SOIL-TRANSMITTED HELMINTHS IN RELATION TO HEMOGLOBIN STATUS AMONG SCHOOL CHILDREN OF THE KASHMIR VALLEY

Showkat Ahmad Wani, Fayaz Ahmad*, Showkat A. Zargar†, Zubair Ahmad Dar‡, Parvaiz Ahmad Dar‡, Hidayatullah Tak*, and Bashir Ahmad Fomda†

Department of Gastroenterology, SK Institute of Medical Science, Soura Srinagar, India 190 011. e-mail: showkatLaish@yahoo.co.in

ABSTRACT: Soil-transmitted helminths (STHs) remain a major threat to the health of children throughout the world, but mostly in developing nations. The aim of the present study was to determine any relationship between STHs and hemoglobin status in school children of Kashmir Valley (India). Stool and blood samples were collected from 382 male and female school children in the age group of 5–15 yr from all 6 school districts of the Kashmir Valley. Finger-prick blood samples were used to collect the hemoglobin, which was then measured on-site by Sahli’s acid hematin method; stool samples were processed using both simple smear and zinc sulphate concentration methods. Of the 382 children surveyed, 299 (78.27%) were infected with *Ascaris lumbricoides*, *Trichuris trichiura*, or both. Children infected by STHs were found to have lower mean values of hemoglobin than uninfected children. The present study reveals that STHs are abundant among school children of Kashmir Valley, creating a negative effect on the hemoglobin values and indicating the necessity of implementing control measures.

Soil-transmitted helminths (STHs) continue to be a major public health burden throughout many countries of the world, but especially where both sanitation and hygiene are poor and access to anthelmintics is limited (Savioli et al., 2002). Among the effects associated with these parasites are growth retardation, intestinal obstruction, hepatic and biliary diseases, impaired cognitive development, and nutritional difficulties, such as iron deficiency anemia (Ramdath et al., 1995; Awasthi et al., 2003). Among the parasitic infections within the Indian subcontinent, helmint problems are the most common. According to WHO (1981), the level of helmint infection can be viewed as an index of a community’s progress toward a desirable level of sanitation. Although several studies have been carried out on the prevalence of STH infections in children of the Kashmir Valley (Khuroo, 1996; Ahmad et al., 2002; Wani, 2007), the impact of these helmints on hemoglobin levels has not been ascertained. Therefore, the present study was undertaken to determine the relationship between STHs and hemoglobin (Hb) status among school children.

**MATERIAL AND METHODS**

The Kashmir Valley, situated at an altitude of approximately 2,000 m, constitutes the major portion of the Jammu and Kashmir States, India, and includes the school districts of Annantnag, Baramulla, Budgam, Kupwara, Pulwama, and Srinagar, with about 26 Tehsils and 33 towns (Gupta, 2005). The study was carried out between May 2006 and November 2006 in all 6 districts. Official meetings with the personnel from health services, city councils, and schools, as well as parents and school children from the study sites, were conducted to explain the protocol of the study. In total, 382 children, including 219 males and 163 females between the ages of 5 and 15 yr (IX ± SD = 9.2 ± 2.3) participated in the study (these children had no apparent disabilities and were not receiving drug therapy for parasitic infections). Written consents were required from both parents in order for the children to participate. Children requiring medical assistance were properly treated or referred for medical attention. The children’s ages were obtained through school records.

Finger-prick blood was analyzed for Hb on-site using Sahli’s Acid Hematin method (Rai et al., 2004). In addition, 5 g of fresh morning stool samples were collected in nylon containers containing 10 ml of 10% formaldehyde. The containers were labeled and immediately transported to the parasitology laboratory, Department of Zoology, University of Kashmir, for further processing. The stool specimens were examined using direct smear and zinc sulphate concentration techniques. A computer program (SPSS v.10.05 for Windows) was used for data analysis. The descriptive data were given as a mean ± standard deviation (SD). Student’s t-test was used for the analytic assessment. The differences were considered to be significant when the P-value obtained was less than 0.05. Following the WHO ethical guidelines of “no survey without service,” all children enrolled in the survey received 1 tablet of 400 mg albendazole as a treatment protocol for STHs.

**RESULTS**

Among 382 children subjected to stool examination, data revealed that 299 (78.27%) were infected with *Ascaris lumbricoides*, *Trichuris trichiura*, or both. Single and mixed infections were observed in almost equal proportions. Thus, 149 (39.0%) children were infected by a single species of helminth. *Ascaris lumbricoides* was found in 91 (23.82%) and *T. trichiura* in 58 (15.18%) children. Mixed infections were observed in 150 (39.26%) children.

As shown in Table I, infected children had significantly lower values of hemoglobin than uninfected children (P < 0.05). It was also observed that children infected with *T. trichiura* had lower hemoglobin values than children infected by *A. lumbricoides* (P < 0.05).

**DISCUSSION**

Results of the present study indicate a prevalence of 78.27% (299 positive cases among the total of 382 children screened). When compared with other parts of the world, the data show that Kashmir Valley is a highly endemic region for intestinal helminthiasis. For example, studies conducted on the frequency distribution of gastrointestinal helminths by Bundy et al. (1988) showed a high overall prevalence of 62% of helminth infections among the urban slum children of Malaysia, while Rodriguez et al. (2000) reported a high prevalence of 72% among the school children studying in a public institution in Maracaibo, Venezuela. Legesse and Erko (2004) noted the high prevalence of 88.2% among the school children in rural Ethiopia, while Kabatereine et al. (2001) reported an overall prevalence of 56% among the school children of southern Uganda. The high prevalence of STH infections is undoubtedly a consequence of a low standard of living, poor sanitation, lack of personal hy-
giene, traditional methods of agriculture, indiscriminate defection, use of night soil as fertilizers, and other occupational hazards. Similar factors have also been found responsible for high prevalence of infection by Okyay et al. (2004) and Ulu-kanligil and Seyrek (2003).

In the present study, STH infection and Hb concentration was correlated, with infected children possessing lower mean Hb than uninfected children. It was also observed that children with multiple infections had much lower Hb levels than those with single species infections. The reasons for latter difference are many. For example, because of poverty, children are already at the risk of having low Hb, and, when infected by intestinal helminths, the condition is aggravated. The present results are supported by Persson et al. (2000) and Gabrielli et al. (2005), who showed that cases of iron deficiency anemia were significantly greater among children with helminth infections. Chakma et al. (2000) demonstrated that continued presence of worms in marginally nourished children could contribute significantly to blood loss in the intestine, with resultant anemia.

In the present study it was observed that *T. trichiura*–infected children had comparatively lower levels of hemoglobin than children infected with *A. lumbricoides*. Adult *T. trichiura* causes the loss of approximately 0.005 ml/day/worm of blood from the colon, leading to anemia in already malnourished children (Annanthakrishnan et al., 1997). Wanachiwawin et al. (2005) suggested that intensity of *T. trichiura* infection with worms producing the equivalent of 500 EPG or greater may also be associated with intestinal bleeding, leading to anemia. Baigi (1963) reported a microcyte hypochromic anemia in *T. trichiura* infection. Layresse et al. (1967) measured blood loss using 15 Cr-tagged red cells in heavily infected children. They reported a loss ranging from 0.8 to 8.6 ml/day and concluded that infections of more than 800 parasites can induce anemia in children.

Based on the majority of studies, it is clear that helminth infections associated with low nutritional conditions lead to anemia in children. Light infection by *A. lumbricoides* and *T. trichiura* does not produce a harmful effect, while moderate to heavy infections certainly lead to anemia and other nutritional problems (Annanthakrishnan et al., 1997). The range of Hb concentration in infected children in the present study was between 6.8 and 14 g/dl, indicating that some children in the uninfected group were also anemic. Endemic malnutrition is the reason for this low Hb, and when STHs are present, the condition is exacerbated.

The present study reveals that STHs are abundant among school children of Kashmir Valley and have a negative impact on the hemoglobin concentration. This situation strongly calls for the institution of control measures, including treatment of infected individuals, improvement of sanitation practices, and provision of clean water. The impact of each measure would be maximized through a health education program directed at school children, and their mothers in particular, and to communities in general.

**ACKNOWLEDGMENT**

We are indebted to all the children, and their parents and teachers for their wholehearted cooperation.

**LITERATURE CITED**


---

**TABLE I. Mean hemoglobin values (g dl⁻¹) in infected and uninfected children.**

<table>
<thead>
<tr>
<th>Type</th>
<th>Mean ± SD</th>
<th>Range</th>
<th>95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infected</td>
<td>10.54 ± 1.5</td>
<td>5.6–14.5</td>
<td>10.37–10.71</td>
<td>0.02</td>
</tr>
<tr>
<td>Not infected</td>
<td>11.92 ± 1.35</td>
<td>6.8–14.0</td>
<td>11.62–12.21</td>
<td>0.01</td>
</tr>
<tr>
<td>Single-species infection</td>
<td>10.81 ± 1.50</td>
<td>5.6–14.5</td>
<td>10.5–11.0</td>
<td>0.01</td>
</tr>
<tr>
<td>Multiple-species infection</td>
<td>10.27 ± 1.3</td>
<td>5.6–13.0</td>
<td>10.04–10.49</td>
<td>0.05</td>
</tr>
<tr>
<td>Infection by <em>A. lumbricoides</em></td>
<td>11.27 ± 1.24</td>
<td>8.5–14.5</td>
<td>11.0–11.5</td>
<td>0.05</td>
</tr>
<tr>
<td>Infection by <em>T. trichiura</em></td>
<td>10.17 ± 1.7</td>
<td>5.6–13.5</td>
<td>9.7–10.6</td>
<td>0.05</td>
</tr>
</tbody>
</table>


