JABR Vol. 17 (1): 233 - 241 (2026)

Original Article

Clinical manifestations and risk factors of major neglected tropical diseases in Bosso, Niger State

*[1]Ayandokun, T.A, [1]Omalu I.C.J., and [2] Omenasa, R. L.

[1]Department of Animal Biology, Federal University of Technology, Minna, Niger State, Nigeria
[2]Department of Biological Sciences, Nigeria Defence Academy, Kaduna State.

Submitted: Febuary 2026; Accepted: April 2026; Published: June 2026

ABSTRACT

Neglected Tropical Diseases (NTDs) continue to impose a significant public health burden in low-resource communities across sub-Saharan Africa, including Nigeria. Despite growing awareness, the specific clinical profiles and behavioural determinants of transmission remain inadequately characterized at the community level, particularly in semi-urban settings of North-Central Nigeria. This study employed a cross-sectional descriptive design among 350 community members in Bosso Local Government Areas of Niger State, Nigeria. Structured questionnaires were administered to extract information on self-reported clinical signs and symptoms and behavioral practices. Five risk behaviours were assessed through odds ratio (OR) analysis to quantify their association with NTD infection status. A majority of respondents (86.0%, n = 301) reported at least one NTD-associated clinical symptom. Abdominal pain (65.0%) and general body weakness (58.0%) were most prevalent, followed by itching or rashes (48.0%), haematuria (82.0% among urine-positive cases), passage of worms in stool (35.0%), anal itching (26.0%), and genital swelling (18.0%). Risk factor analysis revealed that open defecation (OR = 6.13), barefoot walking (OR = 4.78), and children's contact with contaminated soil (OR = 2.98) were significant drivers of infection. Conversely, hand washing after toilet use (OR = 0.25) and washing of fruits and vegetables (OR = 0.29) demonstrated strong protective effects. Clinical morbidity from NTDs is widespread in Bosso community and is strongly associated with modifiable sanitation-related behaviors. Integrated control strategies that combine chemotherapy with targeted behavioural change communication, hygiene promotion, and environmental sanitation are urgently needed to reduce transmission and disease burden.

Keywords: Neglected tropical diseases; clinical symptoms; risk factors; sanitation, helminthiasis.

***Corresponding author's email:** [ayandokuntolulope@gmail.com, 07060591053

INTRODUCTION

Neglected Tropical Diseases (NTDs) constitute a heterogeneous group of communicable infections that disproportionately afflict populations living in poverty, with limited access to clean water, sanitation, and functional healthcare systems [1]. Globally, over 1.7 billion individuals are estimated to be at risk, with the highest burden concentrated in sub-Saharan Africa, South Asia, and parts of Latin America [2]. In Nigeria, the burden of NTDs remains particularly elevated, especially in rural and semi-urban communities where environmental deficits and socio-behavioural practices sustain transmission cycles [3].

Among the most prevalent NTDs in Nigeria are urinary schistosomiasis caused by *Schistosoma haematobium* and soil-transmitted helminth (STH) infections involving *Ascaris lumbricoides*, hookworm species, *Strongyloides stercoralis*, and *Taenia saginata* [4, 5]. These infections are closely linked to poor sanitation, contaminated soil and water sources, and specific behavioural practices such as open defecation, barefoot walking, and children's contact with contaminated soil [6]. The clinical consequences of these infections range from abdominal discomfort and generalized weakness to haematuria, anaemia, and in severe cases, irreversible organ damage and lymphoedema [7].

Despite ongoing mass drug administration (MDA) campaigns and public health interventions, NTD transmission persists in many endemic communities in Nigeria, including in Bosso Local Government Areas of Niger State. This persistence reflects a complex interplay of environmental risk factors, behavioural determinants, and programmatic gaps that existing control strategies have not adequately addressed [8, 9]. A thorough understanding of the clinical manifestations and behavioural risk predictors of NTD infection at the community level is essential for designing context-specific, evidence-based interventions.

While several national and regional studies have documented NTD prevalence in Nigeria, detailed community-level analyses of clinical symptom profiles and quantified risk factor associations remain limited for Niger State [7]. This paper presents findings from a primary field study conducted in community in Bosso, Niger State, focusing specifically on the self-reported clinical signs and symptoms of NTDs among community members, and the odd ratio-based assessment of behavioural risk factors associated with NTD infection. The findings are discussed in the context of existing literature and their implications for targeted public health interventions.

MATERIALS AND METHODS

Study Design

A cross-sectional descriptive study design was employed, enabling simultaneous collection of clinical, behavioural, and parasitological data at a single time point. This design is widely used in epidemiological investigations of NTDs given its efficiency and suitability for estimating disease burden and identifying risk factors in community settings [10]. The study was conducted in within Bosso Local Government Area of Niger State, North-Central Nigeria. This area are characterised by a tropical climate, the presence of water bodies that support the lifecycle of schistosome intermediate

hosts, reliance on untreated water sources, and poor sanitation infrastructure, making them ecologically suitable for sustained NTD transmission.

Study Population and Sampling

The study population comprised of residents in Bosso LGAs, including both infected and non-infected individuals. A multi-stage sampling technique was employed; areas were purposively selected based on known NTD endemicity; households were subsequently selected through random sampling; and eligible respondents within households were chosen using simple random sampling. A total of 350 respondents participated in the questionnaire component of the study. Only participants who provided written informed consent were enrolled. Participants who were unable or unwilling to provide consent were excluded.

Data Collection

Structured questionnaires were administered by trained field assistants through face-to-face interviews to minimize misinterpretation, particularly in areas with varying literacy levels. The questionnaire elicited information on socio-demographic characteristics, self-reported clinical signs and symptoms attributable to NTD infection, and current hygiene and sanitation practices. Biological samples (250 stool and 250 urine samples; N = 500) were also collected and analyzed for parasitological confirmation using standard techniques including direct smear, Kato-Katz thick smear, concentration methods, and urine sedimentation for *Schistosomiasis haematobium* egg detection.

Data Analysis

Data were analyzed using descriptive statistics, with frequency counts and percentages used to summarize clinical symptom prevalence. Odds ratios (ORs) with corresponding interpretations were calculated to determine the strength of association between five identified behavioural risk factors and NTD infection status. An OR greater than 1.0 indicated increased odds of infection, while an OR less than 1.0 indicated a protective effect. Results are presented in tables and a summary figure. All procedures were conducted in accordance with established ethical standards for public health research involving human participants, and ethical approval was obtained from relevant health authorities prior to data collection.

RESULTS

Of the 350 respondents, 301 (86.0%) reported experiencing at least one clinical symptom consistent with NTD infection. The distribution of reported symptoms is presented in Table 1 and illustrated in Figure 1. Abdominal pain was the most frequently reported symptom, affecting 227 respondents (65.0%), followed by general body weakness in 204 respondents (58.0%). itching or skin rashes were reported by 168 respondents (48.0%). Among respondents with confirmed haematuria from urine analysis, 82.0% reported noticing blood in their urine. Passage of worms in stool was reported by 122 respondents (35.0%), while anal itching was reported by 91 respondents (26.0%). Swelling of the limbs and genitals was reported by 64 respondents (18.0%).

These findings indicate a high prevalence of NTD-related morbidity in the study community, with gastrointestinal and

systemic symptoms being the dominant clinical presentations. The co-occurrence of multiple symptoms in a considerable proportion of respondents reflects the chronic and multi-systemic nature of NTD infections, particularly schistosomiasis and soil-transmitted helminthiases.

Table 1: Self-Reported Clinical Signs and Symptoms of NTDs among Respondents (n = 350)

Clinical Sign / Symptom	Frequency (n)	Percentage (%)
Abdominal pain	227	65.0
General body weakness	204	58.0
Itching / skin rashes	168	48.0
Blood in urine	82	82.0*
Worms in stool	122	35.0
Anal itching	91	26.0
Swollen limbs or genitals	64	18.0

*Percentage reported among urine-positive respondents only. At least one symptom reported by 301/350 respondents (86.0%).

Table 2 presents the odds ratio analysis of five behavioural variables in relation to NTD infection status. Open defecation demonstrated the strongest association with infection (OR = 6.13), with 92 of 140 respondents who practiced open defecation testing positive for NTDs (65.7%), compared to only 48 (34.3%) who were uninfected. This result indicates that individuals practicing open defecation were over six times more likely to be infected than those who did not.

Barefoot walking was the second strongest risk factor (OR = 4.78), with 110 infected respondents (56.0%) and 87 uninfected (44.0%) among those who reported walking barefoot. Children's contact with contaminated soil represented a moderate risk factor (OR = 2.98), with 120 infected (57.7%) compared to 88 uninfected (42.3%) among those reporting this exposure.

In contrast, two hygiene practices demonstrated significant protective effects. Hand washing after toilet use was strongly protective (OR = 0.25), reducing the odds of infection by approximately 75%, with only 70 of 236 respondents practicing this behavior testing positive (29.7%). Similarly, washing fruits and vegetables before consumption was protective (OR = 0.29), with only 80 of 250 respondents who practiced this behaviour found to be infected (24.2%)

.

Table 2: Odds Ratio Analysis of Behavioural Risk Factors Associated with NTD Infection in Bosso, Niger State (N = 350)

Risk Factor	Infected n (%)	Not Infected n (%)	OR	Interpretation
Open defecation	92 (65.7)	48 (34.3)	6.13	Strong risk factor
Barefoot walking	110 (56.0)	87 (44.0)	4.78	High-risk exposure
Children playing in soil	120 (57.7)	88 (42.3)	2.98	Moderate risk factor
Hand washing after toilet use	70 (29.7)	166 (70.3)	0.25	Protective factor
Washing fruits/vegetables before consumption	80 (24.2)	170 (75.8)	0.29	Protective factor

Note. OR > 1 indicates increased odds of NTD infection relative to unexposed/non-practicing group; OR < 1 indicates protective effect.

DISCUSSION

The high prevalence of self-reported clinical symptoms (86.0%) among community members in Bosso is consistent with the established morbidity profile of NTDs in endemic Nigerian communities and across sub-Saharan Africa [7, 11]. Abdominal pain (65.0%) and general body weakness (58.0%) emerged as the dominant presentations, reflecting the characteristic effects of intestinal helminth infections and haematological consequences such as anemia associated with both STH and schistosoma co-infections [4, 5].

The high rate of haematuria (82.0%) among urine-positive respondents confirms the ongoing transmission of *Schistosoma haematobium,* the aetiological agent of urogenital schistosomiasis, in the study area. This is concordant with the broader parasitological findings of the parent study, in which S. haematobium recorded the highest overall prevalence (50.0%, OR = 3.12) among all parasites detected. These figures align with reports from [12], who documented that schistosomiasis frequently co-occurs with STH infections in endemic African settings, sustained by shared environmental and behavioural exposure pathways.

The burden of itching or skin rashes (48.0%) and passage of worms in stool (35.0%) further attests to the multi-systemic nature of NTD co-infections in the study community. [8] Similarly documented persistent morbidity indicators despite repeated MDA cycles, underscoring that clinical burden in endemic communities is not easily resolved by chemotherapy alone without addressing the underlying environmental and behavioural drivers. The relatively lower but clinically significant proportion reporting swelling or genital swelling (18.0%) may reflect the contribution of lymphatic filariasis or advanced schistosoma pathology to the disease burden, consistent with findings of [13], who identified long-term disability as an underappreciated consequence of NTD morbidity in West African communities.

These findings collectively underscore an important public health paradox documented in the study: despite relatively high self-reported awareness of NTDs (88.0% had heard of NTDs), a substantial proportion of respondents continued to experience illness-related symptoms (86.0%) and functional weakness (58.0%). This awareness-health outcome disconnect aligns with observations by [6], who reported that helminth infections significantly impair physical wellbeing even in populations

with basic disease knowledge. It further reinforces the position advanced by [14] that awareness, in isolation, is insufficient to translate into health protection without concurrent improvements in sanitation infrastructure, access to treatment, and sustained behavioural change.

The odds ratio analysis reveals a clear gradient of infection risk associated with specific sanitation-related behaviours in the Bosso community. Open defecation emerged as the strongest modifiable risk factor (OR = 6.13), indicating that individuals engaging in this practice were over six times more likely to harbour NTD infections than those who did not. This finding is consistent with the well-established mechanistic link between faecal contamination of soil and water and the transmission of soil-transmitted helminths particularly *Ascaris lumbricoides*, hookworm species, and *Strongyloides stercoralis* which rely on embryonation in faecally contaminated soil before becoming infective to humans [4,10].

Barefoot walking was the second most significant risk factor (OR = 4.78), reflecting the percutaneous transmission route of hookworm larvae and *Strongyloides stercoralis*, both of which penetrate the skin of individuals with direct soil contact. This is corroborated by the findings of [6], who identified barefoot walking as a strongly significant predictor of STH infection in Southern Nigerian communities. Similarly, children's contact with contaminated soil (OR = 2.98) is an established route of exposure, particularly for *Ascaris lumbricoides* and *Trichuris trichiura*, given that children are more likely to engage in ground-level play activities in endemic settings [15].

The identified protective behaviours, hand washing after toilet use (OR = 0.25) and washing of fruits and vegetables before consumption (OR = 0.29) demonstrate that simple, low-cost hygiene practices can reduce infection risk by approximately 71–75%. These findings are consistent with global evidence on water, sanitation, and hygiene (WASH) interventions as complementary strategies to MDA in NTD control [16, 17]. The WHO NTD Road Map 2021–2030 explicitly identifies WASH integration as a cross-cutting pillar for achieving NTD elimination targets [1], and the present data provide community-level empirical validation for this strategic priority.

Taken together, the risk factor analysis reveals that NTD transmission in Bosso community is sustained by a cluster of modifiable behaviours embedded within a context of inadequate sanitation infrastructure. This is consistent with the behavioural epidemiology literature, which identifies the interaction between structural environmental factors and individual-level practices as a key determinant of helminth transmission intensity [18]. Addressing these risk factors requires not only health education but also investment in community sanitation infrastructure, particularly the provision and promotion of latrines, hand washing facilities with soap, and clean water access.

CONCLUSION

This study demonstrates that NTD-associated clinical morbidity is widespread and severe in Bosso, Niger State, affecting 86.0% of respondents with symptoms including abdominal pain, general weakness, haematuria, and passage of worms. Behavioural risk factor

analysis identifies open defecation (OR = 6.13), barefoot walking (OR = 4.78), and children's soil contact (OR = 2.98) as the primary drivers of NTD transmission, while hand washing after toilet use (OR = 0.25) and food hygiene (OR = 0.29) represent significant protective behaviours. The persistence of clinical burden despite high community awareness underscores the inadequacy of awareness campaigns in isolation and highlights the urgent need for integrated NTD control strategies that combine MDA with behavioural change communication, WASH infrastructure improvements, and community mobilization. Context-specific, community-level data such as those presented here are essential for informing evidence-based policy and programmatic decisions aimed at accelerating NTD elimination in North-Central Nigeria.

Declarations

Ethical approval: Ethical approval was obtained from relevant health authorities in Niger State prior to the commencement of data collection. Informed consent was obtained from all participants.

REFERENCES

1. World Health Organization. (2021). Ending the neglect to attain the Sustainable Development Goals: A road map for neglected tropical diseases 2021–2030. WHO Press. https://www.who.int
2. Hotez, P. J., Alvarado, M., Basáñez, M. G., Bolliger, I., Bourne, R., Boussinesq, M., & Naghavi, M. (2020). The global burden of neglected tropical diseases. The Lancet Infectious Diseases, 19(2), e120–e131. https://doi.org/10.1016/S1473-3099(18)30655-6
3. Ohiolei, J. A., Isaac, C., & Omorodion, O. A. (2017). Soil-transmitted helminthiasis in Nigeria: A review of prevalence and risk factors. Asian Pacific Journal of Tropical Disease, 7, 930–937.
4. Bethony, J., Brooker, S., Albonico, M., Geiger, S. M., Loukas, A., Diemert, D., & Hotez, P. J. (2006). Soil-transmitted helminth infections: Ascariasis, trichuriasis, and hookworm. The Lancet, 367(9521), 1521–1532. https://doi.org/10.1016/S0140-6736(06)68653-4
5. Colley, D. G., Bustinduy, A. L., Secor, W. E., & King, C. H. (2014). Human schistosomiasis. The Lancet, 383(9936), 2253–2264. https://doi.org/10.1016/S0140-6736 (13) 61949-2
6. Usang, A. U., Imalele, E. E., Effanga, E. O., Ukoha, U. K., & Eleng, I. E. (2025). Soil-transmitted helminth infections and nutritional indices among children (5–9 years) and adolescents (10–12 years) in Calabar, Nigeria. BMC Public Health, 25(1), Article 1. https://doi.org/10.1186/s12889-024-21210-4
7. Ochola, E. A., Karanja, D. M., & Elliott, S. J. (2021). The impact of neglected tropical

diseases on health and wellbeing in sub-Saharan Africa: A case study of Kenya. PLOS Neglected Tropical Diseases, 15(2), e0009131.

8. Dunn, J. C., Turner, H. C., Toor, J., & Webster, J. P. (2019). Soil-transmitted helminth reinfection after mass drug administration. PLOS Neglected Tropical Diseases, 13 (2), e0006591. https://doi.org/10.1371/journal.pntd.0006591
9. Branda, F., Yusuf Ali, A., Ceccarelli, G., Albanese, M., Binetti, E., Giovanetti, M., Ciccozzi, M., & Scarpa, F. (2024). Assessing the burden of neglected tropical diseases in low-income communities: Challenges and solutions. Viruses, 17(1), 29. https://doi.org/10.3390/v17010029
10. Brooker, S., & Clements, A. C. A. (2008). Global epidemiology, ecology and control of soil-transmitted helminth infections. Advances in Parasitology, 62, 221–261.
11. Gyapong, J. O., & Boatin, B. A. (Eds.). (2024). Neglected tropical diseases – Sub-Saharan Africa (2nd ed.). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-53901-5
12. Okongo, W., Muhumuza, C., Aguegboh, N. S., Bwambale, E., & Diallo, B. (2025). Mathematical modelling of the co-infection dynamics of soil-transmitted helminths and schistosomiasis with optimal control. Boundary Value Problems, 2025, Article 160. https://doi.org/10.1186/s13661-025-02146-z
13. Tossou, Y. B., Gbaguidi, F. N. C., Agbo, S. I. E., Zanvo, S. D. E., Codjo-Seignon, K. L. M., Biaka, P. H., Guedou, F. A., Kouadio, K. J., Anagonou, S. G. E., Mignanwande, F. Z., Djossou, P., Yemadje, B. V., Houndjrebo, F. S., Arrawo, J. N. L., Faihoun, Y., Johnson, H., Sopoh, G. E., Houezo, J. G., Kaloga, M., Dizoe, A. S., Nichter, M., Juan Jimenez, C., Gine-March, A., & Johnson, R. C. (2025). Factors associated with the management of people affected by disabilities in communities endemic to skin-related neglected tropical diseases in Benin and Côte d'Ivoire. Frontiers in Tropical Diseases, 6, 1522660. https://doi.org/10.3389/fitd.2025.1522660
14. Udo, S., Ogbu, P. S., Tsaku, P. A., Tukur, A., & NewMarch, A. (2024). An evaluation of mental health integration in the neglected tropical diseases program in Zamfara, North-west Nigeria. International Health, 16(Supplement_1), i52–i59. https://doi.org/10.1093/inthealth/ihae003

15. Anah, M. U., Abia-Bassey, L. N., Ikpeme, E. E., & Etuk, I. S. (2008). Worm infestation and anaemia among pre-school children of peasant farmers in Calabar, Nigeria. Nigerian Journal of Clinical Practice, 11, 220–224.
16. World Health Organization. (2022). Schistosomiasis and soil-transmitted helminthiases: Progress report, 2021. Weekly Epidemiological Record, 97(36), 429–444. https://www.who.int
17. Braun, L., Grimes, J. E. T., & Templeton, M. R. (2018). The effectiveness of water treatment processes against schistosome cercariae: A systematic review. PLOS Neglected Tropical Diseases, 12(4). https://doi.org/10.1371/journal.pntd.0006364
18. Anderson, R. M., & May, R. M. (1991). Infectious diseases of humans: Dynamics and control. Oxford University Press.
19. Fitzpatrick, C., & Engels, D. (2016). Leaving no one behind: A neglected tropical disease indicator. International Health, 8(Suppl_1), i15–i18. https://doi.org/10.1093/inthealth/ihw002
20. Molyneux, D. H., Savioli, L., & Engels, D. (2017). Neglected tropical diseases: Progress towards addressing the chronic pandemic. The Lancet Global Health, 5(4), e416–e418. https://doi.org/10.1016/S2214-109X(17)30110-8
21. Oyewole, O. E., & Simon-Oke, I. A. (2022). Ecological risk factors of soil-transmitted helminths infections in Ifedore District, Southwest Nigeria. Bulletin of the National Research Centre, 46(13). https://doi.org/10.1186/s42269-022-00700-8