***Original Research Article***

**The Influence of sanitation and Hygiene-related Practices on the Prevalence of Intestinal Helminthes in IDP Camps and Adjourning Host Communities in Benue State Nigeria.**

**ABSTRACT**

Helminth infections remain a significant public health concern, particularly in displaced populations with limited access to water, sanitation, and hygiene (WASH). This study investigated the relationship between helminth infection prevalence and knowledge, practices, hygiene, and other epidemiological conditions among internally displaced persons (IDPs) and host communities in Nigeria. A cross-sectional survey was conducted among 400 participants from two IDP camps and two host communities. Data on awareness, knowledge of helminth transmission, hygiene practices, and environmental sanitation were collected using structured questionnaires. Stool samples were examined for helminth ova using standard parasitological techniques. Chi-square tests were used to assess associations between variables this was carried out between September, 2024 to March 2025. Awareness of helminths showed a statistically significant association with infection status (p = 0.013), although depth of knowledge did not (p = 0.217). Prior testing and treatment history were not significantly associated with infection (p > 0.05). Conversely, poor sanitation (p = 0.001), lack of clean water (p = 0.029), and infrequent handwashing (p = 0.000) were significantly linked to higher infection prevalence. Infection rates were notably higher in settings with poor hygiene infrastructure, particularly in host communities and IDP camps with limited resources. While awareness contributes modestly to helminth prevention, WASH-related factors are the most critical determinants of infection. Control strategies must extend beyond deworming and education to include investments in clean water access, sanitation infrastructure, and hygiene promotion to reduce transmission risk in vulnerable populations.

*Keywords: intestinal helminthes; infection; WASH; host communities; prevalence.*

1. **INTRODUCTION**

Intestinal helminth infections, particularly those caused by soil-transmitted helminths (STHs), remain a pressing public health issue in low- and middle-income countries. These parasitic infections are primarily transmitted through fecal contamination of soil, water, and food, facilitated by inadequate sanitation, poor hygiene, and limited access to safe water (WHO, 2020; Hotez *et al.,* 2008). Globally, an estimated 1.5 billion people are affected by STHs, with the burden disproportionately concentrated in sub-Saharan Africa, where poverty, conflict, and infrastructural deficiencies converge to create ideal conditions for persistent transmission (Bethony *et al.,* 2006; Pullan *et al.,* 2014).

In Nigeria, STHs such as *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms are endemic, particularly in rural and peri-urban areas with limited WASH (Water, Sanitation, and Hygiene) services (Odu *et al.,* 2011; Oluwole *et al.,* 2015). The situation is further exacerbated in Internally Displaced Persons (IDP) camps and adjoining host communities, where conflict-induced displacement has overwhelmed existing public health systems. In Benue State, recurrent farmer-herder conflicts have led to the establishment of multiple IDP settlements, often characterized by overcrowding, inadequate sanitation infrastructure, and a breakdown in public health surveillance (UNHCR, 2023; Omudu and Amuta, 2007).

Although several studies have reported the high prevalence of helminth infections among Nigerian schoolchildren and rural dwellers (Salawu & Ughele, 2015; Ugbomoiko *et al.,* 2006), there is a notable paucity of data on the specific influence of sanitation and hygiene practices on helminth transmission in conflict-affected, displaced populations and their host communities. Most existing research tends to generalize risk factors without considering the unique socio-environmental dynamics of IDP settings (Gyorkos *et al.,* 2013). This represents a critical gap, as IDPs not only suffer disproportionately from neglected tropical diseases (NTDs), but also act as reservoirs for continued transmission to nearby host communities with which they frequently interact.

To address this gap, the present study investigates the influence of sanitation and hygiene practices on the prevalence of intestinal helminths in IDP camps and adjoining host communities in Benue State, Nigeria. By employing a comparative cross-sectional approach, the research seeks to uncover the behavioral, infrastructural, and environmental factors that influence helminth transmission in these fragile contexts.

The contributions of this study are threefold: first, it provides empirical evidence on helminth prevalence in a high-risk, under-researched population; second, it links specific WASH-related practices to infection rates; and third, it informs integrated public health strategies tailored for humanitarian and host community settings.

**2.0 MATERIALS AND METHOD**

2.1 **Study Area**

 This study was conducted in selected IDPs camps located in Makurdi and Guma local government area of Benue State and their respective host communities. Makurdi local government area is located in North-Central Nigeria, latitude 7˚ 33’ 00" N to 7˚ 47' 00" N and longitude 8˚ 27’ 00" E to 8˚ 4’00" E. The local government is bordered by Guma to the north, Gwer-east to the south, Gwer-west to the west and Doma local government area of Nassarawa State to the north-west (BSMIC, 2020). Guma local government on the other hand has a [landmass](https://en.wikipedia.org/wiki/Landmass) of 2,882 square [kilometers](https://en.wikipedia.org/wiki/Kilometre), and situated in the northern region of Benue State on[latitudes](https://en.wikipedia.org/wiki/Latitude) 06° 33' and 07° 03' North and [longitudes](https://en.wikipedia.org/wiki/Longitude)07°60' and 08° 12' East (NBS, 2021). The Makurdi camp is situated at Agan Counsil Ward about 5km from Makurdi toll gate while the other camps are situated at Daudu precisely Mbawa council ward of Guma local government area along Makurdi lafia expressway. The major occupants of these displaced communites in this region are the Tiv speaking tribe of Benue State.



**Figure 1:** Map of Benue State showing the study area. (**Source:** Land, Survey and Solid Minerals Benue State).

**2.2 Study Design**

A cross-sectional study design was employed, 200 stool samples were collected from IDPs and host Communities respectively. The stool samples were analyze using both direct wet mount and formol ether concentration technique. A structured questionnaires was then administered to all 400 participant to investigate risk factors.

**2.3 Sampling Locations**

The sample size covered a total number of three (3) camps in the selected location namely:

* Abagana (camp and host Community)
* Daudu (camp I and host Community)
* Daudu (camp II and host Community)

**2.4 Sample Size Determination**

A total number of 400 participants (200 each from both IDP camps and host communities) were examined for helminth infection. Opportunistic orconvinience sampling technique was used to select participant from each camp.**2.5 Ethical Clearance**

Ethical clearance was obtained from the ethical committee at the Benue State University college of Health sciences, Nigeria. This enabled us apply for permission at the Benue state ministry of Health and to the State Emergency Management Agency (SEMA) for clearance to carry out the study.

**2.6 Sampling Technique**

Opportunistic sampling technique was used to select participant from each camp and their communities. Samples were collected only from persons who consented to participate in the study. The study involved two phases which are; questionnaire administration and laboratory diagnosis.

**2.7 Sample Collection**

**Stool:** stool samples were collected from participants in sterile containers. All samples collected were transported to the Microbiology laboratory at the department of Biological Sciences, Benue State University, Makurdi. The stool samples were examined using standard examination technique for the identification of helminthes eggs or larvae.

**Questionnaire administration:** questionnaire was administered to investigate respondent’s knowledge about intestinal helminthes parasite, their perception and attitude towards the infection. Data on risk factors, such as water sanitation practices, hygiene behaviors, and previous deworming interventions was collected through the structure questionnaires.

**2.8 Laboratory Procedure**

Formol Ether Sedimentation and Direct Wet Mount procedure were used for Stool sample analysis**.**

**2.9 Data Analysis**

Descriptive statistics was used to summarize the prevalence of intestinal helminthes among IDPs and host communities. Chi-square test was employed to compare the prevalence between the IDPs and their Host Communities and also for association of risk factors and prevalence. SPSS (version 19.0) Statistical software was utilized for data analysis and results were presented in tables, figures and graphs.

**3. RESULTS AND DISCUSSION**

**3.1 Prevalence of helminths Infection in relation to Knowledge and Awareness**

The prevalence of helminths infection among IDPs and host community in relation to knowledge and awareness is presented in Table 1.

On the basis of the respondents who have heard of helminths parasites before participating in the study, the rate of infection was observed to be higher among respondents who had no knowledge of the infection in Abagana camp (34.8%), Daudu camp 1 (47.4%), Daudu camp 2 (37.9%) and Daudu host community (32.6%). A significant relationship was observed in relation to awareness before participation (χ2 = 12.702; df = 4; P = 0.013).

On the basis of awareness of the transmission, symptoms and prevention of helminths, those who knew very little had the highest rate of infection in Abagana host community (29.8%) and Daudu camp 2 (38.1%). Those who had some knowledge had the highest rate of infection in Abagana camp (42.9%) and Daudu camp 1 (44.4%). In Daudu host community on the other hand, those who knew a lot about the parasites had the highest rate of infection (39.1%). No significant relationship was however observed in relation to awareness of the transmission, symptoms and prevention of the helminths parasites (χ2 = 10.738; df = 8; P = 0.217).

The prevalence of helminths parasite based on diagnosis showed the highest rate of infection in respondents who had never been diagnosed in all locations with the infection rates of 41.2%, 36.4%, 42.9%, 36.8% and 31.7% in Abagana camp, Abagana host community, Daudu camp 1, Daudu camp 2 and Daudu host community respectively. There was however no significant relationship with diagnosis of the parasites in the study area (χ2 = 3.983; df = 4; P = 0.408).

**3.2 Prevalence of Helminths Parasites in Relation to Infection History, Hygiene and Sanitation**

Table 2 shows the prevalence of helminhsparatises based on the infection history, hygiene and sanitation in the study area. The result showed a significant relationship with the history of diagnosis in the study area with the respondents who have been diagnosed of helminths infection before having the highest rate of infection in all the locations except in Abagana camp which had the infection rate of 35.6% among the non-diagnosed group as against the 20.0% observed for the diagnosed group (χ2 = 10.560; df = 4; P = 0.032). A significant relationship was also observed with the rating of hygiene of facilities in the respondents’ locations (χ2 = 32.602; df = 12; P = 0.001). Those who rated the facilities to be poor where observed to be higher in all the camps and in their respective host communities. The relationship between helminths parasites and access to clean water for domestic use was also significant (χ2 = 10.769; df = 4; P = 0.029); with a highly significant relationship observed with the frequency of washing with soap (χ2 =37.626; df = 12; P = 0.000). The result however showed no significant relationship with the type of helminths diagnosed (χ2 = 6.276; df = 12; P = 0.902); treatment in the past (χ2 = 5.942; df = 4; P = 0.203); as well as the treatment type administered to respondents in the study location (χ2 = 5.566; df = 12; P = 0.936).

**Table 1: Prevalence in relation to Knowledge and awareness**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Abagana Camp | Abagana Host Community | Daudu Camp1 | Daudu Camp 2 | Daudu Host Community |  |  |
| Knowledge & Awareness | **Options** | **No. examined** | **Infected** | **No. examined** | **Infected** | **No. examined** | **Infected** | **No. examined** | **Infected** | **No. examined** | **Infected** | χ2**-value** | **P-value** |
| Have you heard of Helminths parasites(worms) before participating in this survey? | Yes | **77** | 26(33.8) | **79** | 21(26.6) | **31** | 12(38.7) | **21** | 7(33.3) | **54** | 16(29.6) | 12.702 | 0.013 |
|  | No | **23** | 8(34.8) | **21** | 5(23.8) | **19** | 9(47.4) | **29** | 11(37.9) | **46** | 15(32.6) |  |  |
|  | **Total** | **100** | **34(34)** | **100** | **26(26)** | **50** | **21(42)** | **50** | **18(36)** | **100** | **31(31)** |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| How much do you Know about the transmission, symptoms and prevention of the Worms? | Very little | **66** | 24(36.4) | **47** | 14(29.8) | **27** | 11(40.7) | **21** | 8(38.1) | **59** | 17(28.8) | 10.738 | 0.217 |
|  | Some | **14** | 6(42.9) | **33** | 9(27.3) | **18** | 8(44.4) | **18** | 6(33.3) | **18** | 5(27.8) |  |  |
|  | a lot  | **20** | 4(20.0) | **20** | 3(15.0) | **5** | 2(40) | **11** | 4(34.4) | **23** | 9(39.1) |  |  |
|  | **Total** | **100** | **34(34)** | **100** | **26(26)** | **50** | **21(42)** | **50** | **18(36)** | **100** | **31(31)** |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Have you or anyone you know been Diagnosed with helminth (worms) infection? | Yes  | **83** | 27(32.5) | **78** | 18(23.1) | **36** | 15(41.7) | **31** | 11(35.5) | **59** | 18(30.5) | 3.983 | 0.408 |
|  | No | **17** | 7(41.2) | **22** | 8(36.4) | **14** | 6(42.9) | **19** | 7(36.8) | **41** | 13(31.7) |  |  |
|  | **Total** | **100** | **34(34)** | **100** | **26(26)** | **50** | **21(42)** | **50** | **18(36)** | **100** | **31(31)** |  |  |

|  |
| --- |
| **Table 2: Prevalence in relation to helminth infection history, hygiene and sanitation** |
|  |  | Abagana Camp | Abagana Host Community | Daudu Camp 1 | Daudu Camp 2 | Daudu Host Community |  |  |
| Parameters | **Option** | **No. examined** | **Infected** | **No. examined** | **Infected** | **No. examined**  | **Infected** | **No. examined** | **Infected** | **No. examined** | **Infected** | χ2**- value** | **P- value** |
| Have you been tested for Helminth(worms) infection? | Yes  | **10** | 2(20.0) | **22** | 7(31.8) | **6** | 4(66.7) | **5** | 2(40.0) | **35** | 11(31.4) | 10.560 | 0.032 |
| No  | **90** | 32(35.6) | **78** | 19(24.4) | **44** | 17(38.6) | **45** | 16(35.6) | **65** | 20(30.8) |  |  |
| **Total**  | **100** | **34(34)** | **100** | **26(26)** | **50** | **21(42)** | **50** | **18(36)** | **100** | **31(31)** |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| If yes, please specify the type of helminth infection diagnosed. | Enterobiasis | **0** | 0(0) | **4** | 1(25.0) | **2** | 1(50.0) | **2** | 1(50.0) | **9** | 3(33.3) | 6.276 | 0.902 |
| Ascariasis | **6** | 1(16.7) | **7** | 2(28.6) | **3** | 2(66.7) | **2** | 1(50.0) | **13** | 5(38.5) |  |  |
| Taeniasis | **0** | 0(0) | **0** | 0(0) | **0** | 0(0) | **0** | 0(0) | **6** | 1(16.7) |  |  |
| Cystocerciasis | **0** | 0(0) | **0** | 0(0) | **0** | 0(0) | **0** | 0(0) | **1** | 0(0) |  |  |
| Schistosomiasis | **4** | 1(25.0) | **11** | 4(36.4) | **1** | 1(100) | **1** | 0(0) | **6** | 2(33.3) |  |  |
| **Total**  | **10** | **2(20)** | **22** | **7(31.8)** | **6** | **4(66.7)** | **5** | **2(40)** | **35** | **11(31.4)** |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Have you received treatment in the past? | Yes  | **35** | 7(20.0) | **59** | 11(18.6) | **10** | 7(70.0) | **5** | 3(60.0) | **40** | 12(30.0) | 5.942 | 0.203 |
| No  | **65** | 27(41.5) | **41** | 15(36.6) | **40** | 14(35.0) | **45** | 15(33.3) | **60** | 19(31.7) |  |  |
| **Total**  | **100** | **34(34)** | **100** | **26(26)** | **50** | **21(42)** | **50** | **18(36)** | **100** | **31(31)** |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| If yes, please indicate the type of treatment received and it effectiveness. | Mebendazole(500mg) | **7** | 1(14.3) | **13** | 3(23.1) | **4** | 3(75.0) | **2** | 1(50.0) | **12** | 4(33.3) | 5.566 | 0.936 |
| Mebendazole(500mg) | **9** | 2(22.2) | **10** | 2(20.0) | **1** | 1(100) | **0** | 0(0) | **5** | 1(20.0) |  |  |
| Albendazole (500mg) | **14** | 3(21.4) | **31** | 5(16.1) | **3** | 1(33.3) | **1** | 1(100) | **15** | 4(26.7) |  |  |
| Piperazine | **0** | 0(0) | **0** | 0(0) | **0** | 0(0) | **0** | 0(0) | **0** | 0(0) |  |  |
| Praziquantel(30mg/kg) | **5** | 1(20.0) | **5** | 1(20.0) | **2** | 2(100) | **2** | 1(50.0) | **8** | 3(37.5) |  |  |
| **Total**  | **35** | **7(20.0)** | **59** | **11(18.6)** | **10** | **7(70)** | **5** | **3(60)** | **40** | **12(30)** |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| How would you rate the hygiene and sanitation of the facilities of your current living environment? | Excellent  | **0** | 0(0) | **33** | 2(6.1) | **0** | 0(0) | **0** | 0(0) | **18** | 3(16.7) | 32.602 | 0.001 |
| Good  | **13** | 2(15.4) | **29** | 6(20.7) | **0** | 0(0) | **0** | 0(0) | **27** | 6(22.2) |  |  |
| Fair  | **24** | 8(33.3) | **21** | 9(42.9) | **5** | 2(40.0) | **4** | 1(25.0) | **35** | 8(22.9) |  |  |
| Poor  | **63** | 24(38.1) | **17** | 9(52.9) | **45** | 19(42.2) | **45** | 17(37.8) | **20** | 14(70) |  |  |
| **Total**  | **100** | **34(34)** | **100** | **26(26)** | **50** | **21(42)** | **50** | **18(36)** | **100** | **31(31)** |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Do you have access to clean water for domestic use? | Yes  | **57** | 18(31.6) | **36** | 11(30.6) | **32** | 12(37.5) | **42** | 13(30.9) | **73** | 25(34.2) | 10.769 | 0.029 |
| No  | **43** | 16(59.3) | 64 | 15(23.4) | **18** | 9(50.0) | **8** | 5(62.5) | **27** | 6(22.2) |  |  |
| **Total**  | **100** | **34(34)** | **100** | **26(26)** | **50** | **21(42)** | **50** | **18(36)** | **100** | **31(31)** |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| How often do you use soap to wash your hands? | Always  | **0** | 0(0) | **28** | 2(7.1) | **0** | 0(0) | **0** | 0(0) | **11** | 3(27.3) | 37.626 | 0.000 |
| Often  | **0** | 0(0) | **25** | 4(16.0) | **0** | 0(0) | **2** | 1(50.0) | **17** | 7(41.2) |  |  |
| Sometimes  | **15** | 6(40.0) | **17** | 9(52.9) | **17** | 7(41.2) | **26** | 8(30.8) | **54** | 15(27.8) |  |  |
| Rarely/ Never  | **85** | 28(43.1) | **30** | 11(36.7) | **33** | 14(42.4) | **22** | 9(40.9) | **18** | 6(33.3) |  |  |
| **Total**  | **100** | **34(34)** | **100** | **26(26)** | **50** | **21(42)** | **50** | **18(36)** | **100** | **31(31)** |  |  |

**3.3 Discussion**

The analysis in Table 1 revealed a statistically significant association between awareness of helminths and infection prevalence (p = 0.013). Individuals who had heard of helminths exhibited slightly lower infection rates in certain locations (e.g., 26.6% in Abagana Host Community vs. 23.8% among the unaware). However, this trend was not consistent across all sites. This partial alignment with literature is noteworthy. Adegnika *et al.* (2007) reported that health education significantly reduced the prevalence of soil-transmitted helminths (STH) in endemic communities. Similarly, the World Health Organization (WHO, 2012) emphasized that raising awareness is fundamental to achieving long-term control of helminth infections. While awareness appears to be a protective factor, the results suggest that it is not sufficient without concurrent behavioral or environmental interventions.

In terms of the depth of knowledge (ranging from "very little" to "a lot"), no statistically significant association was found with infection prevalence (p = 0.217). This finding contrasts with Gyorkos *et al.* (2013), who reported that a deeper understanding of transmission pathways particularly fecal-oral routes led to better preventive practices. The discrepancy in this study could be due to contextual limitations such as inadequate sanitation or insufficient resources to act on the knowledge, suggesting that information alone does not necessarily translate into practice in constrained environments.

Table 2 indicates no significant association between prior diagnosis or treatment and current infection status (p > 0.05). Even individuals who reported prior testing or treatment showed relatively high infection rates, especially within camp populations. These results align with the findings of Hotez *et al.* (2006) and Bethony *et al.* (2006), who noted that deworming alone is often inadequate in endemic settings, particularly where reinfection risks remain high due to environmental contamination and poor living conditions.

This study identified multiple hygiene and sanitation-related factors with significant associations: Sanitation rating showed a strong association (p = 0.001), with the highest infection rates in areas rated "poor" (e.g., 70% in Daudu Host Community). Access to clean water was also significantly associated with infection prevalence (p = 0.029). Handwashing frequency was highly significant (p = 0.000), with rare or non-practicing individuals consistently exhibiting higher infection rates (exceeding 40%). These findings are consistent with global evidence. Freeman *et al.* (2017) and Strunz *et al.* (2014) demonstrated that inadequate Water, Sanitation, and Hygiene (WASH) infrastructure significantly increases the risk of helminth infections. In particular, access to safe water and routine hand hygiene practices were shown to reduce infection risk by as much as 40%. This study provides important context-specific evidence supporting the global understanding that WASH-related factors are primary determinants of helminth infection. While knowledge and awareness may contribute to risk reduction, they are insufficient without concurrent improvements in hygiene behavior, sanitation infrastructure, and access to clean water. These findings underscore the need for integrated control strategies combining health education with structural interventions, especially in displaced or camp-based populations in Nigeria.

**4. CONCLUSION**

This study investigated the prevalence of helminth infections in displaced persons' camps and host communities in Nigeria, examining how knowledge, awareness, and hygiene-related factors influence infection rates. The findings highlight that while awareness and general knowledge about helminth transmission exist among the population, these factors alone do not significantly reduce infection prevalence. Instead, the most consistent and statistically significant determinants of helminth burden were inadequate sanitation, poor access to clean water, and irregular handwashing practices.

The results underscore a critical public health message: educational interventions must be accompanied by tangible improvements in environmental conditions and hygiene infrastructure to effectively control helminth transmission. In high-risk settings such as IDP camps and resource-limited host communities, the cycle of infection and reinfection persists despite previous treatment efforts, primarily due to environmental contamination and limited access to basic WASH facilities.

These findings support global literature advocating for integrated control strategies that combine health education with investments in water and sanitation infrastructure. Sustainable control of helminth infections in displaced populations requires a multisectoral approach involving health, education, water, and social services. Future interventions should prioritize comprehensive WASH programs, regular deworming, and behavior change communication tailored to community needs and limitations.

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