

Geo-Spatial Epidemiological Study of Schistosomiasis and Soil Transmitted Helminthiasis in Barkin Ladi and Bassa Local Government Areas, Plateau State, Nigeria

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Abstract: *Schistosomiasis and Soil-Transmitted Helminthiasis (STH) continue to pose considerable public health issues in Nigeria, especially in rural areas where access to clean water and sanitation is limited. Plateau State faces ongoing transmission challenges due to its intricate hydrological system and agricultural methods. This research evaluated the prevalence, intensity, and risk factors associated with Schistosomiasis and STH infections in the Barkin Ladi and Bassa Local Government Areas of Plateau State, Nigeria. A community-based cross-sectional study was carried out involving 600 participants (300 from each LGA). Stool samples were examined using the Kato-Katz method for STH, while urine samples were analyzed by filtration for Schistosoma haematobium. A semi-structured questionnaire was utilized to gather demographic, behavioral, and Water, Sanitation, and Hygiene (WASH) information. Environmental risk factors were evaluated using Geographic Information Systems (GIS) and remote sensing data to model the susceptibility to Schistosomiasis and STH. In Barkin Ladi (Ban community), no cases of schistosomiasis were found (0% prevalence), whereas the prevalence of STH was 8.0%. In the Bassa (Khian) community, the prevalence of Schistosomiasis was 2.66% (S. haematobium: 1.67%; S. mansoni: 1.00%), and the prevalence of STH was 10.66%. The highest infection rates for both diseases were observed in the 11–20 years age group, with males exhibiting a higher prevalence than females. The geospatial vulnerability mapping revealed that Land Use/Land Cover (LULC) was the most critical factor for schistosomiasis (weight: 0.402), while soil moisture was the primary determinant for STH (weight: 0.256). The study confirms the spatial variability in the transmission of Schistosomiasis and STH, affirming the predictive capability of geospatial models. There is an urgent requirement for targeted, risk-stratified interventions, including mass drug administration, improvements in WASH, and health education aimed at school-aged children and young adults.*

Keywords: schistosomiasis, soil-transmitted helminthiasis, neglected tropical diseases, geospatial modeling, epidemiology, Plateau State, Nigeria

INTRODUCTION

Schistosomiasis and soil-transmitted helminths (STH) are parasitic diseases that primarily affect rural communities in sub-Saharan Africa, where access to clean water and adequate sanitation remains inadequate [1]. Schistosomiasis, which is caused by *Schistosoma* species, is spread through freshwater snails that act as intermediate hosts, whereas STHs, such as *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms, are transmitted via soil contaminated with feces [2]. The prevalence of schistosomiasis and STH is especially severe in sub-Saharan Africa, attributed to favorable climatic conditions, widespread poverty, insufficient water and sanitation facilities, and reliance on natural water sources for domestic and occupational purposes. The persistence of these infections is further intensified by rapid population growth, environmental degradation, climate fluctuations, and limited access to preventive treatments [3; 4]. Numerous studies have indicated that helminth infections significantly contribute to anemia, malnutrition, stunted growth, impaired cognitive development, poor academic performance, decreased work productivity, and heightened susceptibility to other infectious diseases [5].

Nigeria has one of the highest burdens of Neglected Tropical Diseases (NTDs) in the world. Mapping efforts across Nigeria have revealed that STHs are endemic in 20 out of 36 states, with hookworm and *A. lumbricoides* co-existing in 16 states [6]. Schistosomiasis is endemic in 583 of the 774 local government areas (LGAs) across the country [7]. This substantial burden has made Nigeria a focal point for NTD elimination initiatives as outlined in the WHO NTD Road Map 2021–2030 [8]. Plateau State, situated in north-central Nigeria, is particularly at risk due to its intricate hydrological system, agricultural practices, and ongoing transmission patterns [9]. Despite decades of Mass Drug Administration (MDA) programs, transmission remains heterogeneous and poorly understood at the micro-geographical level. The Federal Ministry of Health's master plan highlighted the critical need for scaled-up, targeted interventions, but a major impediment has been the lack of current, high-resolution risk maps to guide resource allocation [10].

Increasingly, epidemiological studies have shown that environmental and climatic variables play critical roles in shaping the spatial distribution of schistosomiasis and STH. Factors such as rainfall, temperature, elevation, slope, land use/land cover, vegetation density, and soil moisture have been identified as major determinants of parasite survival and transmission [3; 11]. Recent studies further demonstrate that environmental reservoirs and ecological suitability strongly influence the persistence of STH transmission even in communities where preventive chemotherapy has been implemented for several years. Environmental contamination, inadequate sanitation, and poor hygiene practices continue to sustain transmission cycles despite reductions in infection prevalence [12]. Advances in Remote Sensing (RS), Geographic Information Systems (GIS), and spatial epidemiology have provided powerful tools for understanding the environmental determinants of NTD transmission. These technologies facilitate the integration of epidemiological, demographic, and environmental datasets to identify disease hotspots, predict areas of elevated risk, and support evidence-based intervention planning. GIS-based risk modelling has been successfully applied in several African countries to map schistosomiasis and STH distribution and optimize resource allocation for disease control programmes [11; 13]. Recent advances in geospatial

technology, including remote sensing and Geographic Information Systems (GIS), have revolutionized disease mapping and risk prediction. Remote sensing provides environmental variables, vegetation indices, surface temperature, and water indices that correlate with vector habitats and disease risk [8]. Studies have demonstrated that day land surface temperature and dense vegetation are important predictors of STH spatial distribution in Nigeria [6]. Platforms like Google Earth Engine (GEE) enable large-scale environmental data processing, facilitating predictive modeling for NTD transmission [14]. However, a critical gap persists: most studies remain cross-sectional, geographically restricted to single communities, or lack predictive capacity. While local studies have reported prevalence figures [15, 16], no comprehensive, state-wide, validated spatio-temporal risk model has been available for Plateau State. This study addresses this gap by combining retrospective data analysis with primary validation surveys in Barkin Ladi and Bassa LGAs.

Therefore, this study assessed the spatial epidemiology of schistosomiasis and soil-transmitted helminthiasis in Barkin Ladi and Bassa LGAs of Plateau State, Nigeria, through determination of infection prevalence, demographic risk factors, environmental determinants, and geospatial vulnerability patterns. Specifically, the study determined the prevalence and distribution of schistosomiasis and STH, according to age and gender-related risk factors, examined the influence of environmental variables on disease transmission, and validated GIS-based predictive models for identifying transmission hotspots. Findings contributed to evidence-based planning and implementation of integrated NTD control strategies in Plateau State with potential application to endemic settings across Nigeria.

MATERIALS AND METHODS

Study Area

Barkin Ladi and Bassa Local Government Areas are predominantly rural with mixed farming economies in Plateau State, north-central Nigeria. Barkin Ladi is characterized by highland topography (elevation 1,000–1,500 meters above sea level), cooler temperatures, and rapid water drainage. Bassa features low lying areas with gentle slopes, proximity to water bodies, and higher temperatures. Both LGAs have multiple water contact points, including streams, rivers, and seasonal ponds, and are endemic for schistosomiasis and STH.

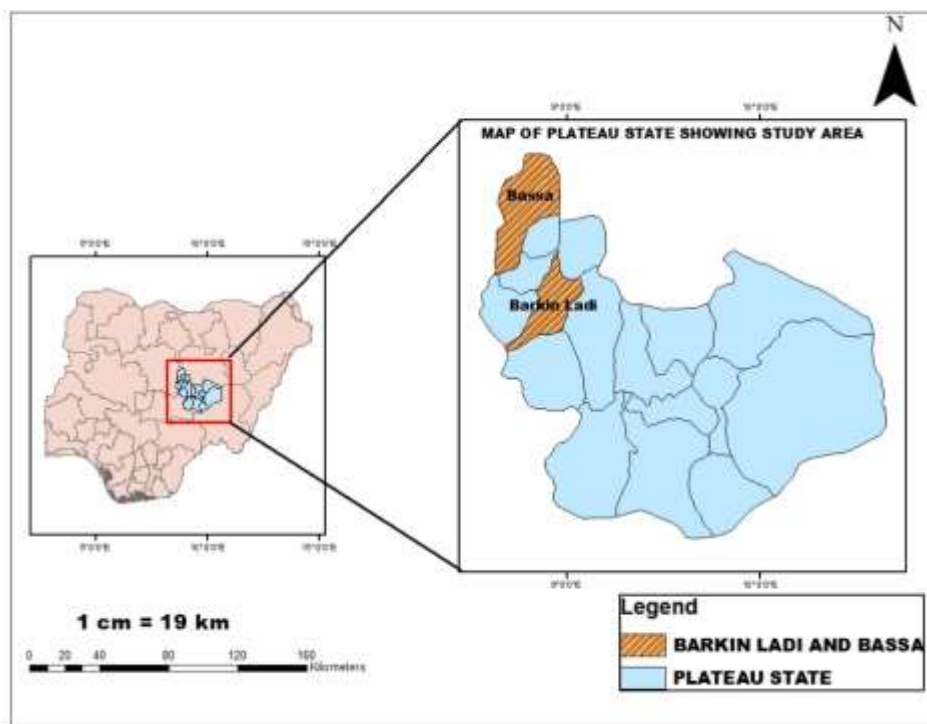


Figure 1 Map of Plateau State Showing Bassa and Barkin Ladi LGAs. (Source: Author analysis, 2026)

Study Design and Population

A community based cross sectional study was conducted. The target population consisted of residents aged 5 years and above in Ban community (Barkin Ladi LGA) and Khian community (Bassa LGA). A sample size of 300 participants per LGA (total N=600) was calculated using the prevalence estimate of 30% from previous studies [17] with 95% confidence interval and 5% margin of error, plus 10% non-response contingency.

Ethical Considerations

Ethical approval was obtained from the Plateau State Ministry of Health Ethics Committee. Written informed consent was obtained from all adult participants and parents/guardians of minors.

Sampling Procedure

A two-stage cluster sampling method was employed. In the first stage, communities were purposively selected based on geospatial risk modeling and accessibility. In the second stage, households were systematically sampled, and all eligible individuals (aged ≥ 5 years) were invited to participate. Informed consent was obtained from adult participants and parents/guardians for minors.

Parasitological Survey

Specimen Collections

Fresh stool samples were collected in sterile, labeled containers and transported to the Primary Health Center (PHC) laboratory within the area. For urinary schistosomiasis, urine samples were collected between 10:00 AM and 2:00 PM to maximize detection of *S. haematobium* eggs, as egg excretion peaks during this period [18; 19].

Stool Analysis (Kato-Katz Technique)

Stool samples were processed using the Kato-Katz thick smear technique [20; 21]. Approximately 41.7 mg of feces was placed on a microscope slide, covered with cellophane soaked in glycerol-malachite green, and examined under a microscope within 30–60 minutes.

Urine Analysis (Urine Filtration)

A 10 ml of urine was filtered through a Nuclepore membrane (12 µm pore size). The filter was placed on a microscope slide, stained with iodine, and examined for *S. haematobium* eggs. Infection intensity was recorded [22; 23].

Quality Control

All slides were examined by two independent trained microscopist and parasitologists. A 10% random sample of slides was re-examined by a senior parasitologist for quality assurance.

Questionnaire Survey

A semi-structured questionnaire was administered by trained field workers in the local language (Berom and Amo). The questionnaire captured: demographic information; water contact sourced; sanitation practices; hygiene practices; knowledge of schistosomiasis and STH; and treatment seeking behaviors.

Geospatial Data Collection and Processing

Data Sources

Environmental data were obtained from multiple sources: Digital Elevation Model (USGS Earth Explorer), Landsat 9 TIRS imagery (USGS), rainfall data (CHIRPS), Land Surface Temperature (MODIS), and NDVI (MODIS).

Variable Derivation

Environmental variables were derived as follows: $NDVI = (NIR - Red) / (NIR + Red)$; LST from Landsat 9 thermal bands; $NDWI = (Green - NIR) / (Green + NIR)$; Soil Moisture Index using the method of [24]; slope and aspect from DEM; distance to water bodies using Euclidean distance.

Vulnerability Model

A multi-criteria decision analysis approach was employed using the Analytic Hierarchy Process (AHP). For schistosomiasis, criteria included: LULC (weight 0.402), rainfall (0.232), slope (0.145), DEM (0.112),

LST (0.058), and NDVI (0.051). For STH, criteria included: SMI (0.256), LULC (0.221), rainfall (0.198), LST (0.152), slope (0.093), and DEM (0.080). Weights were validated by consistency ratio (<0.1).

Statistical Analysis

Data obtained were entered into Microsoft Excel and analyzed using SPSS version 25.0. Descriptive statistics were employed. Chi-square test was used to compare proportions. Logistic regression analysis was performed to identify risk factors. A p-value <0.05 was considered statistically significant. Spatial analysis was conducted in ArcGIS Pro and QGIS 3.16.

RESULTS

Geospatial Vulnerability Assessments

Schistosomiasis Vulnerability Factors

Land Use/Land Cover (LULC): Vegetation covered the largest proportion (82.39%, 21,836.3 km²) and was ranked 4th in vulnerability (High) due to moisture retention and shaded microenvironments conducive to snail habitats. Water bodies, though only 0.17% (43.939 km²), were ranked highest (Very High) due to their direct association with transmission (Table 1).

Table 1: Analysis of Land Use Land Cover (LULC)

S/N	Class	Area km ²	%	Ranking	Vulnerability
1	Bare surface	2025.304	7.64	3	Moderate
2	Built-up area	737.688	2.78	2	Low
3	Rock Outcrop	1859.439	7.02	1	Not vulnerable
4	Vegetation	21836.3	82.39	4	High
5	Water bodies	43.939	0.17	5	Very High

Land Surface Temperature (LST): The highest temperature range (38.8–44.1°C), covering 18.69% of the study area, was classified as Very High vulnerability (Ranking 5). Areas with 35.5–38.7°C (29.61%) were High vulnerability, while cooler areas (24.7–30.1°C) were Not vulnerable (Table 2).

Table 2: Analysis of Land Surface Temperature (LST)

S/N	Temperature	Area	%	Ranking	Vulnerability
1	24.7 - 30.1	2949.139	11.13	3	Not vulnerable
2	30.2 - 33.4	7075.378	26.7	2	Low
3	33.5 - 35.4	3653.843	13.79	1	Moderate
4	35.5 - 38.7	7848.414	29.61	4	High
5	38.8 - 44.1	4952.83	18.69	5	Very High

DEM and Slope: Low-lying areas (91–301 m) covering 43.77% were Very High vulnerability. Flat terrain was also Very High vulnerability due to water stagnation, while higher elevations (1,160 – 1,760) and steeper slopes showed decreasing vulnerability (Table 3).

Table 3: Analysis of Digital Elevation Model (DEM)

S/N	Elevation (m)	Area	%	Ranking	Vulnerability
1	91 - 301	11600.18	43.77	5	Very High
2	302 - 582	3980.284	15.02	4	High
3	583 - 890	2509.454	9.47	3	Moderate
4	891 - 1,150	3529.084	13.32	2	Low
5	1,160 - 1,760	4866.955	18.36	1	Very Low

Rainfall: Highest rainfall zones (2,400–3,340 mm), though only 5.57% of the area, were Very High vulnerability (Table 4).

Table 4: Analysis of Rainfall Distribution

S/N	Rainfall (mm)	Area	%	Ranking	Vulnerability
1	1,190 - 1,460	9368.61	35.35	1	Not Vulnerable
2	1,470 - 1,610	9450.775	35.66	2	Low
3	1,620 - 1,880	3276.735	12.364	3	Moderate
4	1,890 - 2,390	2910.64	10.982	4	High
5	2,400 - 3,340	1475.513	5.567	5	Very High

STH Vulnerability Factors

For STH, bare surfaces were identified as Very High vulnerability (7.64% of area), while water bodies showed low vulnerability (Table 5). Soil moisture emerged as the most important factor, with (21.94%) moist areas classified as Very High vulnerability (Table 6).

Table 5: Analysis of Land Use Land Cover (LULC)

S/N	Class	Area km ²	%	Ranking	Vulnerability
1	Bare surface	2025.304	7.64	5	Very High
2	Built-up area	737.688	2.783	3	Moderate
3	Rock Outcrop	1859.439	7.016	1	Not vulnerable
4	Vegetation	21836.3	82.393	4	High
5	Water bodies	43.939	0.166	2	Low

Table 6: Analysis of Soil Moisture Index (SMI)

S/N	Class	Area km ²	%	Ranking	Vulnerability
1	Dry area	10649.171	40.2	3	Moderate
2	Moist area	5811.215	21.94	5	Very High
3	Wet area	10028.334	37.86	3	High

Composite Vulnerability

The weighted overlay analysis revealed that 52.91% of Plateau State falls within high and very high schistosomiasis vulnerability categories. Bassa LGA was classified as High vulnerability, while Barkin Ladi was categorized as Low vulnerability (Table 7).

Table 7: Schistosomiasis vulnerability

S/N	Vulnerability	Area	%
1	Not Vulnerability	1993.353	7.52
2	Low	4735.678	17.87
3	Moderate	5644.778	21.3
4	High	6435.575	24.28
5	Very High	7586.958	28.63

For STH, low vulnerability covered the largest portion (39.53%), while high vulnerability areas accounted for 23.48%. Barkin Ladi and Bassa were identified as hotspots (Table 8).

Table 8: STH vulnerability

S/N	Vulnerability	Area	%
1	Not Vulnerability	2568.194	9.71
2	Low	10457.654	39.53
3	Moderate	7217.523	27.28
4	High	6212.074	23.48

Parasitological Survey Results**Schistosomiasis Prevalence**

A total of 600 participants were examined (300 from Ban community, Barkin Ladi LGA; 300 from Khian community, Bassa LGA). In Ban, no schistosomiasis cases were detected (0% prevalence). In Khian, 8 cases were positive (2.66% prevalence), with *S. haematobium* (5 cases, 1.67%) more common than *S. mansoni* (3 cases, 1.00%) (Table 9).

Table 9 : Incidence of *Schistosomiasis*

communitites	Number examined	Number infected		Percentage prevalence
		<i>Schistosoma mansoni</i>	<i>Schistosoma haematobium</i>	
Ban (Barkin Ladi)	300	0	0	0
Khian (Bassa)	300	3	5	2.66

STH Prevalence

STH prevalence was 8.0% in Ban (24 cases) and 10.66% in Khian (32 cases) (Table 10). Overall prevalence ranged from 8.0–10.66%, falling within the low transmission category according to WHO guidelines (<20%).

Table 10. Incidence of *Soil Transmitted Helminthiasis*

Communitites and LGAs	Number examined	Number infected	Percentage prevalence
Ban (Barkin Ladi)	300	24	8.0
Khian (Bassa)	300	32	10.66

Gender Distribution

Male predominance was observed for both infections. In Khian, males had 3.92% schistosomiasis prevalence compared to 1.36% in females (Table 11). For STH, males in Khian showed 13.72% prevalence versus 7.48% in females; in Ban, males had 8.67% versus 7.0% in females (Table 12).

Table 11. Incidence of *Schistosomiasis* Among the Inhabitants in Relation to Gender.

Community and LGAs	Gender		Number examined	Number infected		Percentage infected	
	Male	Female		M	F	M	F
Ban (Barkin Ladi)	173	127	300	0	0	0	0
Khian (Bassa)	153	147	300	6	2	3.92	1.36

M=Male, F=Female

Table 12. Incidence of Soil Transmitted Helminthiasis among the inhabitants in relation to Gender.

Community and LGAs	Gender		Number examined	Number infected		Percentage infected	
	Male	Female		M	F	M	F
Ban (Barkin Ladi)	173	127	300	15	9	8.67	7.0
Khian (Bassa)	153	147	300	21	11	13.72	7.48

M=Male, F=Female

Age Distribution

The 11–20 years age group showed a higher prevalence for both diseases. In Khian (Bassa LGA), schistosomiasis prevalence peaked at 5.74% (11–20 years) (Table 13). For STH, the 11–20 years group had a higher prevalence in both communities (Ban: 11.21%; Khian: 17.24%) (Table 14 and 15). Notably, Khian's 21–30 years group also showed an STH prevalence of (13.95%) (Table 15).

Table 13. Incidence of Schistosomiasis Among the Inhabitants of Khian Bassa LGA, Plateau State in Relation to Age

Age Group (years)	Number examined	Number infected	Percentage Infected
0-10	70	2	2.85
11-20	87	5	5.74
21-30	43	1	2.32
31-40	55	0	0
41-50	25	0	0
51-Above	20	0	0

Table 14. Incidence of Soil Transmitted Helminthiasis Among the Inhabitants of Ban Barkin Ladi LGA, Plateau State in Relation to Age Groups

Age Group (years)	Number examined	Number infected	Percentage Infected
0-10	83	6	7.22
11-20	107	12	11.21
21-30	56	3	5.35
31-40	44	3	6.81
41-50	10	0	0
51-Above	0	0	0

Table 15. Incidence of Soil Transmitted Helminthiasis Among the Inhabitants of Khian Bassa LGA, Plateau State in Relation to Age groups

Age Group (Years)	Number examined	Number infected	Percentage Infected
0-10	70	8	11.42
11-20	87	15	17.24
21-30	43	6	13.95
31-40	55	2	3.63
41-50	25	1	4.0
51-Above	20	0	0

WASH Practices and Behavioral Risk Factors

Boreholes served as the primary drinking water source. However, rivers and streams were the main sources for bathing, washing, and other domestic activities. Distance to water sources ranged from 100–500 meters from households. Dense vegetation surrounding water bodies created ideal snail habitats. Daily water contact activities included: bathing, swimming, fetching water, washing clothes/dishes, farming/irrigation, crossing water bodies, and livestock watering. Most households used traditional pit latrines, often shared. Environmental observations confirmed open defecation. Community members reported defecating and urinating near or into water bodies. Inconsistent footwear use was reported. Handwashing with soap after toilet use was inconsistent. Knowledge of schistosomiasis was low and did not know that snails transmit diseases. In contrast, knowledge of STH was higher; respondents could identify symptoms and transmission pathways.

DISCUSSION

Spatial Heterogeneity and Model Validation

The notable disparities in the prevalence of schistosomiasis and soil-transmitted helminths (STH) between Ban (0% schistosomiasis, 8.0% STH) and Khian (2.66% schistosomiasis, 10.66% STH) affirm the predictive capability of the geospatial model. The model accurately recognized Barkin Ladi as a low-risk area and Bassa as a higher-risk area for both infections. This spatial variability, even among relatively close local government areas (LGAs), highlights the significance of local environmental factors in influencing transmission dynamics [12]. The absence of schistosomiasis in Ban corresponds with the ecological features of Barkin Ladi, a highland region characterized by cooler temperatures, steep slopes, and rapid water drainage, conditions that are not conducive to the survival and reproduction of intermediate host snails. Prior research has indicated that altitude is a strong indicator of schistosomiasis distribution in West Africa [25]. A study conducted in Kisayhip, Bassa LGA, Plateau State, reported schistosomiasis prevalence between 4.0% and 8.0% among primary school students [26], which aligns with the 2.66% prevalence noted in Khian, confirming that Bassa continues to be an endemic area. The identification of land use and land cover (LULC) as the most critical factor for schistosomiasis (weight 0.402) is consistent with findings that agricultural regions, vegetation, and proximity to water bodies heighten exposure to habitats inhabited by infected snails [25]. This conclusion is supported by research indicating that dense vegetation is a significant predictor of STH spatial distribution in Nigeria [6].

Regarding STH, soil moisture was identified as the primary factor (weight 0.256), reinforcing the understanding that helminth eggs necessitate sufficient moisture for embryonation and survival [27, 28]. A recent investigation utilizing Random Forest and Particle Swarm Optimization algorithms revealed that soil temperatures ranging from 25–32°C create optimal conditions for the development of helminth eggs [29], further substantiating the role of environmental factors in STH distribution.

Prevalence in Context

The prevalence of schistosomiasis recorded in Khian (2.66%) is lower than the rates documented in numerous other endemic regions of Nigeria. [29] indicated that there was no intestinal schistosomiasis in Ogun State, although an overall prevalence of soil-transmitted helminths (STH) was found to be 38.2%. A separate investigation in primary schools within Ogun State revealed a schistosomiasis prevalence of 4.0% alongside an STH prevalence of 34.64% [30]. In Anambra State, the initial prevalence for helminth infections was 8%, which decreased to 6% during follow-up, with *A. lumbricoides* (7.0%), *T. trichiura* (1.0%), Hookworm (0.1%), and *S. haematobium* (0.5%) being identified [7]. The reduced prevalence observed in this study may be linked to the ongoing mass drug administration (MDA) programs in Plateau State. Research has indicated that MDA coverage in Plateau State has been substantial, with mebendazole coverage reaching 81% and praziquantel coverage at 73% prior to mainstreaming [31]. Nevertheless, the issue of coverage heterogeneity persists, particularly among unenrolled children or those with irregular school attendance [32]. This observation underscores the necessity for community-based distribution systems to effectively reach all populations at risk.

Age and Gender Patterns

The observation that the age group of 11–20 years experiences the greatest burden of schistosomiasis and soil-transmitted helminths (STH) aligns with findings from both global and Nigerian studies. Research indicates that school-aged children and adolescents exhibit the highest prevalence rates due to their increased engagement in water contact activities, the development of immunity, and periods of peak exposure [32]. Significant age-related differences in STH prevalence have been documented ($\chi^2 = 22.225$, $p = 0.002$) [29], reinforcing the notion that school-aged children constitute the primary risk demographic. Furthermore, the notable prevalence of STH in the 21–30 years age group in Khian (13.95% for STH) indicates that young adults also serve as a crucial reservoir for transmission. This finding calls into question the exclusive emphasis on school-based deworming initiatives and supports the World Health Organization's recommendations to incorporate at-risk adult populations into preventive chemotherapy strategies [8]. Modeling studies indicate that implementing community-wide mass drug administration (MDA), coupled with high coverage and adherence, has the potential to disrupt disease transmission [7]. The observed male predominance is consistent with varying exposure patterns. Research has demonstrated that infection intensity tends to be higher in males compared to females, although often without statistically significant differences ($P > 0.05$) [32]. Nonetheless, in certain communities, females may experience greater exposure due to activities such as domestic water collection and laundry [31]. The differences in gender patterns reflect variations in local occupational roles, cultural practices, and behaviors related to water contact.

WASH and Behavioral Implications

The WASH assessment has identified significant gaps that continue to facilitate transmission even in the presence of chemotherapy. The ongoing issue of open defecation, which is reported at 39% in certain studies, poses a major obstacle to eradication [7]. Research indicates that factors such as walking barefoot, the type of toilet used (whether absent or bush), and the inconsistent washing of fruits and vegetables prior to consumption are strongly linked to soil-transmitted helminths (STH) [31]. The lack of knowledge surrounding schistosomiasis is particularly alarming. In the absence of understanding regarding transmission pathways, community members are often unmotivated to alter their water contact practices or pursue treatment. Engaging the community has been recognized as a crucial, yet often neglected, component of control initiatives [7]. Research highlights that misconceptions about interventions or doubts concerning their effectiveness can result in low levels of participation [7, 33].

Strengths and Limitations

Strengths: This study combines geospatial modeling with primary parasitological validation, demonstrating the predictive capacity of environmental risk models. It provides comparative data from two LGAs with contrasting environmental profiles and uses the WHO standard diagnostic techniques.

Limitations: The cross-sectional design captures transmission at a single point in time, not accounting for seasonal variations. The Kato-Katz technique has known limitations in sensitivity for low-intensity infections. The study was limited to two LGAs, limiting generalizability.

Public Health Implications

The findings have several important public health implications:

1. **Targeted Interventions:** The low prevalence in Barkin Ladi suggests this LGA may require only surveillance rather than active MDA, while Bassa requires continued preventive chemotherapy. This supports WHO recommendations for risk-stratified intervention approaches [8].
2. **Focus on School-Aged Children and Young Adults:** The high prevalence in the 11–20 years group confirms that school-based deworming programs remain critical. However, the substantial prevalence in young adults indicates that community-wide MDA may be necessary to achieve elimination [7, 32].
3. **Gender-Sensitive Interventions:** Health education should specifically target boys and young men regarding water contact behaviors.
4. **WASH Interventions:** Chemotherapy alone is insufficient. Studies have shown that addressing cultural and economic challenges, alongside improving WASH infrastructure, is essential to sustain MDA impact [7].
5. **Health Education:** The critical knowledge gap regarding schistosomiasis demands comprehensive community health education. Effective community empowerment through knowledge, engagement, and collaboration can bring about sustainable changes that reduce infection risk [7, 8].
6. **Geospatial Tools for Decision Support:** The validated geospatial model can serve as a decision-support tool for the Plateau State Ministry of Health to optimize resource allocation [7, 29].

CONCLUSION

This study provides important evidence on the prevalence and risk factors of schistosomiasis and STH in Barkin Ladi and Bassa LGAs of Plateau State, Nigeria. The findings validate the predictive capacity of geospatial models, demonstrating spatial heterogeneity that aligns with environmental determinants of transmission. Barkin Ladi showed no schistosomiasis and lower STH prevalence, while Bassa showed a higher transmission. The study confirms that school-aged children (11–20 years) and males bear the highest burden of infection. While prevalence rates are lower than in many other Nigerian settings, likely due to years of MDA, the persistence of transmission demands continued and strengthened interventions. The geospatial vulnerability provides actionable data for targeted, risk-stratified intervention approaches. The Plateau State Ministry of Health and development partners should utilize these to optimize allocation of praziquantel, albendazole, and WASH interventions, prioritizing high-risk areas while maintaining surveillance in low-risk zones. Comprehensive approaches integrating chemotherapy, WASH improvements, health education, and community engagement are essential to achieve the WHO NTD Road Map 2030 targets.

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