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## Research Article

# Evaluation of Albendazole and Ivermectin Against Soil-Transmitted Helminthiasis among Primary School Children in Jalingo Local Government Area, Taraba State, Nigeria

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## ABSTRACT

This study assessed soil-transmitted helminthiasis in relation to the socio-demographic, sanitation, and hygiene of primary school pupils in Jalingo LGA, Taraba State, Nigeria. A total of 395 stool samples were collected from the subjects. Stool samples were analyzed using the Kato-Katz technique. Chi-square ( $\chi^2$ ) test was used to determine the association between the infection and the variables at  $p \leq 0.05$ . The infection was 19.7% (78). Knowledge on transmission pattern was significant with 19.4% (61) ( $\chi^2 = 9.44$ ;  $p = 0.03$ ). Children who knew about helminths significantly were 21.5% (44) ( $\chi^2 = 10.43$ ;  $p = 0.05$ ). Those who were taught to wash hands, and used toilets in schools were 21.8% (68) ( $\chi^2 = 10.50$ ;  $p = 0.05$ ). Children who walked barefoot were 22.0% (34) ( $\chi^2 = 9.28$ ;  $p = 0.02$ ). Children pre-treated with Albendazole were 19.0%, and were at 2.0% at post-treatment, with a cure rate of 89.5%. With Ivermectin, the pre-treatment infection rate was 20.8%, and the post-treatment rate was 2.0%, with a cure rate of 90.2%. The mean egg count reduced from 5.94 eggs per gram (EPG) before treatment to 1.09 EPG after treatment with albendazole. It had an egg reduction rate (ERR) of 81.7%. Ivermectin reduced the mean egg count from 5.85 EPG at pre-treatment to 0.73 EPG at post-treatment, with an ERR of 87.0%. Soil-transmitted helminthiasis remains among pupils in Jalingo Local Government Area, Taraba State, Nigeria. Albendazole had a good cure rate, as did Ivermectin, with better egg reduction rates. There is a necessity to use Ivermectin in control efforts against soil-transmitted helminthiasis in endemic areas.

**Keywords:** Albendazole; Ivermectin; Jalingo; Primary School; Soil-transmitted helminthiasis; Taraba State

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## INTRODUCTION

Soil-transmitted helminths (STHs), are the intestinal parasitic worms such as *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms (*Necator americanus* and *Ancylostoma duodenale*) responsible for global health burden (Udofia *et al.*, 2024). They affect approximately 1.5 billion people, particularly in tropical and subtropical regions with poor sanitation (World Health Organization, 2020). The region with the highest prevalence of soil-transmitted helminths

are sub-Saharan Africa, China, South America and Asia (Akinsaya *et al.*, 2022).

Soil Transmitted Helminthiasis (STHs) are primarily transmitted through the faeces of infected individuals, which contain eggs or larvae. Adult worms living in the gut of an infected person can produce large quantities of eggs daily, leading to contamination of the environment and vegetables or fruit sources that lack proper sanitation. The tropical and sub-tropical climates in certain regions are suitable for the survival of STH eggs and larvae, as

they require warm temperatures and moist soil (Salam *et al.*, 2020). The eggs can be ingested by children who play with contaminated soil and thereafter put their hands into their mouths without proper handwashing and trimming of nails (Akwa *et al.*, 2021). Open defaecation and walking barefooted are also among the risk factors among children. Infections with STHs have profound implications, affecting the nutritional well-being, physical growth, and overall health of children. These infections bring about a range of issues such as gut blood loss, impaired nutrient absorption, diminished appetite, and anaemia, all of which contribute to hindered cognitive development (Daniel *et al.*, 2021). Furthermore, the impact of STH infections on cognitive performance and learning abilities cannot be underestimated. Various studies have shed light on the adverse effects of these infections on children's health, manifesting as stunted growth, anaemia, malnutrition, and decreased school attendance (Garrison *et al.*, 2021), and involve a loss of disability-adjusted life-years in affected children. In Nigeria, Amarachukwu *et al.* (2021) reported that the prevalence of STHs in Anambra state varies widely, with 42.0% prevalence in Omogho and Awa communities. This study provides current baseline data on the prevalence and distribution of soil-transmitted helminthiasis in relation to the socio-demographic, sanitation, and hygiene of the primary school pupils in Jalingo Local Government Area, Taraba State, Nigeria.

## **MATERIALS AND METHODS**

### **Study Area**

This study was carried out in Jalingo LGA, the capital city of Taraba State, Nigeria. Its geographical position is located between latitude 8°47'00" to 9°01'00"N and longitude 11°09'00" to 11°30'00"E. It is bounded to the north by Lau LGA, to the East by Yorro LGA, and to the south and west by Ardo-Kola LGA. It has a total land area of about 195 km<sup>2</sup>. Jalingo LGA has a population of 139,845 people according to the 2006 population census (National Population Commission (NPC) 2006). The study was carried out in four primary schools namely NTA area, Sabongari, Jauro Isa, and Jauro Lavo.

### **Ethical Consideration**

Ethical approval for this study was obtained from the Ethics Committee of Taraba State Ministry of Health (TRS/MOH/DPH/NTDCP/VOL/001). The headteacher and teachers of each school were contacted and informed of the purpose of the study. Written informed consent was obtained from the parents or

guardians of the children. All information obtained from the participants were treated with confidentiality and anonymity of their response.

### **Sample Size Determination**

The sample size for this study is determined using the Cochran's formula as follows:

$$n = \frac{z^2 x p(1 - p)}{e^2}$$

Where:

n= initial sample size

Z = 1.96 for 95% confidence level

p = estimated proportion of the population with the attribute of 50.0%.

e = margin of error (usually 0.05 for 5%)

$$n = \frac{1.96^2 \times 0.5(1 - 0.5)}{0.05^2}$$

$$n = \frac{3.8416 \times 0.5 \times 0.5}{0.0025}$$

$$n = \frac{0.9604}{0.0025}$$

$$n \approx 384$$

### **Administration of questionnaires**

A structured questionnaire was administered to each pupil to collect information on the date of collection, identification number, age, sex, sanitation and hygiene practices, and parents' educational backgrounds.

### **Collection of Samples**

A total of 395 stool samples were obtained from the children after proper orientation was made on how to obtain the samples. Children or parents/guardians were given transparent sterile universal specimen containers to get the stool samples. All stool specimens were properly labelled with the subject's identification number, age, sex and date of collection. The samples were taken for macro- and microscopic examination at the Biological Sciences Laboratory, Faculty of Science, Taraba State University, Jalingo.

### **Laboratory Analysis**

#### **Kato-katz technique**

In the laboratory, samples were examined for STHs using a modified Kato-Katz technique (Katz *et al.*, 1972). The faecal sample was pressed on a mesh screen to remove large particle. A plastic template with a central hole 6 mm in diameter was placed on a clean glass slide, and the hole was filled with a small portion of sieved stool. The template was carefully withdrawn from the slide, leaving a faecal sample of about 14.7 mg on the glass slide. Two drops of

malachite green solution were added to the sample on a slide and then mixed thoroughly. The mixture was covered with a cover slip and examined under a compound microscope for soil-transmitted helminth eggs. Each morphological egg was counted using a hand tally counter. Diagnosis was based on identification of the characteristic helminth's ova outlined by Cheesbrough (2006). The egg intensity of each helminth observed was determined by multiplying the number of eggs per gram of faeces (Epg).

**Data analysis**

Data analysis was performed using Statistical Package for the Social Sciences (SPSS) version 27.0. Descriptive statistics were first conducted to summarize the data. Frequencies and percentages were calculated for categorical variables such as sex, age group, class level, parental education, sanitation practices, deworming history, and infection status. Analysis was carried out by the Chi-square ( $\chi^2$ ) test to determine the association between soil-transmitted helminths' infection and with the variables such as age group, sex, parental education, sanitation practices, water source, footwear use, and anaemia status. The level of statistical significance was set at  $p \leq 0.05$ . The egg reduction rate (ERR) was calculated as follows:

$$ERR (\%) = \frac{\text{Mean EPG before treatment} - \text{Mean EPG after treatment}}{\text{Mean EPG before treatment}} \times 100$$

While the cure rate (CR) was calculated as:

$$CR (\%) = \frac{\text{No. of infected individuals before treatment} - \text{No. of infected after treatment}}{\text{No. of infected individuals before treatment}}$$

**RESULTS**

Table 1 describes the participants that were enrolled in the study. The participants from Jauro Isa primary school had the highest with 25.5% (101), while Jauro Lavo had the lowest with 24.3% (96). The age group [5-8] years had 23.0% (91), while the age group [9-12] years had 76.9% (304). Male had 31.3% (124) and female had 68.6 % (271). The participants with the BMI < 18.5 kg/m<sup>2</sup> had 78.9% (312), while those with

BMI = 18.5 - 24.9 kg/m<sup>2</sup> had 21.0% (83). The non-anaemic participants had highest with 35.1% (139), while the anaemic had the lowest participation with 7.5% (30).

Table 2 shows the soil-transmitted helminthiasis in relation to schools, sex, age, Body Mass Index and Haemoglobin Level of Primary School Children in Jalingo Local Government Area, Taraba State, Nigeria. The pupils had a significant knowledge of transmission for the soil-transmitted helminths, 19.4% (61) ( $\chi^2=9.44, p=0.03$ ). Children who knew that helminths cause sickness were 21.5% (44) with a significant difference ( $\chi^2=10.43, p=0.05$ ), while those that taught hand-washing, and use of toilets in school significantly had 21.8% (68) ( $\chi^2 = 10.50, p = 0.01$ ).

Table 3 presents infection in relation to water, sanitation and hygiene practices among primary school children in Jalingo Local Government Area, Taraba State, Nigeria. Children who walked barefoot significantly had an infection of 18.8% (45) ( $\chi^2 = 9.28, p = 0.02$ ).

Table 4 presents the cure rate (CR) of Albendazole and Ivermectin after a treatment. For Albendazole, pretreatment infection was 19.0% (38), and this reduced to 2.0% (4) post-treatment. This corresponds to a cure rate of 89.5%, indicating substantial effectiveness of the drug in eliminating soil-transmitted helminthiasis. Similarly, Ivermectin recorded a pretreatment infection of 20.8% (41), which decreased to 2.0% (4) after treatment. The calculated cure rate was 90.2%, slightly higher than that observed with Albendazole.

Table 5 presents the egg reduction rate (ERR), which reflects the reduction in egg per gram (EPG) of stool following treatment. For Albendazole, the mean egg count reduced from 5.94 EPG before treatment to 1.09 EPG after treatment, resulting in an egg reduction rate of 81.7%. In comparison, Ivermectin reduced the mean egg count from 5.85 EPG pretreatment to 0.73 EPG post-treatment, yielding an egg reduction rate of 87.0%.

**Table 1: Description of Participant Primary School Children in Jalingo Local Government Area, Taraba State, Nigeria**

Variables	Participants (%) (N=395)
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<b>Primary schools' areas</b>	
Nigeria Television Authority (NTA)	100 (25.3)
Sabongari	98 (24.8)
Jauro Isa	101 (25.5)
Jauro Lavo	96 (24.3)
<b>Age (years)</b>	
[5-8]	91 (23.0)
[9-12]	304 (76.9)
<b>Sex</b>	
Male	124 (31.3)
Female	271 (68.6)
<b>BMI (kg/m<sup>2</sup>)</b>	
< 18.5	312 (78.9)
18.5 – 24.9	83 (21.0)
<b>Hb (g/dL)</b>	
Non-anaemic (12–13.4)	139 (35.1)
Mild (11–11.4)	60 (15.1)
Moderate (8.0–10.9)	166 (42.0)
Anaemic (< 8.0)	30 (7.5)

**Table 2: Soil-transmitted helminthiasis in relation to schools, sex, age, Body Mass Index and Haemoglobin Level of Primary School Children in Jalingo Local Government Area, Taraba State, Nigeria**

Variables	No. Examined	No. Infected (%)	$\chi^2$	p-value
<b>Infection</b>	395	78 (19.7)		
<b>Schools</b>			3.29	0.34
Nigeria Television Authority (NTA)	100	17 (17.0)		
Sabongari	98	21 (21.4)		
Jauro Isa	101	16 (15.5)		
Jauro Lavo	96	24 (25.0)		
<b>Sex</b>			0.09	0.75
Male	124	25 (20.2)		
Female	271	53 (19.9)		
<b>Age (years)</b>			0.02	0.88
[5 - 8]	91	19 (20.9)		
[9 - 12]	304	59 (19.4)		
<b>BMI (kg/m<sup>2</sup>)</b>			0.25	0.61
< 18.5	312	60 (19.2)		
18.5 – 24.9	83	18 (21.7)		
<b>Hb (g/dL)</b>			2.18	0.53
Non-anaemic (12–13.4)	139	26 (18.7)		
Mild (11–11.4)	60	11 (18.3)		
Moderate (8.0–10.9)	166	32 (19.3)		
Anaemic (< 8.0)	30	9 (30.0)		

BMI=Body Mass Index; Hb=Haemoglobin

**Table 3: Infection in Relation to Knowledge about Intestinal Helminth among Primary School Children in Jalingo Local Government Area, Taraba State, Nigeria.**

Variables	No. Examined	No. Infected (%)	$\chi^2$	p-value
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<b>Hearing about intestinal worms</b>				
No	244	47 (19.7)	3.19	0.67
Yes	151	32 (21.3)		
<b>Knowing how they are transmitted</b>				
No	238	61 (19.4)	9.44	0.03
Yes	157	18 (20.2)		
<b>Knowing that helminths make people sick</b>				
No	314	44 (21.5)	10.43	0.05
Yes	81	35 (22.3)		
<b>School teaching about handwashing, and toilet use</b>				
No	157	11 (12.9)	10.50	0.01
Yes	238	68 (21.8)		
<b>Hearing of soil-transmitted helminths</b>				
No	87	16 (18.3)	1.79	0.87
Yes	308	63 (20.3)		

**Table 4: Soil-transmitted helminths' Infection in Relation to Water, Sanitation and Hygiene Practices Among Primary School Children in Jalingo Local Government Area, Taraba State, Nigeria**

Variables	Number Examined	Number Infected (%)	$\chi^2$	p-value
<b>Washing hands after using the toilet</b>				
No	3	0 (0.0)	0.75	0.98
Yes	392	79 (20.2)		
<b>Consumption of fresh vegetables, and fruits</b>				
No	164	31 (18.9)	7.02	0.21
Yes	231	48 (20.8)		
<b>Wash vegetables and fruit before eating</b>				
No	236	49 (20.7)	7.66	0.17
Yes	159	30 (18.9)		
<b>Having functional toilet at school</b>				
No	314	63 (20.0)	5.05	0.40
Yes	81	16 (19.7)		
<b>Walking about barefooted</b>				
No	240	45 (18.8)	9.28	0.02
Yes	155	34 (22.0)		
<b>Playing in soil or sand</b>				
No	235	46 (19.6)	4.43	0.48
Yes	160	33 (20.6)		
<b>Regular trimming of fingers</b>				
No	4	0 (0.0)	1.01	0.96
Yes	391	79 (20.2)		
<b>Sucking of fingers</b>				
No	236	44 (18.5)	6.27	0.28
Yes	159	35 (22.0)		
<b>Source of drinking water at home</b>				
Well	240	47 (19.5)	4.53	0.47
Bore-hole	155	32 (20.5)		
<b>Seeing garbage or feces near home/school</b>				
No	236	51 (21.1)	6.98	0.22
Yes	159	30 (18.9)		

**Table 5: Cure Rate of Albendazole and Ivermectin among Primary School Children in Jalingo Local Government Area, Taraba State, Nigeria.**

Variables	Albendazole	Ivermectin
Pretreatment	38 (19.0)	41 (20.8)
Posttreatment	4 (2.0)	4 (2.0)
CR (%)	89.5	90.2

**Keys:** EPG = Egg per gram, CR= Cure Rate

**Table 6: Egg Reduction Rate of Albendazole and Ivermectin Among Primary School Children in Jalingo Local Government Area, Taraba State, Nigeria.**

Variables	No. Eggs with Albendazole	No. Eggs with Ivermectin
Pretreatment	5.94	5.85
Posttreatment	1.09	0.73
ERR (%)	81.7	87.0

**Key:** ERR=Egg reduction rate

## DISCUSSION

This study assessed the prevalence, associated risk factors, and drug effectiveness against helminthic infections among primary school children in Jalingo Local Government Area, Taraba State. The prevalence (19.7%) indicated that transmission remains ongoing in Jalingo Local Government Area, the capital city of Taraba State, Nigeria.

Knowledge and awareness variables demonstrated partly protective trends, particularly regarding understanding of transmission routes and hygiene teachings at school, both of which showed statistical significance. These findings mirror the conclusions of Tadesse *et al.* (2019), who emphasized the importance of school-based health education in reducing helminths' transmission. Nevertheless, general awareness such as merely hearing about worms or knowing they cause illness did not significantly reduce prevalence.

Environmental and hygiene behaviours exhibited mixed associations. Walking barefoot showed significance, supporting classical epidemiological findings by Haqqarwar *et al.* (2019) and Olukosi *et al.* (2015), who identified footwear as a protective factor in helminths' control.

Drug effectiveness analysis demonstrated high cure and egg reduction rates for both Albendazole and Ivermectin. The strong therapeutic performance of Albendazole aligns with findings by Adegnika *et al.* (2015), who reported cure rates above ninety percent in similar school populations. Likewise, the high efficacy observed for Ivermectin is consistent with reports by Gordon *et al.* (2016) documenting substantial reductions in helminths burden following treatment. The overall high cure and egg reduction rates in this study suggest that both drugs remain effective in the study area, with no immediate evidence of reduced sensitivity. Ivermectin commonly known as an anti-parasitic drug to the river

blindness, loiasis, strongyloidiasis and other nematodes had a high efficacy against the soil-transmitted helminthiasis than the Albendazole in this study. Such efficacy against the soil-transmitted helminthiasis has been reported by Crump and Omura (2011).

Moreso, Albendazole achieved good effectiveness, then periodic deworming (every 6 months) with the two drugs should be institutionalized in all schools to prevent infection and reinfection, and also maintain low parasite loads. However, as highlighted in global literature, continued surveillance is essential to monitor long term drug performance in communities undergoing repeated mass administration.

## CONCLUSION

This study confirms that soil-transmitted helminths' infections remain present among primary school children in Jalingo Local government Area, Taraba State, Nigeria, with moderate prevalence. The study also demonstrates that both Albendazole and Ivermectin remain highly effective in reducing helminth burden, as evidenced by very high cure rates and substantial egg reduction rates following treatment. Pupils, teachers, and parents should receive structured health education on handwashing, wearing footwear, safe water use, and proper waste disposal key behavioural factors that reduce STHs transmission. Local authorities should ensure functional toilets, proper drainage, waste management, and clean surroundings in schools, houses and public environments to limit helminths survival and transmission.

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#### **Authors' Contributions**

HRS, WBE, and ASB: Conceptualization and study design. AVY, AOJ, NEJ, TBT: Data collection, laboratory analysis, data interpretation and original draft preparation. HRS: Project coordination/supervision, data analysis, validation of results, and final manuscript approval. HRS, WBE, AVY, AOJ, TBT, and ASB revised and approved the final manuscript.

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