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# Schistosomiasis and soil-transmitted helminth infections in schoolchildren in north-eastern Democratic Republic of the Congo

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**Background:** There is a paucity of epidemiological data pertaining to schistosomiasis and soil-transmitted helminth (STH) infections in the Democratic Republic of the Congo (DRC).

**Methods:** A cross-sectional survey was carried out in the north-eastern part of DRC enrolling 400 schoolchildren aged 9–14 years. Stool and urine samples were subjected to standard diagnostic methods and examined under a microscope for helminth eggs.

**Results:** Four out of five children were infected with at least one helminth species. *Schistosoma mansoni* was the predominant species (57.8%). Urine examinations were all negative for *S. haematobium*.

**Conclusions:** *S. mansoni* and STH infections are highly endemic in the surveyed part of the DRC, calling for interventions in school-aged children.

**Keywords:** Cross-sectional survey, Democratic Republic of the Congo, Schistosomiasis, Soil-transmitted helminthiasis

## Introduction

The Democratic Republic of the Congo (DRC) is considered a high-burden country for schistosomiasis and soil-transmitted helminthiasis, yet this claim is based on very scattered data.<sup>1–4</sup> We present findings from a cross-sectional survey carried out in nine villages in the Watsa health zone in the north-eastern part of DRC. School-aged children were subjected to standard, quality-controlled diagnostic methods and results were fed into the open-access Global Neglected Tropical Diseases database.<sup>5</sup>

## Materials and methods

The study area is situated in north-eastern DRC in the Watsa health zone in Haut-Uélé province, approximately 190 km north-west of the town of Bunia. A cross-sectional survey was carried out in August 2010, during the rainy season, in primary schools in nine villages around the settlement of Durba (see [Supplementary Figure 1](#)). In each school, a minimum of 30 children aged 9–14 years were randomly selected. In total, 400 children were sampled, comprising 213 boys (53.3%) and 187 girls.

From each child, a fresh morning stool sample and a mid-day, post-exercise urine sample were collected. The samples were processed using standard, quality-controlled methods. For stool samples, a single 41.7 mg Kato-Katz thick smear was prepared on slides and analysed under a microscope.<sup>6</sup> The number of eggs of *Schistosoma mansoni*, *Ascaris lumbricoides*, hookworm, and *Trichuris trichiura* were counted and multiplied by a factor of 24 to obtain an infection intensity measure; i.e., eggs per gram of stool (EPG).<sup>6</sup> Urine samples were examined for *S. haematobium*, using a 10 ml centrifugation method.<sup>7</sup>

Statistical analyses were performed with STATA, version 13 (StataCorp., College Station, TX, USA). Descriptive statistics for frequency, including 95% confidence intervals, were prepared. Geometric mean intensity of helminth infection was used in the analysis. The p-values were calculated using Pearson's  $\chi^2$  test of proportions.

## Ethical approval

The purpose and procedures of the study were explained to village leaders, school teachers, and schoolchildren. Written informed consent was obtained from school directors and

teachers, while children assented orally. At the end of the survey, all children received albendazole (single dose, 400 mg) against soil-transmitted helminthiasis, whilst children with a confirmed *S. mansoni* infection were treated with praziquantel (single dose, 40 mg/kg).

## Results

*S. mansoni* was the predominant helminth species; 231 children were found with egg-positive Kato-Katz thick smears, thus resulting in a prevalence estimate of 57.8% (Table 1). The prevalence increased with age (e.g., children aged 9–10 years had a prevalence of 48.2%, while children in the oldest age group, 13–14 years, had a prevalence of 69.9%;  $p=0.001$ ). No *S. haematobium* eggs were found in urine samples subjected to a filtration method.

Hookworm was the most common soil-transmitted helminth (STH) species (prevalence: 48.5%). Boys had a significantly higher hookworm prevalence than girls (55.4% vs 40.6%,  $p=0.003$ ). *T. trichiura* was found at a relatively low level (5.0%), while no *A. lumbricoides* were found.

Among the *S. mansoni*-infected children, more than half (52.8%) were heavily infected ( $\geq 400$  EPG), whilst an additional 28.6% had a moderate infection intensity (100–399 EPG). For hookworm, most infections were of light intensity with fewer than 2000 EPG (85.1%).

Overall, 140 children (35.0%) were infected with at least two species of intestinal helminths (data not shown). *S. mansoni*-hookworm co-infection affected more than a quarter of the study participants (25.5%). Nine children (2.3%) were found

with a triple species infection (i.e., *S. mansoni*, hookworm and *T. trichiura*).

## Discussion

We found high prevalence and intensity of *S. mansoni* infection among 9- to 14-year-old school-going children (overall prevalence was 57.8%) during a cross-sectional survey conducted in August 2010 in the north-eastern part of DRC. Compared with previous studies, our findings suggest that this part of north-eastern DRC is more highly endemic for *S. mansoni* than expected.<sup>8,9</sup> Discrepancies between modelled and surveyed estimates for *S. mansoni* were also found in highly urbanised settings of DRC.<sup>4,9</sup> Furthermore, we did not find a single *S. haematobium* infection, which is in contrast to previous estimates made by WHO that suggested that between 10 and 50% of children in this province are infected with *S. haematobium*.<sup>9</sup>

The infection prevalence for *T. trichiura* (5.0%) and *A. lumbricoides* (0.0%) were considerably lower than previously modelled rates.<sup>3,10</sup> The hookworm prevalence (48.5% in this study) was found within the range of previous predictions by Karagiannis-Voules et al. who modelled a rate above 50%.<sup>3</sup>

Although DRC is one of three high-burden countries in Africa for helminthiasis and other neglected tropical diseases, the country has yet to set-up a national control programme for neglected tropical diseases.<sup>2,8</sup> The lack thereof was underscored by local health and education authorities reporting that none of the schools had ever received preventive chemotherapy against schistosomiasis and soil-transmitted helminthiasis.

**Table 1.** Prevalence of *Schistosoma mansoni* and soil-transmitted helminth infection in the Durba study area, Democratic Republic of the Congo, 2010

	n	<i>Schistosoma mansoni</i>	Hookworm	<i>Trichuris trichiura</i>	Any helminth
Prevalence of infection, % (95% CI)					
Sex					
Male	213	60.1 (53.5–66.7)	55.4 (48.7–62.1)	6.6 (3.2–9.9)	83.1 (77.4–87.9)
Female	187	55.1 (47.9–62.2)	40.6 (33.5–47.7)	3.2 (0.6–5.8)	78.1 (71.5–83.8)
Age (years)					
9–10	193	48.2 (41.1–55.3)	36.8 (29.9–43.7)	2.1 (0.0–4.1)	72.0 (65.1–78.2)
11–12	114	64.0 (55.1–73.0)	57.0 (47.8–66.2)	7.9 (2.9–12.9)	87.7 (80.3–93.1)
13–14	93	69.9 (60.4–79.4)	62.4 (52.3–72.4)	7.5 (2.1–13.0)	90.3 (82.4–95.5)
Total	400	57.8 (52.9–62.6)	48.5 (43.6–53.4)	5.0 (2.9–7.1)	80.1 (76.5–84.5)
Geometric mean EPG, n (95% CI)					
Total	400	397.8 (327.9–482.6)	456.1 (366.3–567.9)	118.5 (73.4–191.1)	NA
Intensity of infection, % (95% CI)					
Infected, n		231	194	20	NA
Light <sup>a</sup>		18.6 (13.8–24.2)	85.1 (79.2–89.8)	100.0 (83.1–100.0)	NA
Moderate <sup>b</sup>		28.6 (22.8–34.9)	6.2 (3.2–10.6)	0.0 (0.0–0.0)	NA
High <sup>c</sup>		52.8 (46.2–59.4)	8.8 (5.2–13.7)	0.0 (0.0–0.0)	NA

EPG: eggs per gram of stool; NA: not applicable.

<sup>a</sup> Hookworm 1–1999 EPG; *T. trichiura* 1–999 EPG; *S. mansoni* 1–99 EPG.

<sup>b</sup> Hookworm 2000–3999 EPG; *T. trichiura* 1000–9999 EPG; *S. mansoni* 100–399 EPG.

<sup>c</sup> Hookworm  $\geq 4000$  EPG; *T. trichiura*  $\geq 10\ 000$  EPG; *S. mansoni*  $\geq 400$  EPG.

Our study has limitations that are offered for consideration. First, the data presented here were obtained from a cross-sectional survey in selected villages, and hence, cannot be generalised for a wider area as infection with *Schistosoma* spp. and STHs show focal distribution. Second, the true prevalence rates are likely to be higher due to the low sensitivity of single Kato-Katz thick smears.<sup>11</sup>

## Conclusions

Our findings from an undersurveyed area suggest that helminth infections are widespread in north-eastern DRC and that polyparasitism is common. Previous, modelled estimates for the study area did not fully corroborate with our results. The data have been georeferenced and fed into the open-access Global Neglected Tropical Diseases database for subsequent risk profiling, which will help shape spatial targeting of control interventions.<sup>5</sup>

## Supplementary data

Supplementary data are available at Transactions online (<http://trstmh.oxfordjournals.org/>).

**Authors' contributions:** CA, SS, MJD and MSW conceived the study and designed the study protocol; AMK, CA, MO, MJD and MSW carried out the field study; AMK, CA and MSW analysed and interpreted data. AMK and MSW drafted the manuscript; AMK, MJD, JU and MSW critically revised the manuscript for intellectual content. All authors read and approved the final manuscript. AMK and MSW are the guarantors of the paper.

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