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Tay et al.

EPIDEMIOLOGICAL SURVEY OF SOIL-TRANSMITTED HELMINTHS IN OCCUPATIONAL RISK GROUPS AND NON SCHOOL GOING CHILDREN IN THE KINTAMPO NORTH DISTRICT OF GHANA

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ABSTRACT
Soil-transmitted helminths (STHs) remain a major health threat to humans especially children throughout the world, mostly in developing nations including Ghana. The present deworming programme by the Ministry of Health is only for children of school-going age; hence occupational risk groups and non-school going children may remain as sources of infection throughout the year. The aim of this study was to conduct a survey on STHs in occupational risk groups and non-school going children in the Kintampo North District of the Brong Ahafo Region of Ghana. Seven hundred and eleven (711) individuals made up of occupational risk groups and non-school going children, between the ages of 1-90 years, were recruited in a cross sectional survey in six (6) rural communities in the Kintampo North District for various STHs. All faecal samples collected were analyzed using the Kato-Katz method which is recognized as the gold standard for the diagnosis of intestinal helminths. A total of 443 (62.3%) individuals were infected with at least one intestinal parasite. Parasites isolated included hookworm, 376/711 (52.9%); Ascaris lumbricoides, 15 (2.1%); Trichuris trichiura, 6 (0.8%); Hymenolepis nana, 38 (5.3%) and Taenia spp., 8 (1.1%). Hookworm prevalence was higher in all the six communities (p<0.05). More males, 180/268 (67.5%) were generally infected than females, 263/443 (59.4%) but the difference however was not statistically significant (p>0.05). Hookworm intensities observed included 362/376 (96.3%) light infections, 10 (2.7%) moderate infections and 4 (1.1%) heavy infections. All the observed cases of Ascaris lumbricoides and Trichuris trichiura were of light intensities. The incidence rate of STH infection declined with age with the highest of 151/225 observed in the 1-10 age group. The highest prevalence of 81.1% (99/122) was however recorded among the 11-20 age group. Overall prevalence of intestinal parasite infection was found to be 62.3%. Hookworm is the predominant STH found among the general populace. The most affected risk groups are the non-school going children. General knowledge on STHs among the community members is low, with poor attitudes and practices towards STH prevention, control and treatment. It is recommended that future MoH de-worming programmes should include non-school going children and occupational risk groups.
INTRODUCTION

Soil Transmitted Helminths (STHs) are among the most common and widespread of human infections (Chan et al., 1994a) and remain a major threat to the health of children throughout the world, mostly in developing nations (Wani et al., 2008). These nematodes are of considerable medical, veterinary and agricultural importance (Chan et al., 1994a). It is estimated that the morbidity attributable to hookworms, Trichuris and Ascaris, the three most prevalent parasitic nematodes in humans globally, could be as high as 39 disability adjusted life years (Chan et al., 1994b). It contributes to poor nutritional status, anaemia and impaired growth (Stephenson et al., 1989). Intestinal parasites remain a major health problem in many developing countries (Simeon et al., 1995). In 1993, soil transmitted helminths were ranked first among intestinal parasites as the main cause of disease burden in children aged between five (5) and fourteen (14) years old (Andrade et al., 2001; Crompton, 2000; Wani et al., 2008).

It is estimated by the World Health Organization (WHO) that more than one billion of the world’s population is chronically infected with soil-transmitted helminths and 200 million are infected with schistosomes (Andrade et al., 2001; Crompton, 2000; Wani et al., 2008). However, it is relatively easy to control the morbidity resulting from soil-transmitted helminthiasis and schistosomiasis with simple intervention measures (Massa et al., 2009).

The populations most vulnerable to infection by STH are toddlers, children of school going age, pregnant women, farmers, fishermen and traders (Brooker et al., 2000; Massa et al., 2009). The infections are reported to decrease capacity to work in adults, fitness and reduce the nutritional status of children causing growth retardation, reduced learning ability and absenteeism from school (Nokes et al., 1992).

A study of helmith coinfection carried out in Brazil suggests that polyparasitism compromises the host in such a way to benefit all parasites involved, allowing higher egg yield for multiple species of worms (Drake and Bundy, 2001; Garner et al., 1967). A study in Cote d’Ivoire showed a significant association between infection with hookworms and S. mansoni, demonstrating an increased likelihood for infection with multiple parasites rather than one (Brooker et al., 2000; Ellis et al., 2007; Massa et al., 2009). Effective control of STH infections depends on improvement in sanitation and living conditions, but implementation is usually hampered by lack of resources and political will (Andrade et al., 2001; Massa et al., 2009; Wani et al., 2008; Zulkifli et al., 1999). In the short term, school based de-worming has been recommended as a highly cost-effective public health measure in less developed countries (Massa et al., 2009). The WHO also recommends a baseline survey in school children to determine the prevalence and intensity of infections (Andrade et al., 2001), and develop effective treatment strategies and case management options (Andrade et al., 2001). In addition, baseline surveys provide basis for development of control programmes at national, regional and district levels (Andrade et al., 2001; Massa et al., 2009; Wani et al., 2008; Zulkifli et al., 1999).

Both the World Bank and WHO promote helminth control programmes in developing countries as a cost effective intervention (Crompton, 2000). Programmes aim to "target mass treatment of children", giving all children in communities where worms are endemic, anthelmintic drugs every three to six months (Crompton, 2000). Treatment regimens depend on local prevalence rates (Crompton, 2000). Although studies have shown that available drugs are effective in decreasing parasite infection rates, it is not clear if these approaches actually improve the growth and cognitive performance of children (Nokes et al., 1992).

Attempts to develop vaccines against these parasites have been hampered by the difficulty to cultivate them in vitro, the complexity of their multi-cellular organization and/or multistage development, added to their impressive antigenic variability (Daryani et al., 2009; Lachaud et al., 2009).
In Ghana regular de-worming of school aged children was started in February, 2006. However, this did not cover children of school going age who were not enrolled in school and other potential risk groups such as farmers, fishermen and pregnant women. These groups of people who form a significant fraction of the population in developing countries who are left out of the de-worming exercise become a potential source of risk for re-infecting the school children who are de-wormed. This study was therefore designed and conducted to evaluate the prevalence and intensity of STH in these neglected risk groups who are not covered in the regular national de-worming and the risk they pose in re-infecting those in the basic schools. Conclusions drawn from this study will help bring out recommendations for effective integrated and sustainable intervention measures in the Kintampo North District of Ghana and the entire country.

SUBJECTS AND METHODS
This study was a prospective cross sectional survey conducted in six rural communities within the Kintampo North District of the Brong Ahafo Region of Ghana. The study was conducted between April 2007 and March 2008. The study was reviewed by the Committee on Human Research Publications and Ethics (CHRPE), School of Medical Sciences, Kwame Nkrumah University of Science and Technology, Kumasi. After obtaining consent, Questionnaires were administered in the local Akan language to collect demographic information, knowledge of the disease, perceptions, attitudes and practices as well as behavior patterns. A total of three hundred and two (302) of the recruited subjects who were above 11 years of age and could clearly and independently provide required information on their knowledge, attitudes and practices (KAP) were made to respond to questionnaires. A thumb-size stool specimen was collected from each individual using the method described by Kato-Katz (Andrade et al., 2001). All faecal samples collected for the study were transported to the laboratory for analysis within one hour using the Kato-Katz method which is recognized as the gold standard for the diagnosis of intestinal helminths. It relies on the identification of parasite ova by light microscopy and intensity of infection determined by quantifying faecal egg excretion (eggs/gram of faeces) (Andrade et al., 2001).

Between 20 and 50mg of stool specimen was first sieved to remove coarse particles such as fibres and placed in a template on a microscope glass slide. The template was then carefully removed leaving a plug of stool on the slide. The stool cast on the slide was then cleared by covering with a cellophane cover slip (25mm x 35mm) that has been impregnated with 50% (v/v) glycerol in water containing 3% malachite green. The slide was turned upside down on a flat surface and pressed gently but firmly to spread the stool specimen evenly under the cellophane and then followed by microscopic examination. Any identified intestinal worm ova were counted and recorded. Intensity of infection was expressed as eggs per gram of stool (epg).

In all seven hundred and eleven (711) stool samples involving 268 from males and 443 from females were collected for analysis. Subjects recruited were placed into eight (8) occupational risk groups; Non school going children, Farmers, Traders, Unemployed, Students, Civil Servants, Artisans, and Businessmen.

Ethical Issues
Ethical clearance was sought from both the Medical School of the KNUST and the Komfo Anokye teaching Hospital ethical committee for ethical consideration and a waiver was given. Verbal consent was sought from compound and household heads before stool samples were collected from the occupational risk groups and the non-school going children.

Data Analysis
All data were coded and entered into a computer using Microsoft Excel, Epi Info and SPSS for WINDOWS (version 15.0; SPSS Inc, Chicago). Descriptive analysis, chi-square and
other statistical tests were applied to collected data over the period of study.

Information provided via questionnaires were analysed using Epi Info and SPSS for WINDOWS (version 15.0; SPSS Inc, Chicago).

RESULTS

Seven hundred and eleven (711) stool samples from six (6) communities in the Kintampo district were analyzed. There were 268 males and 443 females involved in the study. The largest group was the 1-10 age group making 31.6% (225/711) and the least group was the 81-90 year group making 0.4% (3/711). The mean age was 25.2 years, the modal age was 2 years, and the median age was 21 years with a standard deviation of 19.3. The overall age distribution of the sampled population is shown in Figure 1.

![Age Distribution of Sampled Population](image1.png)

Fig.1: Age distribution of sampled population

![Occupational Distribution of Sampled Population](image2.png)

Fig. 2: Occupational distribution of sampled population
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Overall prevalence of intestinal parasites

Out of the 711 samples analysed 443 (62.3%) were infected with intestinal parasites the distribution of which is shown in Figure 3. Overall Hookworm infections were 376/711 (52.9%); Hymenolepis nana, 38 (5.3%); Ascaris lumbricoides, 15 (2.1%); Taenia spp., 8 (1.1%), and Trichuris trichiura, 6 (0.8%) (Figure 3).

The highest prevalence was recorded among the 11-20 age group with 81.1% (99/122) and 1-10 age group with 67.1% (151/225). The lowest prevalence was recorded in the 61-70 age group with 23.3% (7/30) (Table 1).

A higher prevalence of STH infections was recorded in males, 180/268 (67.2%) than in females, 263/443 (59.4%) but this was not statistically significant (p>0.05) (Table 1).

Dawadawa 2 and Grumah Line recorded the highest prevalence of 72.8% (91/125) and 70.5% (91/129) respectively. The lowest prevalence of 37.8% (37/98) was recorded in Suromuase (Table 2).

Students and Non school going children recorded the highest prevalence rate of 72.5% (29/40) and 72.0% (275/198) respectively. Artisans recorded the lowest prevalence of 33.3% (8/24).

Fig. 3: Distribution of STH among the population

Table 1: Overall prevalence of STH by age and sex

<table>
<thead>
<tr>
<th>Age Group</th>
<th>No. tested</th>
<th>No. Infected</th>
<th>% Prevalence</th>
<th>No. tested</th>
<th>No. Infected</th>
<th>% Prevalence</th>
<th>No. tested</th>
<th>No. Infected</th>
<th>% Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 10</td>
<td>111</td>
<td>79</td>
<td>71.2</td>
<td>114</td>
<td>72</td>
<td>63.2</td>
<td>225</td>
<td>151</td>
<td>67.1</td>
</tr>
<tr>
<td>11 - 20</td>
<td>50</td>
<td>45</td>
<td>90.0</td>
<td>72</td>
<td>54</td>
<td>75.0</td>
<td>122</td>
<td>99</td>
<td>81.1</td>
</tr>
<tr>
<td>21 - 30</td>
<td>27</td>
<td>19</td>
<td>70.4</td>
<td>99</td>
<td>57</td>
<td>57.6</td>
<td>126</td>
<td>76</td>
<td>60.3</td>
</tr>
<tr>
<td>31 - 40</td>
<td>28</td>
<td>13</td>
<td>46.4</td>
<td>63</td>
<td>37</td>
<td>58.7</td>
<td>91</td>
<td>50</td>
<td>54.9</td>
</tr>
<tr>
<td>41 - 50</td>
<td>21</td>
<td>10</td>
<td>47.6</td>
<td>36</td>
<td>18</td>
<td>50.0</td>
<td>57</td>
<td>28</td>
<td>49.1</td>
</tr>
<tr>
<td>51 - 60</td>
<td>16</td>
<td>11</td>
<td>68.8</td>
<td>32</td>
<td>16</td>
<td>50.0</td>
<td>48</td>
<td>27</td>
<td>56.3</td>
</tr>
<tr>
<td>61 - 70</td>
<td>9</td>
<td>2</td>
<td>22.2</td>
<td>21</td>
<td>5</td>
<td>23.8</td>
<td>30</td>
<td>7</td>
<td>23.3</td>
</tr>
<tr>
<td>71 - 80</td>
<td>4</td>
<td>0</td>
<td>0.0</td>
<td>5</td>
<td>4</td>
<td>80.0</td>
<td>9</td>
<td>4</td>
<td>44.4</td>
</tr>
<tr>
<td>81 - 90</td>
<td>2</td>
<td>1</td>
<td>50.0</td>
<td>1</td>
<td>0</td>
<td>0.0</td>
<td>3</td>
<td>1</td>
<td>33.3</td>
</tr>
<tr>
<td>Total</td>
<td>268</td>
<td>180</td>
<td>67.2</td>
<td>443</td>
<td>263</td>
<td>59.4</td>
<td>711</td>
<td>443</td>
<td>62.3</td>
</tr>
</tbody>
</table>
Multiple infections were observed in 41 individual samples with most of them between the ages of 1-10 (17/41) and 11-20 (12/41). Majority were non-school going children (23/41). 40/41 (97.6%) were double infections with most of them, 28/41 (68.3%) being hookworm and *Hymenolepis nana* co-infections. Only one triple infection of hookworm, *H. nana* and *Trichuris trichiura* was observed in a non-school going child.

**Distribution and Intensity of STH infections**

Based on WHO (1987) thresholds, infection intensities were classified as light, moderate or heavy for all the three STHs found in faecal samples analyzed.

**Hookworm**

Hookworm had the most predominant prevalence and intensities in all age groups, sex and occupational groups. Out of the 376 stool samples which were positive for hookworm, 362 (50.9%) were of light intensities, 10 (1.4%) were of moderate intensities and 4 (0.6%) were of heavy intensities (Table 2).

The highest prevalence of hookworm infection of 70.0% (84/120) was among the 11-20 year group. In this group 65% (78/120) were of light intensity, 3.3% (4/120) moderate and 1.7% (2/120) heavy. A prevalence of 54.2% (122/225) was observed among the 1-10 year group with 52% (117/225) light, 1.8% (4/225) moderate and 0.4% (1/225) heavy intensities. The lowest of 23.3% (7/30) was recorded among the 61-70 year group with all of them being light intensity.

A higher prevalence was observed in males, 146/268 (54.5%) than in females, 230/443 (51.9%) but this was not statistically significant (p>0.05). Among the males, there were 139 (57.9%) light, 5 (1.9%) moderate and 2 (0.7%) heavy intensity. Females recorded 223 (50.3%) light, 5 (1.1%) moderate and 2 (0.5%) heavy intensity (Table 2).

The highest hookworm prevalence rates were observed among students, 161/275 (58.5%) with 23 (57.5%) light and 1 (2.5%) moderate intensity. Non school going children recorded a prevalence of 24/40 (60.0%) with 153 (55.6%) light, 6 (2.2%) moderate and 2 (0.7%) heavy intensities. The lowest prevalence was observed among Civil servants with 12/38 (31.6%) (Table 2). One (0.5%) farmer and 1 (2.1%) unemployed had heavy intensities.

**Ascaris lumbricoides**

All Ascaris lumbricoides infections recorded were of light intensities, 15/711 (2.1%). The highest prevalence of 11.1% (1/9) was observed among the 71-80 year group. Males recorded a higher prevalence of 2.6% (7/268) than females 1.8% (8/443) but the difference was not statistically significant (p>0.05). The highest prevalence was observed among farmers with 5/194 (2.6%), followed by non school going children and students with 7/275 (2.5%) and 1/40 (2.5%) respectively.

**Table 2: Overall prevalence of STH by community and occupational group**

<table>
<thead>
<tr>
<th>Community</th>
<th>Number sampled</th>
<th>Number positive</th>
<th>% Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dawadawa 2</td>
<td>125</td>
<td>91</td>
<td>72.8</td>
</tr>
<tr>
<td>Grumah Line</td>
<td>129</td>
<td>91</td>
<td>70.5</td>
</tr>
<tr>
<td>Babato</td>
<td>221</td>
<td>147</td>
<td>66.5</td>
</tr>
<tr>
<td>Tahiru Akura</td>
<td>91</td>
<td>53</td>
<td>58.2</td>
</tr>
<tr>
<td>Dawadawa 1</td>
<td>47</td>
<td>24</td>
<td>51.1</td>
</tr>
<tr>
<td>Soromuase</td>
<td>98</td>
<td>37</td>
<td>37.8</td>
</tr>
<tr>
<td>Total</td>
<td>711</td>
<td>443</td>
<td>62.3</td>
</tr>
</tbody>
</table>

Trichuris trichiura
All 6/711 (0.8%) positive cases recorded for Trichuris trichiura were of light intensities. A higher prevalence was observed in males, 4/268 (1.5%) than in females, 2/443 (0.5%) but this was not statistically significant (p>0.05).

DISCUSSION
There is a paucity of high-quality data and availability regarding the incidence, prevalence and intensities of the various soil-transmitted helminths in risk groups and especially non-school going children in Ghana. In this study, subjects were screened to ascertain the distribution, prevalence and intensities of STH infection within the population outside the basic schools who are not part of the National De-worming Programme in the Kintampo North District of the Brong Ahafo Region of Ghana. Data obtained from this study are consistent with a direct effect of lack of sanitation on prevalence and intensity of intestinal helminth infections. The study showed that the occurrence of STH is high among non-school going children and occupational risk groups in the community and therefore requires regular treatment. This also gives an indication that there is a high risk of re-infection to the de-wormed basic school children since they interact with the same environmental conditions.

Results from this study showed that the overall prevalence of STH within the population under study was 62.3% (443/711) which is higher than the 54.7% recorded in similar research done in the Kashmir Valley of Pakistan (Wani et al., 2008). This study has attributed the relatively high prevalence of STHs in the sampled population to poor environmental sanitation and personal hygiene, unavailability of clean, potable water, indiscriminate defecation as well as lack of de-worming programme in the study population.

The high STH level is also attributable to the deplorable economic situations in the area which is consistent with situations as reported in a similar study in Ecuador which attributed high infection level to poverty, poor housing and sanitation, inadequate diet and other environmental factors (Andrade et al., 2001).

This result is also an indication that STH infection is still of public health importance, not only among basic school children but also among all community members in the Kintampo North District. The majority of the infections found in this survey were caused by hookworms (52.9%), followed by H. nana (5.3%), A. lumbricoides (2.1%), Taenia spp. (1.1%) and T. trichiura (0.8%). The high hookworm prevalence recorded is in agreement with high prevalences observed in rural school children in Ecuador, Malaysia and Pakistan (Andrade et al., 2001; Wani et al., 2008; Zulkifli et al., 1999).

Rats and beetles constitute the intermediate hosts for H. nana infection and these organisms are prevalent in maize and rice producing areas (Daryani et al., 2009; Stark et al., 2009). Given that maize and rice are the major crops produced in this district, it is not surprising that H. nana infection is also high in our study area.

Although the Taenia species identified in this study were not identified to the species level, they were likely to be T. saginata and T. solium, since cattle and pig rearing is also a major occupation in this area, making pork and beef readily available for human consumption.

Although the differences in the prevalence of STH infection between males and females was not statistically significant (p>0.005), males were more likely than females to have an STH infection (67.2% of males versus 59.4% of females). This conformed to previous data from Egwuanyenga et al. (2005) which reported males (60.81%) to be generally more infected with STH than females (43.3%).

Males, especially the youth are usually exposed to risk due to activities such as playing football without footwear and eating improperly cooked meat. In these deprived communities it is not uncommon to find young males playing footballs without boots except when it is a recognized league fixture. Since more men are into farming than women they have a greater risk of exposure to infection.
The high prevalence of hookworms among the 1-10 years group (67.1%) and 11-20 years group (81.1%) could be attributed to their more active nature at play especially with bare foot in the open environment. There were also high prevalence among the 21-30 years group (60.5%) and 31-40 years group (54.9%) which may be reflective on the active nature of members of these groups and their direct contact with the soil since most of them are farmers. The fact that filariform larvae positions itself so as to maximize its chances of contacting a new host, which it penetrates after skin contact (Loukas et al., 2001), it is likely to increase infection rate.

The highest prevalence was recorded in non-school going children (42.8%), followed by farmers (25.3%) and traders (12.8%). This conformed to a study undertaken by Nokes et al. (1992) which reported that populations most vulnerable to infection by STH are farmers, fishermen, food vendors and traders (Nokes et al., 1992). In adults infections are reported to decrease capacity to work or fitness due to anaemia, while reducing the nutritional status of children leading to growth retardation and reduced intellectual ability (Nokes et al., 1992). Questionnaire analysis also revealed low levels of knowledge on the causes, signs, symptoms and control of STH infections. This provides a poor premise for people to make efforts in preventing infection and therefore calls for increased intensity of education on STH infections.

CONCLUSION AND RECOMMENDATIONS
The STH prevalence of 62.3% among non-school going children and occupational risk groups in the Kintampo North District of the Brong Ahafo Region of Ghana is high. More than half of the population sampled (i.e. 52.9%) was infected with hookworms with a lower percentage having *T. trichiura* (0.8%) and *A. lumbricoides* (2.1%). This indicates that hookworm is the predominant STH found among the sampled population.

Infection intensity shows that most of the hookworm infections comprised (96.3%) light infection, 2.7% moderate infection and 1.1% heavy infection. All cases of *T. trichiura* and *A. lumbricoides* detected were of light intensities.

The age groups most affected are 11-20 (81.1%) followed by 1-10 (67.1%), 21-30 (60.3%) and 31-40 (54.9%). This implies that children and the young energetic working population are those who mostly harbor these parasites.

The most affected risk groups are the non school going children (42.8%), farmers (25.3%) and traders (12.8%).

Babato recorded the highest prevalence of STH contributing 33% of total prevalence followed by Dawadawa 2 and Grumah Line (both with 20.5%), Tahiru Akura (12.0%), Soronuase (8.4%) and Dawadawa 1 (5.4%)

The general STH knowledge of the community members is low. They have poor attitudes and practices towards STH prevention, control and treatment.

In the Kintampo North District, measures should be put in place to provide adequate private and public toilet facilities. Non-school going children and occupational risk groups should be included in the Ministry of Health de-worming programme. These measures, including health education, will work effectively in achieving reduction in the level of STH infection in the Kintampo North District of the Brong Ahafo Region of Ghana.

REFERENCES


