

Prevalence of Intestinal Helminth Infections and Comparative Therapeutic Efficacy of Albendazole among HIV-Infected Children in Numan General Hospital and Mayo Belwa General Hospital, Adamawa State, Nigeria

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ABSTRACT

Intestinal helminth infections and paediatric HIV remain major public health challenges in sub-Saharan Africa. Their coexistence may worsen immune suppression and disease progression, yet comparative evidence from north-eastern Nigeria is limited.

To determine the prevalence of intestinal helminth infections and assess the therapeutic efficacy of albendazole among HIV-infected children attending Numan General Hospital and Mayo Belwa General Hospital, Adamawa State, Nigeria.

A hospital-based longitudinal interventional study was conducted among 132 HIV-infected children aged 5–18 years, with 66 recruited from each facility. Stool samples were examined using the Kato-Katz technique for helminth detection and quantification. Infected children who consented received a single 400-mg dose of albendazole and were reassessed after three months. Data were analysed using descriptive statistics, chi-square tests, and multivariable logistic regression at $p < 0.05$.

Overall helminth prevalence was 47.0% (62/132), significantly higher at Numan (59.1%, 39/66) than Mayo Belwa (34.8%, 23/66) ($\chi^2 = 7.72$, $p = 0.005$). *Trichuris trichiura* was predominant (48.4%), followed by *Ascaris lumbricoides* (29.0%) and *Hymenolepis nana* (22.6%); moderate-intensity infections predominated (69.4%). 62 infected children and 41 received treatment. Overall parasitological clearance was 58.5% (24/41), with higher clearance at Numan (66.7%) than Mayo Belwa (47.1%). Independent predictors of infection included maternal and paternal occupations.

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Intestinal helminth infection was common among HIV-infected children, with significantly higher prevalence at Numan General Hospital. Albendazole demonstrated moderate therapeutic efficacy, with higher clearance at Numan. Routine deworming should be integrated into paediatric HIV care programmes to reduce helminth burden and improve health outcomes among HIV-infected children.

Keywords:

Intestinal helminths; HIV-infected children; Albendazole; Prevalence; Therapeutic efficacy

INTRODUCTION

Intestinal helminth infections, particularly those caused by soil-transmitted nematodes, remain among the most common parasitic infections worldwide and continue to disproportionately affect impoverished and marginalized populations (Akanksha *et al.*, 2023). Globally, more than 1.5 billion people are infected with at least one species of soil-transmitted helminth, with children in low-resource settings carrying the greatest burden of infection. These infections are associated with chronic malnutrition, iron-deficiency anaemia, impaired physical growth, and poor cognitive development, thereby contributing significantly to childhood morbidity (Fauziah *et al.*, 2022; Lebu *et al.*, 2023). In sub-Saharan Africa, persistent poverty, inadequate sanitation facilities, unsafe drinking water, and poor hygiene practices provide favourable conditions for continuous transmission of intestinal helminths. Nigeria remains one of the countries with the highest burden of these infections, particularly among vulnerable populations (Oyedemi *et al.*, 2016; Bayleyegn *et al.*, 2021).

Nigeria also carries a disproportionate share of the global paediatric HIV burden, accounting for approximately 10% of HIV infections among children worldwide. Within the

country, Adamawa State in north-eastern Nigeria reports HIV prevalence rates of approximately 4–5% (Onyia *et al.*, 2024). Over the past decade, the region has experienced prolonged armed conflict and population displacement, leading to the destruction of sanitation infrastructure, disruption of healthcare services, and deterioration of environmental health conditions. These factors have created an environment conducive to the transmission of intestinal helminths, yet there remains a paucity of data regarding the burden of these infections among HIV-infected children in the region (UNICEF, 2026).

The coexistence of HIV infection and intestinal helminthiasis presents a significant public health concern because HIV-induced immunosuppression increases susceptibility to opportunistic and parasitic infections, while chronic helminth infections further compromise immune function through persistent immune activation and modulation. This interaction may accelerate HIV disease progression, reduce the effectiveness of antiretroviral therapy, and worsen clinical outcomes among affected children (Mpaka-Mbatha *et al.*, 2022; Onyia *et al.*, 2024).

Numan General Hospital, situated along the floodplains of the Benue River, is characterized by extensive agricultural

activities and frequent water-logging, which may contribute to higher environmental contamination with helminth eggs. In contrast, Mayo Belwa General Hospital, located on a slightly elevated terrain with a drier savannah climate, may present different transmission dynamics. These geographical, ecological, and possibly socioeconomic differences could influence not only the baseline prevalence of helminths but also treatment response. However, no comparative data exist between these two facilities regarding the burden of intestinal helminths or the efficacy of albendazole treatment among HIV-infected children.

In view of these knowledge gaps, this study aimed to determine the prevalence and intensity of intestinal helminth infections and evaluate the comparative therapeutic efficacy of albendazole among HIV-infected children attending Numan General Hospital and Mayo Belwa General Hospital, Adamawa State, Nigeria.

MATERIALS AND METHODS

Study Design and Setting

This was a hospital-based longitudinal interventional study conducted at Numan General Hospital and Mayo Belwa General Hospital, Adamawa State, Nigeria. Numan is located in the central zone of Adamawa State, situated along the floodplains of the Benue River, characterised by extensive agricultural activities and frequent water-logging. Mayo-Belwa is located in the southern zone, on a slightly elevated terrain with a drier savannah climate. Both hospitals serve as major referral centres for paediatric HIV care, drawing both urban and rural populations from surrounding local government areas. The study was conducted from April to June 2025.

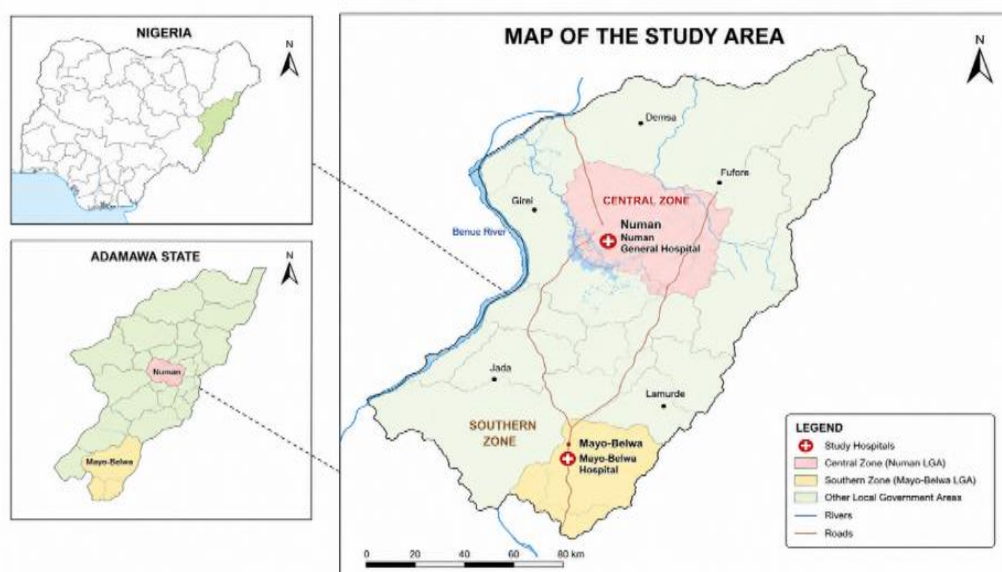


Figure 1: Map of the Study Area

Study Population

The target population was HIV-infected children aged 5–18 years attending the antiretroviral therapy (ART) clinics at Numan General Hospital and Mayo Belwa General Hospital.

Inclusion Criteria

- Confirmed HIV-positive children (documented in medical records)
- Age 5–18 years
- Receiving care at the ART clinic during the study period
- Parent/guardian provided written informed consent
- Child assent obtained (where applicable)
- Willing to provide a stool sample

Exclusion Criteria

- Receipt of anti-helminthic drugs within 3 months prior
- Acute severe illness requiring hospitalisation at recruitment
- Caregiver refusal to consent
- Inability to provide stool sample

Sample Size Determination

The sample size was determined using the single population proportion formula for prevalence studies:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

Where:

- n = minimum sample size.
- Z = standard normal deviate at 95% confidence level = 1.96.
- P = prevalence of intestinal helminth infection among HIV-infected children in Adamawa State = 0.41 (41%) (Onyia *et al.*, 2024).
- d = margin of error = 0.05.

Substituting the values:

$$n = \frac{(1.96)^2 \times 0.41(1-0.41)}{(0.05)^2}$$

$$n = \frac{3.8416 \times 0.41 \times 0.59}{0.0025}$$

$$n = \frac{0.9299}{0.0025} = 58.8 \approx 59$$

Thus, the minimum sample size was 59 participants per hospital.

To account for an anticipated 10% non-response or loss to follow-up, the sample size was adjusted using:

$$n_{adj} = \frac{59}{1-0.10} = \frac{59}{0.90} = 65.6 \approx 66$$

Therefore, the final sample size was 66 participants per facility, giving a total sample size of 132 HIV-infected children (66 from Numan General Hospital and 66 from Mayo Belwa General Hospital).

Sampling Technique

Consecutive sampling was used: all eligible HIV-infected children attending the ART clinics at both hospitals during the study period were approached until the target sample of 66 per facility was reached.

Data Collection

Socio-demographic Data

A structured, interviewer-administered questionnaire was developed and pre-tested on 5 caregivers to assess clarity and cultural appropriateness. It collected data on child's age, sex, parental education and occupation and household size,

Parasitological Assessment

Fresh stool specimens (approximately 5 g) were collected from each participant in sterile, pre-labelled stool containers and transported to the laboratory within 2 hours of collection for immediate processing. Intestinal helminth infection was assessed using the Kato--Katz thick smear technique following the World Health Organization (WHO) standard protocol (WHO, 2019). Helminth eggs were identified based on their characteristic morphological features using WHO diagnostic criteria (WHO, 2019). Infection intensity was classified according to WHO guidelines as light, moderate, or heavy (WHO, 2019). To ensure reliability, all slides were independently examined by two experienced laboratory technologists blinded to participants' clinical information.

Intervention

Albendazole Administration

Children found to be infected with intestinal helminths who consented to treatment received single-dose albendazole (400 mg, age-appropriate) according to national and WHO treatment guidelines.

Follow-Up and Post-Intervention Assessment

After albendazole administration, participants were followed up after three months. Repeat stool examination was

conducted to assess reduction or clearance of helminth infections.

Data Analysis

Data were entered into Microsoft Excel and analysed using SPSS version 25. Descriptive statistics (frequencies, percentages, means, standard deviations) summarized participant characteristics, prevalence, and intensity. Prevalence was reported with 95% confidence intervals using the Wilson score method. Chi-square tests (or Fisher's exact test where expected cell counts <5) explored associations between infection and categorical variables. Multivariable logistic regression identified independent predictors of infection. Statistical significance was set at $p < 0.05$.

Ethical Considerations

Ethical approval was obtained from the Adamawa State Ministry of Health Ethics Review Committee (Protocol number: ADHREC 21/02/2023; Research approval number: 21/03/2023/076). Written informed consent was obtained from parents/guardians, and assent was obtained from children aged ≥ 12 years. Confidentiality was maintained by assigning unique participant codes. All infected children were offered free treatment with albendazole (400 mg single dose) according to national guidelines.

RESULTS AND DISCUSSION

Socio-demographic Characteristics

A total of 132 HIV-infected children were enrolled in the study, 66 from Numan General Hospital and 66 from Mayo Belwa General Hospital. The overall mean age was 11.4 ± 3.5 years (range: 5–17 years). Children aged 10–14 years constituted 89 (67.4%) of participants, followed by those aged 5–9 years, 26 (19.7%), and 15–18 years, 17 (12.9%). Females constituted 70 (53.0%) of the study population while males accounted for 62 (47.0%). More than half of the participants resided in urban areas, 71 (53.8%), while 61 (46.2%) were from rural communities.

Table 1: Socio-Demographic Characteristics of HIV-Infected Children Enrolled in the Study

Characteristic	Numan (n=66)	Mayo-Belwa (n=66)	Total (N=132)
Age group (years)			
5–9	13 (19.7)	13 (19.7)	26 (19.7)
10–14	44 (66.7)	45 (68.2)	89 (67.4)
15–18	9 (13.6)	8 (12.1)	17 (12.9)
Age (years) Mean $\pm$ SD	11.3 $\pm$ 3.4	11.5 $\pm$ 3.6	11.4 $\pm$ 3.5
Sex			
Male	31 (47.0)	31 (47.0)	62 (47.0)
Female	35 (53.0)	35 (53.0)	70 (53.0)
Residence			
Urban	35 (53.0)	36 (54.5)	71 (53.8)
Rural	31 (47.0)	30 (45.5)	61 (46.2)
Father's education			
Primary	14 (21.2)	14 (21.2)	28 (21.2)
Secondary	24 (36.4)	24 (36.4)	48 (36.4)
Non-formal	16 (24.2)	16 (24.2)	32 (24.2)
Tertiary	12 (18.2)	12 (18.2)	24 (18.2)
Mother's education			
Primary	15 (22.7)	15 (22.7)	30 (22.7)
Secondary	25 (37.9)	25 (37.9)	50 (37.9)
Non-formal	16 (24.2)	16 (24.2)	32 (24.2)
Tertiary	10 (15.2)	10 (15.2)	20 (15.2)
Father's occupation			
Civil servant	18 (27.3)	17 (25.8)	35 (26.5)

Characteristic	Numan (n=66)	Mayo-Belwa (n=66)	Total (N=132)
Trader	16 (24.2)	14 (21.2)	30 (22.7)
Farmer	12 (18.2)	15 (22.7)	27 (20.5)
Artisan	10 (15.2)	10 (15.2)	20 (15.2)
Others	10 (15.2)	10 (15.2)	20 (15.2)
Mother's occupation			
Civil servant	14 (21.2)	15 (22.7)	29 (22.0)
Housewife	16 (24.2)	14 (21.2)	30 (22.7)
Trader	12 (18.2)	14 (21.2)	26 (19.7)
Farmer	10 (15.2)	9 (13.6)	19 (14.4)
Others	14 (21.2)	14 (21.2)	28 (21.2)
Household size			
1–2 persons	12 (18.2)	14 (21.2)	26 (19.7)
3–4 persons	30 (45.5)	28 (42.4)	58 (43.9)
≥5 persons	24 (36.4)	24 (36.4)	48 (36.4)

Prevalence and Types of Intestinal Helminths

Overall, 62 of 132 children (47.0%; 95% CI: 38.5–55.5%) were positive for at least one helminth species. At Numan General Hospital, 39 (59.1%) children were infected, while at Mayo Belwa General Hospital, 23 (34.8%) were infected. The difference between facilities was statistically significant ($\chi^2 = 7.72$, $p = 0.005$). The species distribution is shown in Table 2. *Trichuris trichiura* was the most prevalent (30, 48.4%), followed by *Ascaris lumbricoides* (18, 29.0%) and *Hymenolepis nana* (14, 22.6%). No hookworm infections

were detected. At Numan, *Trichuris trichiura* accounted for 18 (46.2%) of infections, while at Mayo-Belwa, it accounted for 12 (52.2%). The difference in species proportions between facilities was not statistically significant ($\chi^2 = 0.22$, $df = 2$, $p = 0.896$). This finding implies that helminth infection was substantially more common among the children attending Numan General Hospital, although the distribution of individual helminth species was similar between the two facilities.

Table 2: Prevalence and Types of Intestinal Helminth Infections by Health Facility

Helminth Species	Numan (n=66)	Mayo-Belwa (n=66)	Total (N=132)	χ^2 , p-value
<i>Trichuris trichiura</i>	18 (27.3)	12 (18.2)	30 (22.7)	7.72, 0.005
<i>Ascaris lumbricoides</i>	12 (18.2)	6 (9.1)	18 (13.6)	
<i>Hymenolepis nana</i>	9 (13.6)	5 (7.6)	14 (10.6)	
Total infected	39 (59.1)	23 (34.8)	62 (47.0)	

Prevalence by Age, Sex, and Residence

Table 3 presents the prevalence of intestinal helminth infection according to age, sex, and residence, with comparative data between the two facilities.

Table 3: Prevalence of Intestinal Helminth Infection According to Age, Sex, and Residence

Variable	Numan (n=66)		Mayo-Belwa (n=66)		Total (N=132)		χ^2	p-value
	Positive (%)	Negative (%)	Positive (%)	Negative (%)	Positive (%)	Negative (%)		
Age (years)								
5–9	6 (46.2)	7 (53.8)	3 (23.1)	10 (76.9)	9 (34.6)	17 (65.4)	13.21	0.001
10–14	24 (54.5)	20 (45.5)	14 (31.1)	31 (68.9)	38 (42.7)	51 (57.3)		
15–18	9 (100.0)	0 (0.0)	6 (75.0)	2 (25.0)	15 (88.2)	2 (11.8)		
Sex								
Male	19 (61.3)	12 (38.7)	11 (35.5)	20 (64.5)	30 (48.4)	32 (51.6)	0.10	0.757
Female	20 (57.1)	15 (42.9)	12 (34.3)	23 (65.7)	32 (45.7)	38 (54.3)		
Residence								
Urban	18 (51.4)	17 (48.6)	9 (25.0)	27 (75.0)	27 (38.0)	44 (62.0)	4.93	0.026
Rural	21 (67.7)	10 (32.3)	14 (46.7)	16 (53.3)	35 (57.4)	26 (42.6)		

Socio-demographic Factors Associated with Helminth Infection

Table 4 presents the association between socio-demographic factors and intestinal helminth infection among HIV-infected children, with comparative data between the two facilities. At Numan, infection was significantly associated with maternal occupation ($\chi^2 = 8.14$, $p = 0.043$), paternal occupation ($\chi^2 = 8.92$, $p = 0.030$), and household size ($\chi^2 = 6.18$, $p = 0.045$). At

Mayo-Belwa, infection was significantly associated with maternal occupation ($\chi^2 = 7.86$, $p = 0.049$) and paternal occupation ($\chi^2 = 8.14$, $p = 0.043$), but not with household size ($\chi^2 = 1.02$, $p = 0.601$). These findings imply that parental occupational characteristics were consistently associated with helminth infection across both facilities, while household size appeared to be an important factor only among children attending Numan General Hospital.

Table 4: Socio-demographic Factors Associated with Intestinal Helminth Infection

Variable	Category	Numan (n=66)		Mayo-Belwa (n=66)		Total (N=132)	
		Positive (%)	Negative (%)	Positive (%)	Negative (%)	Positive (%)	Negative (%)
Father's education	Primary	8 (57.1)	6 (42.9)	5 (35.7)	9 (64.3)	13 (46.4)	15 (53.6)
	Secondary	15 (62.5)	9 (37.5)	9 (37.5)	15 (62.5)	24 (50.0)	24 (50.0)
	Non-formal	9 (56.3)	7 (43.7)	5 (31.3)	11 (68.7)	14 (43.8)	18 (56.2)
	Tertiary	7 (58.3)	5 (41.7)	4 (33.3)	8 (66.7)	11 (45.8)	13 (54.2)
Mother's education	Primary	9 (60.0)	6 (40.0)	5 (33.3)	10 (66.7)	14 (46.7)	16 (53.3)
	Secondary	15 (60.0)	10 (40.0)	9 (36.0)	16 (64.0)	24 (48.0)	26 (52.0)
	Non-formal	9 (56.3)	7 (43.7)	5 (31.3)	11 (68.7)	14 (43.8)	18 (56.2)
	Tertiary	6 (60.0)	4 (40.0)	4 (40.0)	6 (60.0)	10 (50.0)	10 (50.0)
Father's occupation	Civil servant	8 (44.4)	10 (55.6)	4 (23.5)	13 (76.5)	12 (34.3)	23 (65.7)
	Trader	10 (62.5)	6 (37.5)	6 (42.9)	8 (57.1)	16 (53.3)	14 (46.7)
	Farmer	10 (83.3)	2 (16.7)	7 (46.7)	8 (53.3)	17 (63.0)	10 (37.0)
	Artisan	5 (50.0)	5 (50.0)	3 (30.0)	7 (70.0)	8 (40.0)	12 (60.0)
	Others	6 (60.0)	4 (40.0)	3 (30.0)	7 (70.0)	9 (45.0)	11 (55.0)
Mother's occupation	Civil servant	5 (35.7)	9 (64.3)	3 (20.0)	12 (80.0)	8 (27.6)	21 (72.4)
	Housewife	12 (75.0)	4 (25.0)	6 (42.9)	8 (57.1)	18 (60.0)	12 (40.0)
	Trader	8 (66.7)	4 (33.3)	6 (42.9)	8 (57.1)	14 (53.8)	12 (46.2)
	Farmer	8 (80.0)	2 (20.0)	5 (55.6)	4 (44.4)	13 (68.4)	6 (31.6)
	Others	6 (42.9)	8 (57.1)	3 (21.4)	11 (78.6)	9 (32.1)	19 (67.9)
Household size	1–2 persons	4 (33.3)	8 (66.7)	4 (28.6)	10 (71.4)	8 (30.8)	18 (69.2)
	3–4 persons	18 (60.0)	12 (40.0)	10 (35.7)	18 (64.3)	28 (48.3)	30 (51.7)
	≥5 persons	17 (70.8)	7 (29.2)	9 (37.5)	15 (62.5)	26 (54.2)	22 (45.8)

Logistic Regression Analysis of Risk Factors

Table 8 presents the multivariable logistic regression analysis of socio-demographic factors associated with intestinal helminth infection. After adjusting for confounders, maternal occupation (housewives, farmers, traders) and paternal occupation (traders, farmers) remained independently

associated with infection. This finding implies that parental occupational characteristics may independently influence the likelihood of helminth infection among HIV-infected children, even after accounting for other socio-demographic factors.

Table 8: Multivariable Logistic Regression Analysis of Socio-demographic Factors Associated with Intestinal Helminth Infection

Variable	Category	COR (95% CI)	p-value	AOR (95% CI)	p-value
Residence	Urban	1.00	—	1.00	—
	Rural	1.54 (0.92–2.58)	0.099	1.47 (0.84–2.55)	0.176
Father's occupation	Civil servant	1.00	—	1.00	—
	Trader	2.66 (1.28–5.55)	0.009	2.21 (1.01–4.86)	0.048
	Farmer	3.45 (1.49–7.98)	0.004	2.87 (1.17–7.05)	0.021
	Artisan	2.76 (0.85–8.93)	0.091	2.19 (0.63–7.63)	0.218
	Others	0.57 (0.20–1.62)	0.292	0.63 (0.21–1.92)	0.417
Mother's occupation	Civil servant	1.00	—	1.00	—
	Housewife	8.11 (2.93–22.42)	<0.001	5.72 (1.92–17.04)	0.002
	Trader	6.37 (2.21–18.34)	0.001	4.83 (1.57–14.88)	0.006
	Farmer	8.50 (2.55–28.30)	<0.001	5.96 (1.66–21.40)	0.006
	Others	1.28 (0.40–4.10)	0.675	1.16 (0.34–4.01)	0.812
Household size	1–2 persons	1.00	—	1.00	—
	3–4 persons	1.61 (0.72–3.58)	0.245	1.44 (0.61–3.40)	0.404
	≥5 persons	2.31 (1.04–5.12)	0.040	1.96 (0.84–4.57)	0.119

COR = Crude Odds Ratio; AOR = Adjusted Odds Ratio; CI = Confidence Interval. Multivariable logistic regression adjusted for age, gender, residence, parental occupation, and household size. Statistical significance was set at $p < 0.05$.

Infection Intensity

Among the 62 infected children, moderate-intensity infections were predominant (43, 69.4%), while light infections accounted for 19 (30.6%). No heavy infections were detected. At Numan, moderate-intensity infections accounted for 28 (71.8%) compared to 15 (65.2%) at Mayo-

Belwa. The difference in intensity distribution between facilities was not statistically significant ($\chi^2 = 0.28$, $p = 0.597$). This finding implies that although moderate-intensity infections were more common, infection intensity did not differ significantly between the two facilities.

Table 5: Intensity of Intestinal Helminth Infections by Health Facility

Helminth Species	Numan (n=39)		Mayo-Belwa (n=23)		Total (N=62)		χ^2	p-value
	Light (%)	Moderate (%)	Light (%)	Moderate (%)	Light (%)	Moderate (%)		
<i>Ascaris lumbricoides</i>	4 (33.3)	8 (66.7)	2 (33.3)	4 (66.7)	6 (33.3)	12 (66.7)	0.28	0.597
<i>Trichuris trichiura</i>	5 (27.8)	13 (72.2)	4 (33.3)	8 (66.7)	9 (30.0)	21 (70.0)		
<i>Hymenolepis nana</i>	2 (22.2)	7 (77.8)	2 (40.0)	3 (60.0)	4 (28.6)	10 (71.4)		
Total	11 (28.2)	28 (71.8)	8 (34.8)	15 (65.2)	19 (30.6)	43 (69.4)		

Effectiveness of Albendazole in Reducing Intestinal Helminth Infections

A total of 41 HIV-infected children who were positive for intestinal helminths at baseline consented to albendazole treatment and were successfully followed up (24 from Numan and 17 from Mayo-Belwa). At baseline, all 41 were infected

with intestinal helminths. Following treatment, the number of infected children reduced to 17, representing a parasitological clearance rate of 58.5% (24/41) shown in figure 2. This finding implies that albendazole treatment substantially reduced intestinal helminth infections among the treated children, although 41.5% remained infected after treatment.

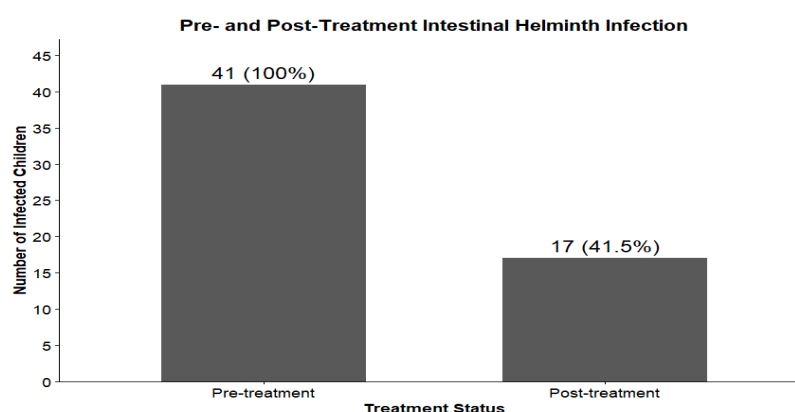


Figure 2: Pre-Post Infection Prevalence

At Numan General Hospital, out of the 24 children treated, 16 achieved clearance, reducing the infected count from 24 to 8 (clearance rate: 66.7%). At Mayo Belwa General Hospital, out of the 17 children treated, 8 achieved clearance, reducing the infected count from 17 to 9 (clearance rate: 47.1%) table 6. The difference in clearance rates between the two facilities

was not statistically significant ($\chi^2 = 1.61$, $p = 0.205$). This finding implies that albendazole was associated with a higher observed clearance rate at Numan than at Mayo Belwa, although the difference between the facilities was not statistically significant.

Table 6: Albendazole Clearance Rates by Health Facility

Health Facility	Treated	Cleared	Remaining Infected	Clearance Rate (%)
Numan General Hospital	24	16	8	66.7
Mayo Belwa General Hospital	17	8	9	47.1
Total	41	24	17	58.5

$\chi^2 = 1.61$, $p = 0.205$ (between facilities)

Parasite intensity Table 7 showed a marked reduction. Mean egg count decreased from 1,549.8 (± 412.6) eggs/g at baseline to 324.2 (± 115.3) eggs/g at follow-up, representing a mean reduction of 78.8%. The median reduction was 79.2% (IQR: 140–390). This reduction was statistically significant

(McNemar's test, $p = 0.002$). The reduction was comparable between Numan (79.0%) and Mayo-Belwa (78.6%). This finding implies that albendazole substantially reduced parasite burden among treated children, with a similar magnitude of reduction observed at both facilities.

Table 7: Effect of Albendazole on Parasite Intensity Reduction

Variable	Baseline	Follow-up	Reduction (%)
Mean parasite density (eggs/g)	1,549.8 $\pm$ 412.6	324.2 $\pm$ 115.3	78.8
Median parasite intensity (IQR)	1,530 (1200–1880)	258 (140–390)	79.2

Discussion

This study provides the first comparative evidence of the burden of intestinal helminth infections and therapeutic efficacy of albendazole among HIV-infected children attending Numan General Hospital and Mayo Belwa General Hospital in Adamawa State, north-eastern Nigeria. The overall prevalence indicates that intestinal helminthiasis

remains highly endemic in this vulnerable population despite enrolment in HIV care.

The prevalence at Numan General Hospital was significantly higher than at Mayo Belwa General Hospital. This difference is clinically and epidemiologically important. Numan, situated along the floodplains of the Benue River, is characterized by extensive agricultural activities and frequent water-logging, which may contribute to higher environmental

contamination with helminth eggs. The weather conditions favour the survival and embryonation of helminth eggs in soil, leading to increased transmission. In contrast, Mayo Belwa, located on a slightly elevated terrain with a drier savannah climate, may present less favourable conditions for parasite survival and transmission. This geographical and ecological difference likely explains the significant disparity in prevalence between the two facilities.

The overall prevalence exceeds previous reports among HIV-infected children from Enugu (27.1%), Owerri (5.7%), and Lagos (5.9%) (David *et al.*, 2020; Iheakaram *et al.*, 2022; Onyia *et al.*, 2024). These differences are likely attributable to contextual rather than biological factors. North-eastern Nigeria has experienced prolonged armed conflict, resulting in population displacement, disruption of health services, deterioration of water and sanitation infrastructure, and increased exposure to environments that facilitate helminth transmission (UNICEF, 2026). These environmental conditions, together with HIV-associated immune dysfunction, may create a synergistic effect that increases both susceptibility to infection and persistence of intestinal helminths.

The predominance of *Trichuris trichiura* observed in this study is consistent with reports from several endemic settings where whipworm has become the dominant soil-transmitted helminth following repeated albendazole-based deworming programmes (Behniafar *et al.*, 2024). Unlike *Ascaris lumbricoides*, *T. trichiura* eggs possess greater environmental resilience and remain viable for prolonged periods under favourable conditions. Furthermore, *T. trichiura* responds poorly to single-dose albendazole, allowing infections to persist despite routine preventive chemotherapy (Keiser & Utzinger, 2018).

Age-related differences followed the expected epidemiological pattern, with the highest prevalence occurring among children aged 15–18 years. Same at Numan and Mayo-Belwa. The exceptionally high prevalence in the oldest age group is noteworthy and may reflect cumulative exposure over time, as older children have had more years of potential exposure to contaminated environments. This finding underscores the need for continued deworming throughout adolescence.

Most infected children harboured moderate-intensity infections, while no heavy infections were detected. At Numan, moderate-intensity infections was higher when compared to Mayo-Belwa. This pattern has also been reported in other endemic populations receiving periodic deworming or antiretroviral therapy (Jourdan *et al.*, 2018). The absence of heavy infections should not be interpreted as indicating a low disease burden because moderate-intensity infections are sufficient to cause chronic blood loss, iron deficiency, impaired growth, and poor nutritional status, particularly among HIV-infected children whose immune status may already be compromised (Fauziah *et al.*, 2022).

The single-dose albendazole treatment had higher clearance rate. Numan facility recorded a higher clearance rate compared to Mayo-Belwa, though this difference was not statistically significant. The observed cure rate is lower than the efficacy commonly reported for albendazole against *Ascaris lumbricoides* and hookworm infections in immunocompetent populations (Keiser & Utzinger, 2018; Montresor *et al.*, 2020). Given that *Trichuris trichiura* was the predominant species, the moderate cure rate is consistent with the known reduced susceptibility of this parasite to albendazole monotherapy.

In multivariable logistic regression, maternal occupation emerged as a strong independent predictor of infection.

Children whose mothers were housewives (aOR = 5.72), farmers (aOR = 5.96), or traders (aOR = 4.83) had significantly higher odds of infection compared to those with civil servant mothers. Similarly, paternal occupation as trader (aOR = 2.21) or farmer (aOR = 2.87) was independently associated with infection. These findings are easily interpretable: civil servants typically have higher education, more stable income, and better access to sanitation and health information. In contrast, trading and farming often involve outdoor work, contact with soil, and less time for childcare hygiene, all of which elevate helminth transmission risk.

CONCLUSION

This study established a high prevalence of intestinal helminth infection (47.0%), predominantly moderate-intensity *Trichuris trichiura*, among HIV-infected children at both Numan General Hospital and Mayo Belwa General Hospital. The prevalence was significantly higher at Numan (59.1%) compared to Mayo-Belwa (34.8%), likely reflecting the ecological differences between the floodplain and drier savannah settings. Albendazole treatment demonstrated moderate efficacy, with an overall clearance rate of 58.5%, with Numan facility showing a higher clearance rate (66.7%) compared to Mayo-Belwa (47.1%). Maternal occupation and paternal occupation were independent predictors of infection. These findings support integrating routine deworming and hygiene education into paediatric HIV care programmes at both facilities, with particular attention to the higher-burden Numan setting. Therefore, routine deworming, strengthened hygiene and sanitation education, improved access to safe water, targeted interventions for vulnerable households, consideration of appropriate combination therapy in areas with persistent *T. trichiura* infection, and further multicentre research are recommended to reduce the burden of intestinal helminth infections among HIV-infected children.

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