


Zero Prevalence of Soil-Transmitted Helminth Infections among Students with Disabilities and Symptoms of Attention-Deficit/Hyperactivity Disorder in Bengkulu City, Indonesia

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ABSTRACT

Introduction: Soil-transmitted helminth (STH) infections remain a significant public health concern in Indonesia, particularly among children living in suboptimal sanitation environments. Children with disabilities, especially those exhibiting symptoms of Attention-Deficit/Hyperactivity Disorder (ADHD), are theoretically considered more vulnerable to STH infection because of behavioral factors that may interfere with personal hygiene. However, epidemiological data on STH infections in this population in Bengkulu City are limited.

Methods: This descriptive cross-sectional study was conducted among students with disabilities enrolled in special schools (Sekolah Luar Biasa) in Bengkulu. A total of 70 students were selected using proportional stratified random sampling method. ADHD symptoms were assessed using the Indonesian Hyperactive Child Behavior Assessment Scale (SPPAHI), which was completed by parents or guardians. Stool samples were collected and examined for STH infections using the Kato-Katz technique.

Results: All 70 stool samples examined were negative for STH infection, indicating a prevalence of zero. Based on the SPPAHI assessment, 56 students (80.0%) were identified as having ADHD symptoms, while 14 students (20.0%) were classified as suspected ADHD.

Conclusion: No STH infection was detected among students with disabilities or ADHD symptoms in special schools in Bengkulu City. This zero prevalence may be associated with enhanced parental supervision, limited exposure to high-risk environments, and the effectiveness of the national mass drug administration deworming program in the country.

Disability, ADHD, Children, Soil-Transmitted Helminths, Special Education, Parasitic Infection.

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INTRODUCTION

Soil-transmitted helminth (STH) infections remain a major public health problem worldwide, particularly in low- and middle-income countries (LMICs). According to the World Health Organization, an estimated 267 million preschool-aged children and 568 million school-aged children are at risk of STH infection globally [1]. These infections are closely associated with inadequate sanitation, poor hygiene practices, and limited access to clean water, disproportionately affecting the vulnerable population. In Indonesia, intestinal helminth infections remain endemic, with reported prevalence ranging from 20% to 86% and an average prevalence of

approximately 30%, especially among communities with low socioeconomic status and suboptimal environmental sanitation [2,3].

Children with disabilities represent a particularly vulnerable group for STH infection due to functional limitations that may impair personal hygiene, self-care abilities, and comprehension of healthy behaviors [4-6]. Data from the 2018 Indonesian Basic Health Research indicate that Bengkulu Province has approximately 4,474 children aged 5–17 years with disabilities [7]. International studies have demonstrated a substantial burden of helminth infections among individuals with disabilities, with notable prevalence reported in countries such as Canada, the Philippines and Ethiopia [4]. Furthermore, studies conducted among disabled children have reported higher STH prevalence compared to their non-disabled peers, including 31% among Nigerian children with chronic neurological disorders and 20.19% among mentally disabled students in Ethiopia [8,9]. The risk may be further exacerbated in children exhibiting symptoms of Attention-Deficit/Hyperactivity Disorder (ADHD), a neurodevelopmental condition characterized by inattention, impulsivity, and hyperactivity [10]. These behavioral characteristics may hinder adherence to clean and healthy lifestyle practices, potentially increasing the susceptibility to parasitic infections. In the United States, the prevalence of diagnosed ADHD among children and adolescents aged 4–17 years was reported to be 10.2% in 2015–2016, highlighting the global significance of this condition [11].

Bengkulu City, the capital of Bengkulu Province, is a tropical coastal area with warm temperatures and high humidity, environmental conditions that are favorable for the survival and transmission of STH eggs and larvae [12,13]. Despite these risk factors, data on STH infection among students with disabilities and ADHD symptoms in Indonesia remain scarce. Therefore, this study aimed to describe the prevalence of STH infection among students with disabilities presenting symptoms of inattention and hyperactivity attending special needs schools (Sekolah Luar Biasa/SLB) in Bengkulu City.

METHOD

This study was designed as a school-based descriptive cross-sectional survey conducted between February and March 2023 in Bengkulu City, Indonesia. The study was performed in five registered Special Needs Schools (Sekolah Luar Biasa/SLB), which provide formal education for children with various physical, intellectual, and developmental disabilities in Indonesia. Bengkulu City is a tropical coastal area characterized by high humidity and warm temperatures, environmental conditions that may facilitate the transmission of soil-borne helminths (STH). The study population comprised all students with disabilities enrolled in the five SLBs in the 2023 academic year. The sample size was determined based on feasibility and school enrollment data. A total of 70 participants were selected using proportional stratified random sampling to ensure a balanced representation across schools.

Eligible participants met the following inclusion criteria: (1) age 5 - 18 years; (2) registered as active students in participating SLBs; (3) body mass index (BMI) >17.0; (4) written informed consent provided by parents or legal guardians; and (5) a score ≥ 12 on the Indonesian Hyperactive Child Behavior Rating Scale (SPPAHI), indicating suspected Attention-Deficit/Hyperactivity Disorder (ADHD) symptoms. Students were excluded if they had received anti-helminthic therapy within the previous six months to avoid misclassification of their infection status. Data collection consisted of behavioral assessments and parasitological examinations. ADHD symptoms were assessed using the validated Indonesian Hyperactive Child Behavior Rating Scale (Skala Penilaian Perilaku Anak Hiperaktif Indonesia/SPPAHI), which was administered through structured interviews with parents or guardians. The instrument contains 35 items scored on a 4-point Likert scale (0 = never to 3 = very often), with total scores ranging from 0–105.

For parasitological assessment, each participant was provided with a sterile pre-labeled stool container and standardized written instructions. Parents were instructed to collect approximately 5–10 g of fresh morning stool and return the specimen within four hours of collection. The samples were transported in sealed containers to the laboratory for immediate processing. The primary outcome was the presence of STH infection, defined as the microscopic detection of eggs of *Ascaris lumbricoides*, *Trichuris trichiura*, *Necator americanus*, or *Ancylostoma duodenale*. Stool specimens were examined using the Kato–Katz thick smear

technique, which is recommended by the World Health Organization for STH diagnosis in epidemiological surveys. Two slides were prepared for each sample to enhance the diagnostic sensitivity. Microscopic examination was performed at 100× and 400× magnification by a trained laboratory analyst blinded to the participants’ behavioral data.

Ethical approval was obtained from the Research Ethics Committee of the Faculty of Medicine and Health Sciences, University of Bengkulu (No. 64/UN30.14.9/LT/2023). Written informed consent was obtained from the parents or legal guardians prior to participation. All collected data were anonymized and handled confidentially, in accordance with ethical research standards. The data were entered into a secure electronic database and analyzed using descriptive statistical methods. Categorical variables were summarized using frequencies and percentages. Inferential analyses were not conducted due to the absence of positive STH cases. All findings are presented in tabular format.

RESULTS

A total of 70 students with disabilities from five Special Needs Schools (Sekolah Luar Biasa/SLB) in Bengkulu City were included in this study. Most participants were aged 11–18 years (n = 46; 65.7%), while 24 students (34.3%) were aged 5–10. Male students predominated (n = 44; 62.9%), whereas female students accounted for 37.1% (n = 26) of the sample. Regarding parental characteristics, most fathers were employed (n = 61; 87.1%), while most mothers were homemakers or not employed outside the home (n = 52; 74.3%). Higher educational attainment was reported by 67.1% of fathers and 65.7% of mothers. Detailed demographic and parental characteristics are summarized in Table 1.”

Table 1. Demographic and Parental Characteristics (n = 70)

Variable	n (%)
Age 5–10 years	24 (34.3)
Age 11–18 years	46 (65.7)
Male	44 (62.9)
Female	26 (37.1)
Father working	61 (87.1)
Mother working	18 (25.7)
Father higher education	47 (67.1)
Mother higher education	46 (65.7)

Based on assessment using the Indonesian Hyperactive Child Behavior Rating Scale (SPPAHI), 56 students (80.0%) were classified as having symptoms consistent with Attention-Deficit/Hyperactivity Disorder (ADHD), while 14 students (20.0%) were suspected of having ADHD. Frequently reported behavioral manifestations included difficulty in maintaining attention, inability to remain still, and easy distractibility when given instructions. The distribution of ADHD symptoms is presented in Table 2.”

Table 2. Distribution of ADHD Symptoms Based on SPPAHI (n = 70)

Classification	n	%
ADHD Symptoms	56	80.0
Suspected ADHD	14	20.0

All 70 stool specimens were examined using the Kato–Katz technique. No Soil-Transmitted Helminth (STH) infections were detected, resulting in an overall prevalence of 0%. None of the samples contained eggs of *Ascaris lumbricoides*, *Trichuris trichiura*, or hookworms. The infection status is shown in Table 3.”

Table 3. Prevalence of Soil-Transmitted Helminth Infection (n = 70)

Infection Status	n	%
Positive	0	0
Negative	70	100

Overall, hygiene-related behaviors among the participants were favorable. Regular trimming of fingernails and toenails was reported by 67 students (95.7%), while 65 students (92.9%) reported washing their hands with soap after defecation. Handwashing with soap before eating was practiced by 60 students (85.7%), and 61 students (87.1%) consistently wore shoes during outdoor activities. Nevertheless, certain risk behaviors have been identified. Seventeen students (24.3%) reported habitual finger-biting or placing objects in their mouths, and 11 students (15.7%) reported consuming raw vegetables. Detailed behavioral characteristics are presented in Table 4.”

Table 4. Hygiene-Related Behavioral Characteristics (n = 70)

Behavior	Yes n (%)	No n (%)
Eating Raw Vegetables	11 (15.7)	59 (84.3)
Nail or Object Biting	17 (24.3)	53 (75.7)
Regular Nail Trimming	67 (95.7)	3 (4.3)
Handwashing Before Eating	60 (85.7)	10 (14.3)
Handwashing After Defecation	65 (92.9)	5 (7.1)
Wearing Footwear Outdoors	61 (87.1)	9 (12.9)

DISCUSSION

This study identified a zero prevalence of soil-transmitted helminth infection among students with disabilities and ADHD symptoms attending special needs schools in Bengkulu City, a finding that contrasts with previously reported prevalence rates in similarly vulnerable populations. Previous studies conducted in other countries have reported STH prevalence ranging from 7% to 13% among individuals with disabilities [4], with even higher rates (20.19 %) observed in Ethiopia [9]. Even within Indonesia, a study conducted in Bantul Regency, Yogyakarta, reported a 1.5% prevalence of intestinal helminth infections among children with disabilities [14]. The absence of STH infections observed in the present study represents a notable divergence from earlier epidemiological findings.

Assessment using the SPPAHI questionnaire revealed that the most frequently reported ADHD-related behaviors included difficulty in sustaining attention, inability to remain still, and easy distractibility. These behaviors correspond to the core symptom domains of ADHD—namely, inattention, hyperactivity, and impulsivity—as defined in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) [16]. Such behavioral characteristics may theoretically increase the risk of parasitic infection by impairing adherence to personal hygiene [17,18]. In this study, students with intellectual disabilities exhibited the highest proportion of ADHD symptoms, consistent with previous evidence indicating that hyperactive and impulsive behaviors are common in this population [19,20]. Despite this theoretical vulnerability, no STH infection was identified. Several factors may explain these unexpected findings. First, the hygiene-related behaviors of the participants were generally favorable. Most students regularly trimmed their nails, washed their hands with soap before eating and after defecation, and wore shoes during outdoor activities. These practices are well recognized as key preventive measures against STH transmission, which primarily occurs through contact with contaminated soil or the ingestion of infective eggs [21]. Second, children with disabilities often receive increased supervision from their parents or caregivers [22]. Many parents reported restricting outdoor activities and closely monitoring their daily routines. For children with physical disabilities, limited mobility further reduces exposure to soil, which is a critical component in the transmission cycle of STH [23]. Additionally, dependence on caregivers for daily activities may contribute to better personal hygiene [24].

Third, the national Mass Drug Administration (MDA) program for deworming in Indonesia may have played a role in reducing community-level transmission. According to the Ministry of Health Regulation No. 15 of 2017, preventive chemotherapy is implemented in areas with moderate to high STH prevalence, targeting children aged 1–12 years. In Bengkulu City, routine administration of albendazole was reported in several schools. Even in schools without consistent implementation, the broader impact of MDA at the community level may have contributed to the observed lack of infection. Some studies have suggested that children with ADHD may have altered immune function, potentially increasing their susceptibility to infectious diseases [25]. The findings of the present study indicate that environmental and behavioral protective factors may

outweigh individual biological vulnerabilities. Adequate hygiene practices, parental supervision, limited exposure to contaminated environments, and public health interventions appear to collectively mitigate the risk of STH infections in this population.

This study has several limitations. First, the cross-sectional design captured the infection status at a single point in time and did not account for seasonal variation. Second, although the Kato–Katz method is recommended by the World Health Organization, it may fail to detect very light infections, potentially leading to an underestimation of prevalence. Third, hygiene behaviors were reported by parents or guardians and may be subject to response bias. Finally, the relatively small sample size limits the generalizability of these findings to other regions and populations.

CONCLUSION

This study demonstrated a zero prevalence of Soil-Transmitted Helminth (STH) infection among students with disabilities and symptoms of Attention-Deficit/Hyperactivity Disorder (ADHD) attending special needs schools in Bengkulu City. Despite the theoretical vulnerability related to behavioral and functional limitations, no infections were detected, likely reflecting the protective effects of adequate personal hygiene practices, close parental supervision, limited environmental exposure, and sustained deworming programs. These findings indicate that effective environmental and public health interventions can substantially reduce STH transmission among vulnerable child populations. However, continued surveillance, hygiene education, and targeted support for children with behavioral challenges are essential to maintain favorable outcomes.

DECLARATIONS

Ethical approval for this study was obtained from the Research Ethics Committee of the Faculty of Medicine and Health Sciences, University of Bengkulu (No. 64/UN30.14.9/LT/2023). Written informed consent was obtained from all parents or legal guardians prior to their participation. All data were anonymized and handled confidentially, in accordance with ethical research standards.

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All authors have reviewed and approved the final version of the manuscript and agreed to its publication in the Journal of Society Medicine.

AUTHORS' CONTRIBUTIONS

L.F.V.G. contributed to the conception and design of the study, supervised data collection and laboratory analysis, interpreted the data, and critically reviewed the manuscript. R.N.H.M. contributed to data acquisition, laboratory examinations, data analysis, and drafting the initial manuscript. A.S. contributed to the study design, particularly in the assessment of ADHD symptoms, and assisted in the behavioral data interpretation. D.T. contributed to data collection and laboratory analysis and assisted with manuscript preparation. D.N. contributed to the statistical analysis, data interpretation, and critical revision of the manuscript. All authors have reviewed and approved the final manuscript and agree to be accountable for all aspects of the work.

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