Background

Soil transmitted helminthiasis (STH) is one of the most common infestations all over the world. The soil transmitted helminths of major concern to humans are *Ascaris lumbricoides*, *Trichuris trichiura* and hookworms (*Necator americanus*, *Ancylostoma duodenale*).

STH is transmitted through soil contaminated by helminth eggs in areas with poor sanitary condition. Adult worms reside in small intestines of infested humans and lay around 0.2 million eggs every day. These helminth eggs pass through stools of infested humans and contaminate soil in areas with poor sanitary conditions. Non-infested humans acquire the disease faeco-orally through (i) contaminated hands, (ii) improperly washed vegetables, and (iii) contaminated water. Children are easily infested through their contaminated hands after playing with contaminated soil when they do not wash their hands properly.

Symptoms of STH do not commonly manifest when the infestations are mild. However, diarrhoea, abdominal pain, fatigue, weakness, impairment of cognitive development and delayed physical growth etc. are associated with severe infestations. Hookworms are responsible for chronic loss of blood in the intestine, leading to anaemia. These parasites feed on nutrient elements of the host such as blood and tissue fluids and cause loss of iron and proteins. They also impact on the uptake of nutrient elements in the host. In addition, *A. lumbricoides* impairs synthesis of vitamin A in the body of the host. As a result of the lowered appetite and inhibited uptake of nutrient materials, physical growth is impaired with the manifestation of malnutrition.

Control of STH is prioritized in endemic countries, given the high burden of STH among School Attending Children (SAC). WHO recommends that national programmes in each endemic country implement mass drug administration (MDA) using albendazole or mebendazole as a broad-spectrum anti-helminthic for protecting the health of people, keeping the environment clean and reducing STH prevalence. In DPR Korea, MDA campaigns have been conducted twice a year targeting Pre School Attending Children (Pre-SAC) and School Attending Children (SAC) for deworming geo-helminths.

Prevalence of STH varies between countries and areas within a country. It also varies significantly during the survey period within an area. Previous data in DPR Korea showed that children under 14 years of age were affected the most in terms of STH infestations and intensity of *A. lumbricoides* infestations. Against this background, conducting a nationwide STH prevalence survey in DPR Korea was deemed necessary to determine the current epidemiology of STHs in DPR Korea. In this context, the Ministry of Public Health in collaboration with the WHO Country Office conducted a nationwide STH prevalence survey to relook at the STH control strategy in DPR Korea based on new epidemiological evidence generated.

Objective

**General objective**

To determine the prevalence and distribution of STH in DPR Korea with a view to revising the national STH control strategy based on generated local evidence.

**Specific objective**

- To determine the overall prevalence and intensity of STHs (*A. lumbricoides*, *T. trichiura* and *Ancylostoma duodenale*)
- To determine the age specific prevalence and intensity of STHs (*A. lumbricoides*, *T. trichiura* and *Ancylostoma duodenale*)
- To determine the urban and rural area-specific prevalence and intensity of STHs (*A. lumbricoides*, *T. trichiura* and *Ancylostoma duodenale*)
- To apply the results of the survey to revise the national STH control strategies based on generated local evidence

Methodology

This was a nationwide cross sectional prevalence survey. The study population included adults, Pre SAC and SAC. For the prevalence survey, a sample was selected using the multi-stage cluster sampling method. The sample size was estimated to be 10 800. The sample was selected from 36 clusters. Ub in urban areas and Ri in rural areas were considered as Primary Sampling Units (PSU). The cluster size was defined to be 300 and within a cluster, 100 participants each of the three target groups (Adults, SAC and Pre SAC) were randomly selected. To select the sample, first the country was divided into five broad regions. In the second stage 18 cities/counties were selected from the five regions. Within these cities/counties one Ub and one Ri each (36 PSU) was selected. Thus 10 800 participants were selected from 36 PSUs.

Eligible study participants were informed about the purpose of the survey and verbal consent was obtained.

Information was collected from those who consented. They were provided with a labelled container for stool collection the next morning. Household doctors and/or volunteers took the stool specimen to the field laboratory. In the field laboratory, faecal specimens were tested by trained field laboratory technicians on the same day using...
STH prevalence survey in DPR Korea

STH Fact Sheet

Kato-katz test kits. Those who tested positive were provided with anti-helminthic medicine. Study end points were as follows:

1. **Overall STH prevalence (%)** = (number of positive specimens for any STH species/total number of specimens examined) × 100

2. **STH species specific prevalence (%)** = (Number of positive specimens for each STH species/total number of specimens examined) × 100

3. **STH proportion by intensity of infestation (%)** = (number of STH positive specimens by intensity of infestations/ total number of specimens positive for STH) × 100

STH-specific prevalence was calculated for single, double and triple infections.

**Intensity of infestation:** Intensity of individual STH parasites were defined as follows:

<table>
<thead>
<tr>
<th>STH parasite</th>
<th>Mild (epg)</th>
<th>Moderate (epg)</th>
<th>Severe (epg)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Ascaris lumbricoides</em></td>
<td>1–4999</td>
<td>5000–49 999</td>
<td>&gt;50 000</td>
</tr>
<tr>
<td><em>Trichuris trichiura</em></td>
<td>1–999</td>
<td>1000–9999</td>
<td>&gt;10 000</td>
</tr>
<tr>
<td><em>Necator americanus</em> or <em>Ancylostoma duodenale</em></td>
<td>1–1999</td>
<td>2000–3999</td>
<td>&gt;4000</td>
</tr>
</tbody>
</table>

**Estimates of prevalence of STH at the national level**

Overall estimate of STH prevalence was 37.0% (95% CI–36.1%–37.9%). Prevalence of infestation only with *A. lumbricoides* (single infection) was 32.9% (95% CI–32.2%–33.8%). It was significantly higher than the prevalence of infestation with other species (1.6% (95% CI–1.4%–1.8%) for *T. trichiura* and 0% for hookworms) (P<0.05). Since the prevalence of hookworms was zero, the only combination of double infestation was with *A. lumbricoides* and *T. trichiura*. The prevalence of double infection (*A. lumbricoides*, *T. trichiura*) was 2.5% (95% CI–2.2%–2.8%) and the study did not find triple infections.

Fig. 1 and 2 show results of STH prevalence survey

**Prevalence and intensity of *A. lumbricoides* by target age groups**

Overall prevalence of *A. lumbricoides* was 35.4% (95% CI–33.9%–36.9%). Prevalence of *A. lumbricoides* among the adult population was 41.0% (95% CI–39.4%–42.6%), which was significantly higher than that among SACs and Pre-SACs (P<0.05). The distribution of STH by intensity of infestations caused by *A. lumbricoides* according to different age groups is summarized in Fig 6 and 7.

The proportion of light-intensity infestations was 67.4% (95% CI–66.5%–68.3%). This estimate was significantly higher than the estimate of moderate and heavy-intensity infestations (32.6% (95% CI–33.5%–31.6%) and 0%, respectively) (P<0.05). The proportion of light-intensity infestations among SACs and Pre-SACs was 84.7% (95% CI–83.5%–85.9%) and 89.4% (95% CI–88.3%–90.4%), respectively. These estimates were significantly higher than that among the adult population (36.0%–95% CI–34.4%–
37.6%) (P<0.05). However, as far as moderate-intensity infestations are concerned, the proportion among adult population (64.0%–95% CI=62.4%–65.6%) was higher than that among the SAC and Pre-SAC groups [15.3% (95% CI=14.1%–16.5%) and 10.6% (95% CI=9.5%–11.6%), respectively]. This was statistically significant (P<0.05).

**Fig 3:** Prevalence of STH by target groups

**Fig 4:** Prevalence of STH by geographical areas

**Fig 5:** Prevalence of STH by geographical regions of the country

**Fig 6:** Prevalence of *A. lumbricoides* by different target groups

**Fig 7:** Distribution of STH due to *A. lumbricoides* in target groups by intensity of infestation
Prevalence of *A. lumbricoides* among population living in rural areas was 57.0% (95% CI–55.7%–58.3%). This was significantly higher than that among those living in urban sites (32.7%–95% CI–31.4%–34%) (P<0.05). The distribution of light-intensity STH infestations among those who live in urban areas (69.8%–95% CI–68.5%–71%) was significantly higher than among those who live in rural areas (65.3%–95% CI–64%–66.6%) (P<0.05).

Conversely, the proportion of moderate-intensity infections was higher in those who live in rural sites (34.7%–95% CI–33.4%–35.9%) than those who live in urban areas (30.2%–95% CI–28.9%–31.4%) (P<0.05). In all areas, the proportion of light-intensity infestations was significantly higher than that of moderate- and heavy-intensity infestations.

**Conclusion**

1. The overall estimate of STH prevalence in DPR Korea was estimated to be 37.0%. Single infestations were the most common infestations (*A. lumbricoides*–32.9%; *T. trichiura*–1.6%). Interestingly, there were no infestations by hookworms. Double infestations were less common (*A. lumbricoides+T. trichiura*–2.5%) while there were no triple infections.

2. STH infection is more common among adults than among pre-SACs and SACs target groups. The severe intensity infestations were also seen within the same target group. Prevalence of STH was higher in the rural areas than in urban areas.

3. There was regional variation in the prevalence of STH infestations. Overall STH prevalence and prevalence of STH caused by *A. lumbricoides* was the highest in the central region (41.9% and 40.0%, respectively) and the lowest in the northern region (33.5% and 32.1%, respectively). The geographical variation in the prevalence of *T. trichiura* infestation ranged from 5.3% in the southern region to 3.1% in the Eastern region.