practical understanding of a subject.

Prevalence: A statistical concept referring to the number of cases of a disease that are present in a particular population at a given time.

Regular Treatment: Scheduled and continuous medical care given to a patient for an illness, injury.

Risk factor: Any attribute, characteristic or exposure of an individual that increases the likelihood of developing a disease or injury [1].

Soil-Transmitted Helminthiases: Refer to the intestinal worms infecting humans that are transmitted through contaminated soil and, is a type of helminth infection caused by different species of roundworms [18].

3. RESULTS

3.1 Prevalence of SHT among the Primary School Children in Rarieda

Prevalence of Soil-Transmitted Helminthiases among the primary school going children in Rarieda was determined to be 27.3 percent. Boys had a higher prevalence of STH (29.3 percent) than females (25.3 percent). Boys tested positive of the STH from class three to seven were 12, 10, 8, 6 and 8 respectively while the total number of girls tested positive from class three to seven were recorded as 8,7,8,8, and 7 respectively.

Data collected on prevalence of STH among the primary school children in Rarieda was recorded in Table 1.

Table 1. Prevalence of STH by ward, type, and class

Variables	Frequencies (f)	Percentages (%)	Chi-square (X ²)	p-values
Class (n=60)				
Standard 3	20	33.3	1.293	0.86262
Standard 4	17	28.3		
Standard 5	16	26.7		
Standard 6	14	23.3		
Standard 7	15	25.0		
Gender (n=150)				
Boys	44	29.3	0.439	0.50759
Girls	38	25.3		
Community (n=150)				
Uyoma	57	31.7	3.091	0.0787
Asembo	25	20.8		
Ward (n=60)				
West Uyoma (Akuom)	20	33.3	6.415	0.17025
North Uyoma (Ochieng'a)	14	23.3		
South Uyoma (Ramoya)	23	38.3		
West Asembo (Mabinju)	10	16.7		
East Asembo (Ong'ielo)	15	25.0		
Type of STH (n=82)				
Hookworms		53		
Roundworms		39		
Whipworms		8		

In terms of prevalence by classes, and ages, it was determined that the prevalence in class three to seven were 33.3 percent, 28.3 percent, 26.7 percent, 23.3 percent and 25.0 percent respectively. The prevalence therefore reduced with a rise in age and class.

Prevalence of STH was higher in Uyoma community (31.7 %) than in Asembo community (20.8). Prevalence of STH was highest in South Uyoma ward (38.3 percent). It was followed by West Uyoma ward with a percentage prevalence of 33.3 percent, East Asembo (25 percent). West Asembo ward recorded the least prevalence of

STH with a percentage of 16.7 percent while North Uyoma had a prevalence of 23.3 percent.

3.2 Knowledge about STH among the Primary School Children

The calculated average knowledge on STH for the pupils was 38.9 percent. As far as each school was concerned and as noted in Table 2, the calculated level of knowledge on STH among the primary school children in Mabinju, Akuom, Ramoya, Ochieng'a and Ong'ielo primary schools were 43.9,37.3,30.4,48.2, and 34.6 respectively.

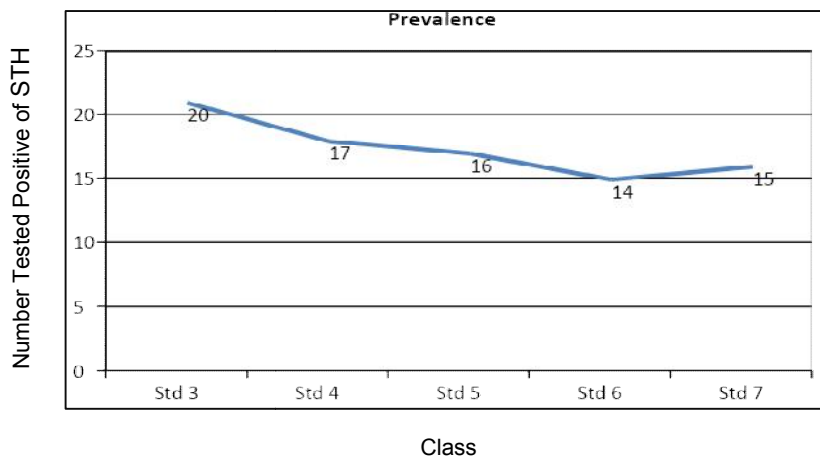


Fig. 1. Prevalence of STH by class

Table 2. Knowledge on STH

School	Had heard about STH n=60		Knowledge on signs and symptoms n=120		Know mode of transmission n=120		Understand the causes and Risk Factors n=120		Understand prevention and control measures n=180		Calculated Percentage Averages
	Numbers	Percentages	Numbers	Percentages	Numbers	Percentages	Numbers	Percentages	Numbers	Percentages	
Mabinju	48	80.0	45	37.5	29	24.2	47	39.2	70	38.9	43.9
Akuom	44	73.3	35	29.2	24	20.0	40	33.3	55	30.6	37.3
Ramoya	36	60.0	23	19.2	13	10.8	34	28.3	61	33.9	30.4
Ochieng'a	52	86.7	50	41.7	27	22.5	52	43.3	84	46.6	48.2
Ong'ielo	41	68.3	34	28.3	18	15.0	35	29.2	58	32.2	34.6
Percentage Average		73.7		31.2		18.5		34.7		36.4	38.9

Table 3. Risk factors on STH

School	Lack Toilets N=60				Inadequate Hygiene & Sanitation Practice N=60				Lack of Health Education and Promotion N=60		Lack of Regular Deworming N=60		Percentage at Risk of STH (By School)
	At school		At home		At school		At home		No	%	No	%	
	No	%	No	%	No	%	No	%					
Mabinju	6	10.0	34	56.7	21	35.0	40	66.7	15	25.0	31	51.7	40.9
Akuom	15	25.0	37	61.7	22	36.7	40	66.7	26	43.3	42	70.0	50.6
Ramoya	18	30.0	42	70.0	29	48.3	43	71.7	22	36.7	44	73.3	55.0
Ochieng'a	5	8.3	30	50.0	15	25.0	35	58.3	22	36.7	29	48.3	37.8
Ong'ielo	8	13.3	33	55.0	21	35.0	39	65.0	25	41.7	37	61.7	45.3
% Risk of STH (By Specific Risk Factor Indicator)		17.3		58.7		36.0		65.7		36.7		61.3	45.9

The data presented in the above table shows that Ochieng'a primary school pupils were the most knowledgeable on average on matters or questions asked related to STH. Their average knowledge on STH was 48.2 percent. Average knowledge for primary school children in Mabinju primary school was 43.9% percent, Akuom primary (37.3%), Ong'ielo primary (34.6%) and Ramoya primary school at 30.4 percent.

Analysing by specific knowledge indicators and based on the figures above, most pupils had heard about STH at 73.7 percent. However, very few pupils, 36.4 percent, were able to demonstrate an understanding of the prevention and control measures, tell the signs and symptoms (31.2 percent), causes and risk factors (34.7 percent) or even tell the mode of transmission of STH (18.5 percent).

3.3 Risk Factors Associated with STH Infections

Risk factor indicators associated with STH that were considered during this study included inadequate or absolute lack of the following: toilets, hygiene and sanitation practices such hand washing, health education and promotion and deworming programs. It was determined that the primary school children in Rarieda were 45.9 percent at risk of being infected with STH. The risk factors varied across the schools whereby Mabinju, Akuom, Ramoya, Ochieng'a and Ong'ielo primary schools were 40.9, 50.6, 55.0, 37.8, and 45.3 at risk of STH respectively.

The greatest risk factor of STH was that the pupils did not observe adequate health hygiene practice (such as washing of hands after visiting toilets, or before eating) while at home (65.7 %). Lack of regular deworming programs followed as the second common risk factor at 61.0 percent while poor toilets coverage especially at homes was a third risk factor with a percentage of 58.7 percent. Lack of adequate health education and promotion and poor hygiene practice at school came fourth and fifth with percentages of 36.7 % and 36.0% respectively. The least risk factor recorded was in regards to adequate toilets and pit latrines in schools. This was recorded at only 17.3 percent. The 17.3 percent was attributed to inadequate toilets compared to pupils population and the unhygienic conditions of some of the toilets.

4. DISCUSSION

Out of 300 pupils tested for STH infections, 82 were positive. This translated to prevalence of

27.3 percent. The prevalence was found to be higher in lower classes compared to upper classes with class three, four and five having prevalence of 33.3 percent, 28.3 percent and 26.7 percent, respectively. Standard seven had a prevalence of 25 percent while standard six had the least prevalence of 23.3 percent. This agrees with the research done in Ogun state in Nigeria which showed that the younger age groups were more infected by STH than older age groups [13]. According to this research done in Nigeria, children of age group 5-7 had a prevalence of 33.3 percent whereas age group 14 years and above had a prevalence of 26.8 percent [13]. Similarly, a research done in Nepal showed that prevalence of STH ranged from 3.3 to 51.5percent with the highest prevalence of 51.4 percent recorded from Khokana community. Rapid Assessment of Soil Transmitted Helminth (STH) Infections among School Girls in Odisha reported that the prevalence of STH I girls was 29.3 percent [9].

As far as prevalence by community was concerned, 57 out of 180 pupils in Uyoma community had STH infections translating to 31.7 percent whereas only 25 out of one 120 pupils (20.8 percent) in Asembo were infected. Even though the difference between the two communities was not statistically significant, (p-value of .0787), it meant that STH prevalence in Uyoma was higher than in Asembo. This difference was attributed to the types of soils found in Uyoma and Asembo. Most parts of Uyoma are covered by clay soil or the black cotton soil while most parts of Asembo are covered by either red loam soil or sand soil. During rainy seasons, it is more difficult to walk on shoes in sticky clay soil (Uyoma) while the same did not apply to sandy soils (Asembo). It is important to note that it is especially during the rainy season that the human faecal matter is washed away by surface run offs thus exposing more pupils to risk of STH in Uyoma. This was noted to be especially true due to low level of toilets coverage in the area, which left many pupils (and adult community members as well), to defecate on open fields.

Chi-square tests and calculations showed that the difference in prevalence of STH among the five schools were not statistically significant, (p-value of .17025). Similarly, there was no statistical significance on prevalence of STH between the boys and girls with p-value calculated at .50759. However, it was noted that the prevalence in boys (29.3 percent) was higher than the prevalence in girls with a percentage

difference of four percent. This finding did not corroborate to the study done in Nepal in which it was found that the prevalence of STH in females was higher than the prevalence in males [8]. The difference in the finding of the two studies was attributed to the fact that the study in Nepal included females and males of all age groups. It attributed the high prevalence of STH to be higher in females than in boys due to the high roles played by females in the fields and gardens compared to males. However, this study in Rarieda only included boys and girls of the primary school age, mostly between age groups of seven and fourteen. High prevalence of STH on boys than girls in the sampled pupils was also attributed to their behaviours and responsibilities brought by gender. Boys mainly walk and play barefooted, compared to girls. Boys are also mainly responsible for looking after the animals in the open fields, and due to the type of soil in

the area, clay soil in most areas, walking on shoes especially during rainy seasons is a big problem. On the other hand, girls' main chores involve mainly working within their home compounds hence exposing them to lesser risk of STH than boys. Low prevalence of STH among pupils of upper classes compared to lower classes colleagues was attributed to two factors: maturity and learning pressure in upper classes. With a p-value of .86262 the difference in prevalence of STH among the pupils of different classes was however, not statistically significant. Interventions for the control and prevention of STH must therefore, among other measures, focus on health promotion and education, and must also focus on behaviour change such as encouragement of the pupils to wear shoes always when outdoors, washing of hands after toilets visitation, and even washing of fruits before eating them.

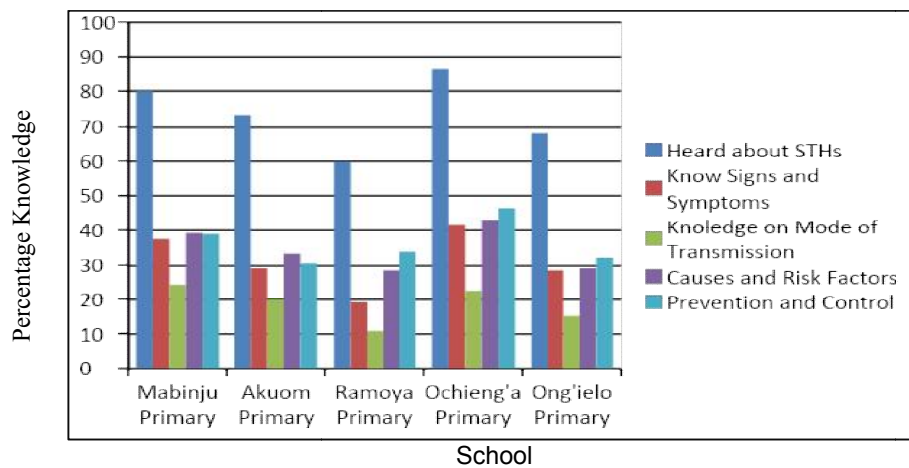


Fig. 2. Knowledge on STH by specific knowledge indicators

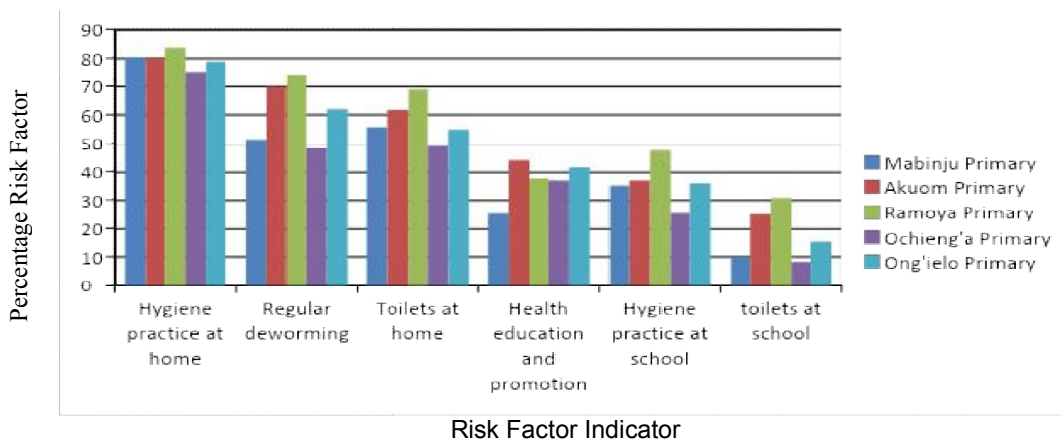


Fig. 3. Associated Risk factor of STH

Based on the type Soil-Transmitted Helminthiases, it was established that infections by hookworms were the highest at 53 percent followed by roundworms at 39 percent whereas infections by whip worms were the least at only eight percent. These results were similar to the study in Nigeria, in which it was found that *A. lumbricoides* was the most common STH at 29.3 percent while *T. trichiura* had the least prevalence at 2.3 percent [4,8]. This implied that interventions for control and prevention of STH among the community as much as it should focus on all types of worms, should pay much specific attention to *A. lumbricoides*. This is because if *A. lumbricoides* alone could be eradicated, the prevalence of STH would reduce by more than fifty percent. Eradicating, or controlling hookworms and roundworms would reduce prevalence of STH in Rarieda to below eight percent. When this is achieved, complete eradication of STH would almost have been achieved. There is therefore need to research more and develop efficase drugs towards these two types of worms. These drugs, coupled with adequate prevention measures, would lead to elimination of STH.

High prevalence of STH in Rarieda was attributed to the climatic conditions in the area. According to Akinola et al. (2018), STH are prevalent in areas with favourable climatic and environmental conditions [4]. The unhygienic eating habits, poor water supply, poor sanitation and personal hygiene conditions which facilitate the transmission of STH could also have been a contributing factor for the high prevalence of these worms [13]. The study findings were better than those reported by Osazuwa et al. in Nigeria in 2010 where parasitic infection was reported at nearly 80% and hookworm being 75 %. In an Indian study done at Vellore in 2010 among school children in 6-14 years age, STH prevalence was noted much less, that is, 7.8 percent, though hookworm rates were highest, that is, 8.4 percent. In that study residing in hut (Katcha house) and open field defecation emerged as major risk factors for STH. This indicated that STH was a pending public health preventable problem which is mainly because of food and hygiene habits. Primary school children should be made conscious of these and appropriate health programs like Iron-Folic Acid (IFA) and deworming should rightly and stringently be implemented with regular monitoring to address the problem of not just STH but associated problems of anaemia and underweight [9].

As far as risk factors associated with STH was concerned, it was established that the pupils in Rarieda were 45.9 percent more likely to get infected with STH. In terms of the individual risk factor indicators, it was established that 65.7 percent of the pupils did not take seriously hygiene practices (such as washing of hands after visiting toilets or eating) while at homes. This was quite higher compared to only 36.0 percent of the pupils who did not practice hygiene while at schools. On the issues of the toilets, 58.7 percent of the pupils did not have access to good functioning toilets while at homes. This meant that the pupils were most at risk of STH while at homes than while in schools. Only 63.3 percent of the pupils indicated that they received average health education and promotion programs leaving another 36.7 percent at risk of STH. On deworming, only 39 percent received regular deworming as recommended by the WHO. This meant that up to 61 percent of the pupils in Rarieda were at risk of STH due to lack of deworming programs in schools.

Calculations on correlation between risk factors associated with STH and prevalence of STH showed that there was a strong positive correlation, $R = + 0.8983$, between risk factors and the prevalence. This implied that any intervention that reduces the risk factors would definitely result in to the reduction of STH in the area, Rarieda Sub-County.

There were poor toilets and/or latrines coverage in Rarieda. Only 41.3 percent of the pupils sampled had access to toilets in their homes, implying that majority of them at 58.7 percent were at risk of STH infections due to lack of toilets. Most of the pupils, and their parents as well, did defecate in open fields. This situation was made worse by the fact that most pupils did not wear shoes to schools. Low toilets coverage in Rarieda was attributed to lack of health information to the locals on the need to construct toilets. There was also laxity as far as implementation of public health laws and policies was concerned. Ideally, the area public health officers should have been at fore front to urge and if possible, ensure that every home had a toilet. For this to succeed, there would have been a political good will, and support from all the leaders in the area, including political and non-political leaders.

The results on the risk factors were in agreement with results from other studies previously done

on the same or closely related topic. For example, Multivariable logistic regression analysis in the study of prevalence and risk-factors of soil-transmitted helminth infections in Nepal revealed that not using soap for hand-washing was a significant risk factor for the prevalence of roundworm, hookworms and whipworm [4,8]. Similarly, not using sandals or shoes outside was a significant risk factor for the prevalence of roundworm and hookworms [4,8]. A study in Anhui Province in central China indicated that labouring barefooted in farmlands was one of the risk factors for *A. lumbricoides* infection among local residents [9,19]. Moreover, as one of the poor hygiene behaviours, not wearing shoes outside or walking barefooted also were the main risk factors for STH among local population in poor communities in Nepal, Vietnam and Ethiopia [8,19]. An evaluation for the control program of STH infections in rural Malaysia and a systematic review for STH infection around the world showed that wearing shoes outside was associated with reduced odds of infection with any STH [19]. Similarly, exposure to dirt, soil and improper hand washing could cause the intensity of infections related to *roundworm, hookworms and whipworm* [15]. Health education and promotion, regular deworming programs and even support from Non-Governmental Organizations (NGO) and Community Based Organizations (CBO) was therefore necessary to support the needy pupils acquire pair of shoes, and even support the families to build toilets.

Level of knowledge of the pupils was determined to be 38.9 percent and it was also determined that there was a strong negative correlation, Pearson's correlation, R of negative 0.7518, between knowledge about STH and prevalence of STH. This information implied that inadequate knowledge on STH was also a risk factor of STH. Interventions geared towards empowering the pupils with knowledge on STHs would have a positive impact of reducing the prevalence of STHs in the Rarieda sub-county [14,20].

Correlations between prevalence of STH and knowledge on STH and between prevalence of STH and STH associated risk factors were calculated using the Pearson Correlation formula,

Correlation r,

$$r = \frac{N\epsilon xy - \epsilon(x)\epsilon(y)}{\sqrt{[N\epsilon x^2 - \epsilon(x)^2][N\epsilon y^2 - \epsilon(y)^2]}}$$

The calculated R values for correlation between prevalence of STH was knowledge on STH was R = - 0.7518, while the calculated R values for correlation between prevalence of STH and STH associated risk factors was R = +0.8985. There was therefore, a strong negative correlation between prevalence of STH and level of knowledge on STH.

On the other hand, there was a strong positive correlation between prevalence of STH and associated risk factors, hence a conclusion that the prevalence of the STH was directly proportional to the level of risk factors associated with it.

Most pupils were keen to practice health hygiene such as hand washing after every toilet visits while at school than when they were at home. In all the five schools, the level or percentage of health hygiene and sanitation practice was high while the pupils were in schools than when they were at home. Using the Pearson's Correlation Formula, the value of R was calculated as + 0.9675. There was therefore, a strong positive correlation between hygiene practice at school and at home.

5. CONCLUSION

From the study, it was concluded that the prevalence of STH among the primary school going children in Rarieda was high (27.3 percent). The pupils were 45.9 percent at risk of Soil-Transmitted Helminthiases. Lack of adequate knowledge on STH was also considered a major risk factor for STH in Rarieda. The pupils were poorly knowledgeable (38.9 percent) on issues of STH. Strong negative correlation between prevalence of STH and knowledge on STH and a strong positive correlation between prevalence of STH and associated risk factors of STH were noted. In order to control and effectively prevent occurrences of STH infections, an integrated approach was considered to be very necessary. These would include regular deworming, health education and promotion, maintenance of hygiene and sanitation, and appropriate health policy formulation and implementations. With these measures in place, it should indeed be possible eradicate Soil-Transmitted Helminthiases from Rarieda community, from Country Kenya, and even from the rest of East Africa as a whole. Public Health Officers (PHO) ought to take a fore front role in appropriate

policy formulations, implementations, and enforcements and lead all other health care workers and the society at large in this noble exercise.

CONSENT

As per international standard written and informed parental consent has been collected and preserved by the authors.

ETHICAL APPROVAL

Ethical approvals were also sought and obtained from the Mount Kenya University Ethical and Research Committee (MKU-ERC), the National Commission for Science, Technology and Innovation (NACOSTI) and the County government of Siaya.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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