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Epidemiological Patterns of Schistosomiasis in North Central Nigeria: A Systematic Review of Prevalence, Risk Factors, and Control Strategies

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Abstract

Schistosomiasis remains one of the most important neglected tropical diseases and constitutes a persistent public health challenge in Nigeria, which bears the highest global burden of infection. Although numerous epidemiological studies have been conducted in North Central Nigeria, no previous systematic review has comprehensively synthesized regional evidence on disease prevalence, associated risk factors, diagnostic approaches, and control strategies. This systematic review therefore aimed to synthesize the available evidence on the epidemiological patterns of schistosomiasis in North Central Nigeria to provide region-specific evidence for disease control and policy. The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. A comprehensive search of Google Scholar, PubMed, African Journals Online (AJOL), and ScienceDirect was performed to identify eligible studies published between January 2000 and July 2026. Methodological quality was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for prevalence studies, and findings were synthesized narratively because of substantial heterogeneity among included studies. Nineteen studies involving 13,729 participants across six states and the Federal Capital Territory met the inclusion criteria. The included studies demonstrated moderate to high methodological quality, with JBI quality scores ranging from 5 to 7 out of 9. Reported prevalence ranged from 2.07% to 77.4%, with *Schistosoma haematobium* identified as the predominant species and school-aged children representing the most affected population. Frequent contact with contaminated freshwater bodies was the most consistently reported risk factor, while urine filtration and the Kato–Katz technique were the principal diagnostic methods. Mass drug administration with praziquantel, health education, and improvements in water, sanitation, and hygiene (WASH) were the most frequently recommended control strategies. These findings highlight the need for strengthened integrated schistosomiasis control programmes that combine preventive chemotherapy with improved WASH infrastructure, health education, snail control, and enhanced surveillance to support progress toward the WHO 2030 elimination targets. This review is the first to systematically synthesize epidemiological evidence specifically for North Central Nigeria, thereby providing region-specific evidence to guide public health planning and resource allocation. However, interpretation of the findings should consider the substantial heterogeneity in study designs, populations, and diagnostic methods, which precluded quantitative meta-analysis and limited direct comparison across studies.

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1.0 Introduction

Schistosomiasis (bilharzia) is one of the most important neglected tropical diseases (NTDs) and remains a major public health challenge in many low- and middle-income countries. The disease is caused by blood flukes of the genus Schistosoma and is transmitted through contact with freshwater contaminated by cercariae released from infected freshwater snails (Verjee, 2019; Ezeh et al., 2019). Globally, an estimated 250 million people are infected, with over 90% of cases occurring in sub-Saharan Africa, where the disease continues to contribute substantially to morbidity, disability, and socioeconomic losses (Klohe et al., 2021; Ogongo et al., 2022).

Although several systematic reviews have summarized the epidemiology and control of schistosomiasis in Nigeria (Ezeh et al., 2019; Oyeyemi et al., 2020; Oluwole et al., 2022), these reviews primarily provide national or continental perspectives and do not specifically examine the epidemiological characteristics of individual geopolitical regions. Consequently, important regional differences in disease transmission, prevalence, risk factors, diagnostic practices, and implementation of control strategies remain insufficiently characterized. This represents an important knowledge gap because schistosomiasis transmission is strongly influenced by local ecological, environmental, socioeconomic, and public health conditions, which vary considerably across Nigeria.

North Central Nigeria deserves independent epidemiological synthesis because the region possesses unique ecological and demographic characteristics that favour persistent schistosomiasis transmission. The region contains numerous rivers, dams, irrigation schemes, wetlands, and freshwater bodies that provide suitable habitats for intermediate host snails. Furthermore, rural communities throughout the region frequently depend on rivers and streams for domestic, occupational, agricultural, and recreational activities, thereby increasing human exposure to infective cercariae. Despite the implementation of preventive chemotherapy programmes in several states, transmission continues to occur, suggesting substantial geographical heterogeneity in disease burden and effectiveness of control interventions (Griswold et al., 2022).

Previous studies conducted across North Central Nigeria have reported markedly different prevalence estimates, diagnostic approaches, and associated risk factors (Abdullahi & Saidu, 2011; Nyamngee et al., 2018; Abba et al., 2022; Opeyemi et al., 2024; Jacob et al., 2025). Reported prevalence ranges from very low to extremely high across different communities, while considerable variation exists in sample sizes, target populations, diagnostic techniques, and study settings. Some investigations relied exclusively on urine filtration for detecting Schistosoma haematobium, whereas others combined urine filtration with the Kato–Katz technique to identify both urinary and intestinal schistosomiasis. Such methodological heterogeneity limits direct comparison of findings and makes it difficult for policymakers to obtain a clear understanding of the epidemiological situation across the region.

Several important questions therefore remain unanswered. First, what is the overall epidemiological pattern of schistosomiasis

across the states of North Central Nigeria? Second, which demographic and environmental factors consistently contribute to transmission throughout the region? Third, how do differences in diagnostic methods influence reported prevalence estimates? Finally, what evidence exists regarding the effectiveness and consistency of currently recommended control strategies? Addressing these questions is essential for identifying priority intervention areas and supporting evidence-based planning for schistosomiasis elimination.

Nigeria carries the highest burden of schistosomiasis globally, with approximately 20 million people requiring treatment annually and more than 130 million individuals living in endemic communities requiring preventive chemotherapy (Oluwole et al., 2022). The two predominant human species are Schistosoma haematobium, which causes urogenital schistose-miasis, and Schistosoma mansoni, which causes intestinal schistosomiasis. School-aged children remain the population most affected because of their frequent contact with contaminated freshwater during domestic, recreational, and occupational activities (Alade et al., 2023).

Transmission occurs when infected individuals contaminate freshwater with urine or faeces containing parasite eggs. Following hatching, miracidia infect freshwater snails, where they develop into cercariae that are subsequently released into surrounding water bodies. Human infection occurs when cercariae penetrate intact skin during water contact. Adult worms establish within the venous circulation, and retained eggs induce chronic inflammatory responses that may result in urinary tract pathology, intestinal disease, hepatic fibrosis, impaired growth, reduced cognitive development, and, in severe cases, bladder cancer (Ejinaka et al., 2019; Carbonell et al., 2021).

Given the substantial disease burden, the wide variation in reported prevalence, and the absence of a region-specific evidence synthesis, a comprehensive systematic review focusing exclusively on North Central Nigeria is both timely and necessary. By consolidating fragmented epidemiological evidence, evaluating methodological quality, identifying consistent risk factors, and synthesizing reported control strategies, this review provides a comprehensive regional assessment to support public health decision-making, guide future research priorities, and contribute toward achieving the World Health Organization's 2030 schistosomiasis elimination targets.

Therefore, this systematic review aimed to synthesize the available evidence on the prevalence, risk factors, diagnostic approaches, and control strategies of schistosomiasis in North Central Nigeria.

2.0 Methods

2.1 Search Strategy

A comprehensive systematic literature search was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (Page et al., 2021). The review aimed to identify published studies reporting the epidemiology of schistosomiasis in North Central Nigeria. The review protocol was not prospectively registered in the International Prospective Register of Systematic Reviews (PROSPERO) or any other registry, which is acknowledged as a limitation of this review.

Electronic searches were conducted in four databases: PubMed, Google Scholar, African Journals Online (AJOL), and ScienceDirect. The databases were searched between 15 and 20 July 2026 for studies published from January 2000 to July 2026. The search strategy combined Medical Subject Headings (MeSH), where applicable, and free-text keywords using Boolean operators (AND and OR) to maximize retrieval of relevant studies.

The search terms included: "schistosomiasis", "*Schistosoma haematobium*", "*Schistosoma mansoni*", "urinary schistosomiasis", "intestinal

schistosomiasis", "prevalence", "epidemiology", "risk factors", "control strategies", "North Central Nigeria", "Kwara", "Kogi", "Benue", "Nasarawa", "Niger State", "Plateau", and "Federal Capital Territory". These terms were combined using the following Boolean search strategy: ("schistosomiasis" OR "*Schistosoma haematobium*" OR "*Schistosoma mansoni*" OR "urinary schistosomiasis" OR "intestinal schistosomiasis") AND ("prevalence" OR "epidemiology" OR "risk factors" OR "control strategies") AND ("North Central Nigeria" OR "Kwara" OR "Kogi" OR "Benue" OR "Nasarawa" OR "Niger State" OR "Plateau" OR "Federal Capital Territory").

Only peer-reviewed articles published in English were considered eligible for inclusion. In addition, the reference lists of all included studies were manually screened to identify potentially relevant publications that might not have been retrieved through the electronic database search. The complete database-specific search strategies have been provided as Supplementary Appendix S1 to enhance the transparency and reproducibility of the review.

2.2 Eligibility Criteria

Peer-reviewed publications reporting the epidemiology of schistosomiasis in North Central Nigeria were included if they met the following criteria:

- were conducted in any of the states within North Central Nigeria or the Federal Capital Territory;
- reported prevalence of schistosomiasis among human participants;
- identified risk factors associated with schistosomiasis infection;
- published in peer - reviewed journals between January 2000 and July 2026; and
- written in English language.

Articles were excluded if they:

- were conducted outside North Central Nigeria;
- consisted of case reports, editorials, commentaries, or conference abstracts;
- were animal studies;
- lacked prevalence data;
- were duplicate publications or
- comprised grey literature or unpublished studies.

2.3 Selection Process

Records retrieved from the four electronic databases were screened using a two-stage process. In the first stage, titles and abstracts were screened by two independent reviewers in line with the predefined eligibility criteria to identify potentially eligible studies. In the second stage, full texts of potentially eligible studies were retrieved and assessed against the inclusion and exclusion criteria. Studies that did not satisfy the inclusion criteria at the full-text stage were excluded, with reasons for exclusion appropriately documented. Ultimately, nineteen studies met the inclusion criteria and were included in the final review with eligibility criteria consistently applied throughout the review to minimize selection bias.

2.4 Critical Appraisal and Risk of Bias

Methodological quality of all included 19 eligible studies were examined using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for prevalence studies (Munn *et al*., 2020). The checklist consists of nine domains: evaluating the appropriateness of the sample frame, sample method, sample size, description of study participant and setting, coverage of the identified sample, validity of the methods used to identify the condition, consistency of condition measurement, appropriate of statistical analysis, and adequacy of response rate. Each criterion was rated as yes, no or unclear to inform the risk of bias assessment by two independent reviewers. The quality scores of the studies ranged from 5 to 7 out of 9 possible scores, which shows moderate to high methodological quality. Each study was scored out of 9 points based on JBI Critical Appraisal Checklist for studies reporting prevalence data.

Studie with 7-9 were classified as having low risk of bias (high methodological quality), those with 0-3 have high risk of bias (low methodological quality), while those with 4-6 have moderate risk of bias. The results of this review were contextualized and interpreted using quality ratings, and no study was excluded based on its appraisal score alone.

2.5 Data Extraction and Analysis

The two reviewers R.A.A. and R.B.I., used Microsoft Excel standardized forms to extract data through their independent work. Publications that failed to meet the inclusion criteria were excluded, whereas those that met the review's objectives were retrieved for full-text evaluation. The following data (i-ix) were extracted from each publication included in the final analysis:

i. Author (s) and publication date (year)
ii. The study state (Location)
iii. Sample size (Total number of participant)
iv. Age group of the study population
v. Schistosomiasis prevalence reported
vi. Schistosoma spp. specifically Identified (e.g., S. haematobium and S. mansoni)
vii. Diagnostic technique(s) employed
viii. Risk factors associated with infection (Covariates or behaviours)
ix. Reported control and prevention strategies (e.g., Mass Drug Administration [MDA], WASH initiatives, snail control).

As a result of the difference in study designs, study populations, geographical settings, and diagnostic techniques across the 19 included studies, a narrative synthesis was employed. Study location, prevalence rates, Schistosoma species distribution, associated risk factors, diagnostic methodologies, and reported control strategies were used to systematically organized and thematically summarized results.

3.0 Results

3.1 Search and Selection Results

The systematic literature search identified 9,594 records from four electronic databases (Google Scholar, PubMed, African Journals Online, and ScienceDirect). After removing 1,200 duplicate records using EndNote X9, 8,394 unique records remained for title and abstract screening. Two independent reviewers (R.A.A. and A.M.) screened the records using predefined eligibility criteria implemented through Covidence software.

Following the initial screening, 8,321 records were excluded because they did not meet the inclusion criteria. The full texts of the remaining 73 articles were independently assessed for eligibility. Of these, 54 studies were excluded because they were conducted outside North Central Nigeria (n = 20), lacked prevalence data (n = 15), were case reports (n = 10), involved animal studies (n = 5), or represented duplicate publications (n = 4). Consequently, 19 studies fulfilled all eligibility criteria and were included in the final narrative synthesis. Disagreements during study selection were resolved through discussion, with arbitration by the third reviewer (M.A.A.). The complete study identification and selection process is presented in the PRISMA 2020 flow diagram (Figure 1).

3.2 Characteristics of Included Studies

The characteristics of the 19 studies included in this review are summarized in Table 1. Collectively, the studies were published between 2010 and 2026 and represented all six states of the North Central geopolitical zone—Kwara, Kogi, Plateau, Benue, Nasarawa, and Niger—as well as the Federal Capital Territory (FCT), Abuja. Overall, the studies involved 13,729 participants, with sample sizes ranging from 80 to 4,902 individuals (Abdulazeez et al., 2024; Sunday et al., 2025).

Most investigations focused on school-aged children, reflecting the recognized vulnerability of this population to schistosomiasis transmission. Only two studies included broader community populations spanning childhood to adulthood (Nzelu et al., 2025; Sunday et al., 2025). Across the included studies, reported prevalence ranged from 2.07% to 77.4%, demonstrating substantial epidemiological variability within the region.

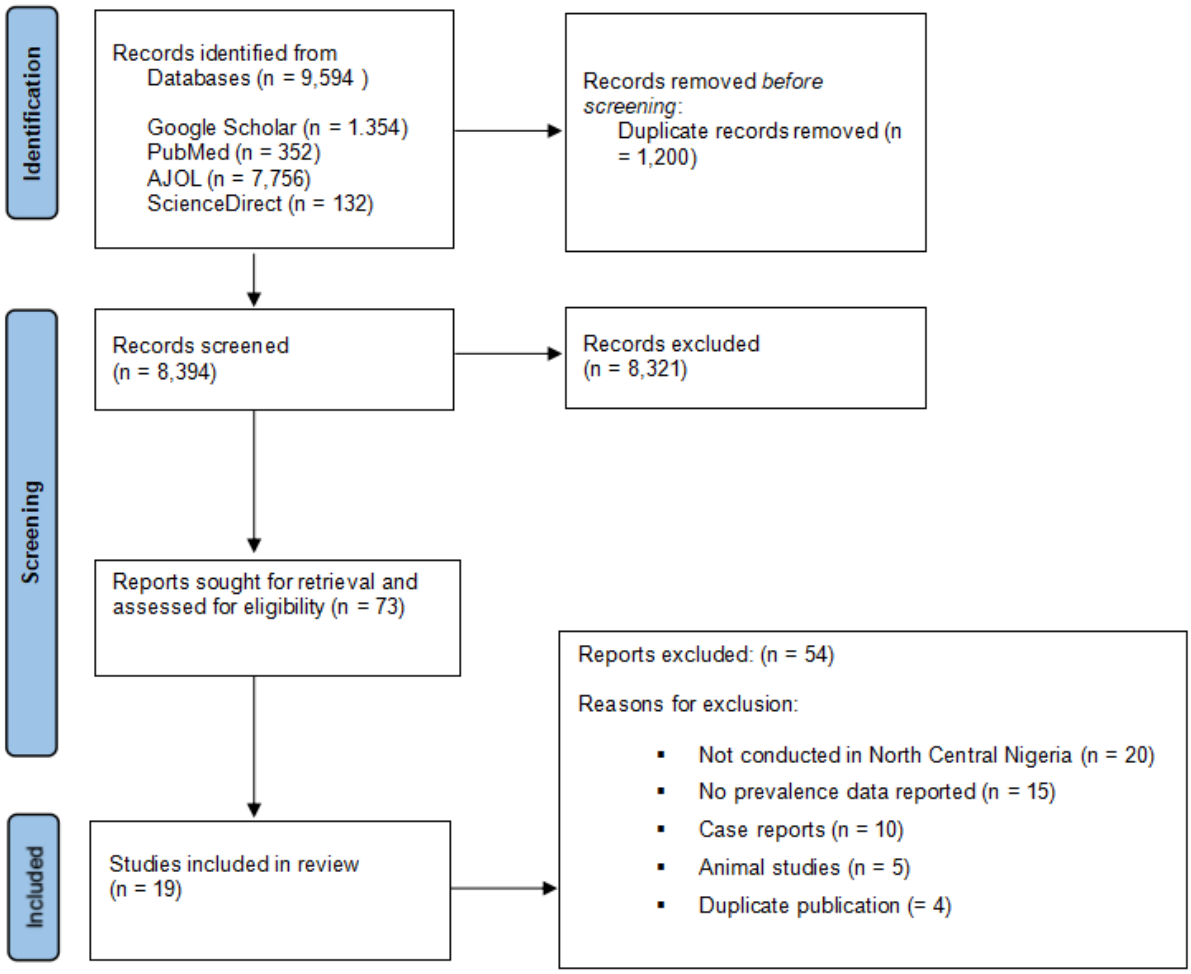

Figure 1: PRISMA 2020 flow diagram illustrating the literature search and study selection process for the systematic review on the epidemiological patterns of schistosomiasis in North Central Nigeria (Page *et al*., 2021).

Methodological quality, assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist, ranged from 5 to 7 out of 9, indicating that all studies were of moderate to high methodological quality. Seven studies were classified as having low risk of bias, whereas the remaining studies demonstrated moderate risk of bias, providing an acceptable evidence base for narrative synthesis.

3.3 Geographic Distribution of Studies

The included studies demonstrated an uneven geographical distribution across North Central Nigeria (Figure 2). Kwara State contributed the largest number of studies (n = 5), followed by Plateau State (n = 4) and Kogi State (n = 3). Benue, Nasarawa, and Niger States each contributed two studies, while the Federal Capital Territory (Abuja) was represented by a single investigation (Abba et al., 2022; Reuben et al., 2013; Inalegwu & Amuta, 2026; Nzelu et al., 2025; Abdullahi & Saidu, 2011; Mahmud, 2024; Jacob et al., 2025).

This distribution indicates that epidemiological evidence is concentrated in relatively few states, with Kwara and Plateau accounting for nearly half of all available studies. Consequently, although evidence exists across the geopolitical zone, research coverage remains uneven, highlighting the need for additional epidemiological investigations in underrepresented areas to improve regional disease surveillance and programme planning.

Table 1: Included Studies in this systematic review. Characteristics of studies included to evaluate the epidemiological patterns of schistosomiasis in North Central Nigeria: A systematic review of risk factors, control strategies, and prevalence

SN	Author and Year	State	Sample Size	Prevalence (%)	Age Group	Risk factors	Species	Diagnostic method	Control Strategies	Quality Score	Risk of Bias
1	Abba *et al.*, 2022	Nasarawa	100 school-aged children	5.8%	school-aged children age 5 - 12 years were included	Swimming and taking baths in river	*Schistosoma mansoni and S. haematobium*	Urine filtration and Kato-katz	1. MDA; 2. HE; 3. WS	6/9	Moderate
2	Opeyemi *et al.*, 2024	Kwara	1,341 School age Pupils	20.7%	School-aged children age 4 - 20 years were recruited	Water contact, especially fishing	*Schistosoma haematobium*	Urine filtration	1. MDA; 2. HE; 3. WS	7/9	Low
3	Mac *et al.*, 2026	Plateau	1,368 School-aged children	20.7%	School-aged children age 9 - 19 years were included	Open defecation	*Schistosoma haematobium*	Urine filtration and Kato-katz	NR	7/9	Low
4	Sunday *et al.*, 2025	Kwara	4,902 participants	30.1%	5 - 40 years individuals	Frequent water contact	*Schistosoma haematobium*	Urine filtration	1. MDA; 2. HE; 3. WS	6/9	Moderate
5	Amaechi *et al.*, 2024	Jebba, Kwara	276 School age children	20.6%	School-aged children 5 - >14 years were included	Open defecation and frequent water contact	*Schistosoma mansoni*	Kato-katz	1. MDA; 2. HE	7/9	Low
6	Nyamngee *et al.*, 2018	Edu, Kwara	1,479 pupils	77.4%	School-aged children 4 - 20 years were examined	Frequent water contact	*Schistosoma haematobium*	Urine filtration	1. MDA; 2. HE; 3. WS	7/9	Low
7	Dawet *et al.*, 2012	Gwong and Kabong Districts, Plateau	242 individuals	2.07%	10 -14 and 35 -39 years	Frequent water contact	*Schistosoma haematobium*	Urine filtration	1. WS; 2. HE	6/9	Moderate
8	Goselle *et al.*, 2010	Public and Private Primary and Secondary schools, Plateau State	280 pupils/students	4.6%	10 -14 years	Contaminated water supply	*Schistosoma mansoni*	Kato-katz	NR	6/9	Moderate
9	Nzelu *et al.*, 2025	Benue state	452 participants	16.8%	1 - 60 years individuals	proximity to open water bodies and drinking from open water bodies	*Schistosoma mansoni and S. haematobium*	Urine filtration and Kato-katz	1. MDA; 2. HE; 3. SC	7/9	Low

SN	Author and Year	State	Sample Size	Prevalence (%)	Age Group	Risk factors	Species	Diagnostic method	Control Strategies	Quality Score	Risk of Bias
10	Obiora *et al.*, 2022	Pupils in Pilot Primary School Jos North,Plateau State	100 pupils were included	36.0%	<=8 - >=17 years	stream as source of water	*Schistosoma haematobium*	Urine filtration	1. MDA; 2. HE; 3.WS; 4. SC	5/9	Moderate
11	Abdulkareem *et al.*, 2018	Kwara	724 participants	45.6%	4 -18 years	Frequency of water contact, source of water supply, unemployment, and lack of knowledge of infection	*Schistosoma haematobium*	Urine filtration	1. MDA; 2.WS	7/9	Low
12	Reuben *et al.*, 2013	Nasarawa	160 urine samples from school-aged children	16.3%	11 - 21> age group	Stream as source of water	*Schistosoma haematobium*	Urine filtration	1. MDA; 2. HE; 3.WS	6/9	Moderate
13	Inalegwu *et al.*, 2026	Makurdi, Benue State	1,032 school-aged children	56.69%	School-aged children (5 –19 years)	Direct reliance on streams for domestic use	*Schistosoma haematobium*	Urine filtration	1. MDA; 2. HE; 3.WS	6/9	Moderate
14	Umar *et al.*, 2023	Lokoja, Kogi state	463 residents were included	60.4%	13 - 50 years	Proximity to contaminated water and frequent water contact	*Schistosoma mansoni and S. haematobium*	Urine filtration and Kato-katz	1. MDA; 2. HE; 3.WS; 4. SC	6/9	Moderate
15	Jacob *et al.*, 2025	Abuja	1370 participants were recruited	27.5%	5 – 14 years for SAC and 15 years and above for the adult population	Swimming in river water	*Schistosoma mansoni and S. haematobium*	Urine filtration and Kato-katz	1.HE; 2.WS	6/9	Moderate
16	Abdulazeez *et al.*, 2024	primary school pupils in Adankolo, Lokoja	80 urine samples	26.5%	4 -12 years	Swimming and washing in rivers and ponds	*Schistosoma haematobium*	Urine filtration	1. MDA; 2. HE	5/9	Moderate
17	Yusuf *et al.*, 2025	School pupils in Okengwe, Kogi State	100 urine samples	10.00%	5 - 15 years	Swimming, washing and bathing in open water bodies	*Schistosoma haematobium*	Urine centrifugation	1. MDA; 2. HE	5/9	Moderate

SN	Author and Year	State	Sample Size	Prevalence (%)	Age Group	Risk factors	Species	Diagnostic method	Control Strategies	Quality Score	Risk of Bias
18	Mahmud, 2024	School-aged childreN Residing near streams in the Kpakungu, Fadukpe, and Chanchaga municipal areas of Minna, Niger State.	200 urine samples	15%	School-aged children (3 - 15) years	swimming, fishing, and irrigation	*Schistosoma haematobium*	Urine filtration	NR	7/9	Moderate
19	Abdullahi & Saidu, 2011	School-aged children in Zungeru and Wushishi Minna, Niger State.	100 urine samples	40.00%	School aged children (1 - 20) years	Bathing and washing of clothes in surface water.	*Schistosoma haematobium*	Urine filtration	1. MDA; 2. HE	6/9	Moderate
Average										6.21	

Key: MDA = Mass Drug Administration; HE = Health education; WS = Water and Sanitation; NR = Not Reported; FCT = Federal Capital Territory; SAC= School aged children; JBI = Joanna Briggs Institute

3.4 Study Participants

The reviewed studies predominantly investigated school-aged children, who constituted the principal target population in 17 of the 19 included studies. Participant ages ranged from 3 to 20 years in most investigations, reflecting the emphasis of national schistosomiasis control programmes on school-based surveillance and preventive chemotherapy.

Only two studies extended recruitment to include wider community populations, encompassing individuals aged 1–60 years (Nzelu et al., 2025) and 5-40 years (Sunday et al., 2025). Overall, the review synthesized epidemiological data from 13,729 participants, providing substantial regional evidence regarding schistosomiasis occurrence in North Central Nigeria. The predominance of school-aged children among study participants further emphasizes the disproportionate burden of infection within this high-risk demographic.

3.5 Prevalence of Schistosomiasis

Considerable variation in schistosomiasis prevalence was observed across North Central Nigeria, with reported prevalence ranging from 2.07% to 77.4%. The wide variation reflects differences in geographical location, environmental exposure, study populations, diagnostic approaches, and transmission intensity across endemic communities.

Among the states, Kwara State exhibited the widest range of reported prevalence and contained the highest prevalence documented in this review. Five studies conducted in the state reported prevalence estimates ranging from 20.6% to 77.4%. The highest prevalence (77.4%) was recorded among school pupils in Edu Local Government Area (Nyamngee et al., 2018), while other studies reported prevalence of 45.6%, 30.1%, 20.7%, and 20.6%, respectively (Abdulkareem et al., 2018; Sunday et al., 2025; Opeyemi et al., 2024; Amaechi et al., 2024). These consistently moderate-to-high prevalence estimates indicate persistent transmission within several communities in Kwara State.

Similarly, Kogi State demonstrated a substantial disease burden, although considerable heterogeneity was evident across communities. Reported prevalence ranged from 10.0% to 60.4%, with the highest prevalence observed among residents living along the River Niger in Lokoja (Umar et al., 2023), followed by 26.5% among primary school pupils in Adankolo (Abdulazeez et al., 2024), whereas Yusuf et al. (2025) reported a comparatively lower prevalence of 10.0% among school children in Okengwe.

In Benue State, prevalence estimates varied from 16.8% to 56.7%. Inalegwu et al. (2026) documented a particularly high prevalence among school-aged children in Makurdi, whereas Nzelu et al. (2025) reported considerably lower prevalence among a broader community population. The observed variation may reflect differences in study populations and environmental exposure.

Studies conducted in Plateau State reported prevalence ranging from 2.07% to 36.0%. The highest prevalence (36.0%) was reported by Obiora et al. (2022), while Mac et al. (2026) documented a prevalence of 20.7% among school-aged children. In contrast, substantially lower prevalence was reported by Goselle et al. (2010) (4.6%) and Dawet et al. (2012) (2.07%), suggesting considerable geographical variation within the state.

Lower prevalence estimates were generally reported in Nasarawa State, where studies documented prevalence of 5.8% and 16.3% (Abba et al., 2022; Reuben et al., 2013). In Niger State, prevalence ranged from 15.0% among school-aged children living near streams (Mahmud, 2024) to 40.0% among school children in Zungeru and Wushishi (Abdullahi & Saidu, 2011). The only study conducted in the Federal Capital Territory reported a prevalence of 27.5% among both school-aged children and adults (Jacob et al., 2025).

Overall, prevalence patterns indicate that schistosomiasis remains endemic throughout North Central Nigeria but exhibits marked geographical heterogeneity. States such as Kwara, Kogi, and Benue generally reported higher prevalence than Nasarawa and parts of Plateau State, suggesting differences in transmission dynamics, environmental conditions, water-contact behaviour, and implementation of control programmes across the region. Figure 2 summarizes the highest prevalence reported in each state.

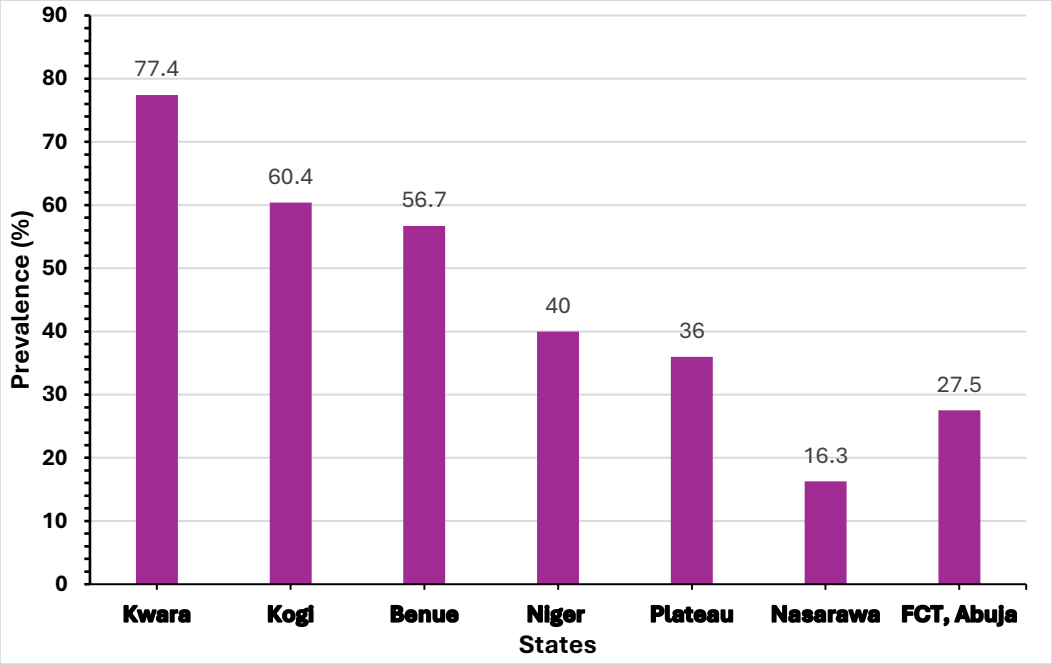

Figure 2: An Illustration of schistosomiasis prevalence recorded by states in North-Central Nigeria

3.6 Diagnostic Methods

The included studies employed a limited number of standard parasitological techniques for the diagnosis of schistosomiasis, with the choice of diagnostic method largely reflecting the Schistosoma species under investigation. Overall, urine filtration was the most frequently used diagnostic technique, consistent with the predominance of urinary schistosomiasis (Schistosoma haematobium) across North Central Nigeria. Fourteen studies relied exclusively on urine filtration for parasite detection (Goselle et al., 2010; Reuben et al., 2013; Nyamngee et al., 2018; Abba et al., 2022; Mahmud, 2024; Abdulazeez et al., 2024; Opeyemi et al., 2024; Sunday et al., 2025; Jacob et al., 2025; Yusuf et al., 2025; Nzelu et al., 2025; Inalegwu et al., 2026; Mac et al., 2026; Amaechi et al., 2024).

In contrast, four studies combined urine filtration with the Kato–Katz thick smear technique, enabling simultaneous detection of both urinary and intestinal schistosomiasis (Dawet et al., 2012; Abdullahi & Saidu, 2011; Obiora et al., 2022; Umar et al., 2023). Only one study employed the Kato–Katz technique alone because it focused exclusively on intestinal schistosomiasis.

The predominance of urine-based diagnostic methods reflects the greater epidemiological importance of S. haematobium within the region. Nevertheless, the use of different diagnostic techniques across studies may have contributed to variations in reported prevalence, particularly in communities where mixed infections occurred. Consequently, methodological differences should be considered when comparing prevalence estimates across locations.

3.7 Distribution of Schistosoma Species

The reviewed studies consistently identified Schistosoma haematobium as the predominant species responsible for human schistosomiasis in North Central Nigeria. Sixteen of the nineteen studies investigated urinary schistosomiasis exclusively, confirming that S. haematobium remains the principal parasite circulating within the region (Goselle et al., 2010; Reuben et al., 2013; Nyamngee et al., 2018; Abba et al., 2022; Mahmud, 2024; Abdulazeez et al., 2024; Opeyemi et al., 2024; Sunday et al., 2025; Jacob et al., 2025; Yusuf et al., 2025; Nzelu et al., 2025; Inalegwu & Amuta, 2026; Mac et al., 2026; Amaechi et al., 2024).

Evidence of intestinal schistosomiasis caused by Schistosoma mansoni was comparatively limited. Five studies reported S. mansoni infections either alone or alongside S. haematobium, indicating that intestinal schistosomiasis occurs in localized foci within the region rather than being uniformly distributed (Abdullahi et al., 2011; Dawet et al., 2012; Obiora et al., 2022; Umar et al., 2023).

3.8 Risk Factors Associated with Schistosomiasis

Across the included studies, schistosomiasis transmission was consistently associated with a combination of environmental, behavioural, demographic, and socioeconomic factors, highlighting the multifactorial nature of disease persistence in North Central Nigeria.

The most consistently reported risk factor was frequent contact with contaminated freshwater bodies, including rivers, streams, ponds, dams, and irrigation canals. Activities such as swimming, bathing, washing clothes, fishing, farming, fetching water, and other occupational or recreational water-contact behaviours were repeatedly identified as major drivers of infection (Goselle et al., 2010; Dawet et al., 2012; Nyamngee et al., 2018; Umar et al., 2023; Mahmud, 2024; Jacob et al., 2025).

School-aged children represented the population at greatest risk, largely because of their frequent recreational and domestic exposure to freshwater environments. Several studies also identified male sex as an independent risk factor, reflecting greater participation in outdoor water-

related activities (Abba et al., 2022; Abdulazeez et al., 2024; Yusuf et al., 2025).

Environmental determinants further contributed to transmission. Communities located near rivers, dams, wetlands, and irrigation schemes consistently exhibited higher infection rates than communities with improved access to safe water sources (Abdullahi & Saidu, 2011; Opeyemi et al., 2024; Sunday et al., 2025). Poor sanitation, open defecation, inadequate access to potable water, low socioeconomic status, limited health awareness, and parental occupation were also identified as important contributors to continued transmission in several endemic communities (Nzelu et al., 2025; Inalegwu et al., 2026).

Collectively, these findings indicate that schistosomiasis transmission in North Central Nigeria is sustained by the interaction of environmental exposure and socioeconomic conditions rather than by a single determinant. Consequently, effective disease control requires integrated interventions that address both behavioural and environmental drivers of transmission.

3.9 Reported Control Strategies

The reviewed studies consistently emphasized that sustainable schistosomiasis control requires integrated interventions combining chemotherapy with environmental and behavioural measures.

Mass drug administration (MDA) using praziquantel was the most frequently recommended intervention and was identified as the cornerstone of schistosomiasis control across endemic communities (Nyamngee et al., 2018; Umar et al., 2023; Sunday et al., 2025). Most authors recommended expanding treatment coverage, particularly among school-aged children and other high-risk populations.

In addition to preventive chemotherapy, health education was widely recommended to improve community awareness of disease transmission and promote behavioural change aimed at reducing risky water-contact practices (Abba et al., 2022; Abdulazeez et al., 2024; Jacob et al., 2025).

Several studies further emphasized the importance of improving water, sanitation, and hygiene (WASH) infrastructure through increased access to safe drinking water, improved sanitation facilities, and reduction of dependence on contaminated freshwater sources (Mahmud, 2024; Nzelu et al., 2025; Inalegwu et al., 2026). Other recommended interventions included environmental management, snail control, strengthened disease surveillance, routine screening, and community-based health promotion programmes.

In general, the evidence demonstrates broad consensus that preventive chemotherapy alone is unlikely to interrupt transmission. Instead, long-term control and eventual elimination will require coordinated implementation of MDA alongside improvements in WASH, health education, environmental management, and surveillance systems.

3.10 Methodological Quality Assessment

Methodological quality was evaluated using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Studies Reporting Prevalence Data (Table 2). In all, the included studies demonstrated moderate to high methodological quality, with JBI scores ranging from 5 to 7 out of 9.

Seven studies achieved high methodological quality (score = 7), indicating low overall risk of bias and strong adherence to recommended methodological standards (Abba et al., 2022; Mahmud, 2024; Abdulazeez et al., 2024; Sunday et al., 2025; Jacob et al., 2025; Nzelu et al., 2025; Inalegwu et al., 2026). The remaining studies obtained scores of 5 or 6, reflecting moderate methodological quality with minor limitations related primarily to sampling procedures, participant recruitment, or statistical reporting rather than major flaws in study design. Importantly, no study was excluded because of poor methodological quality, as all satisfied the minimum quality threshold established during

study selection. Consequently, the overall evidence base supporting this review is considered sufficiently robust for narrative synthesis. Nevertheless, variations in study design, sample size, diagnostic methods, and reporting approaches contributed to methodological heterogeneity, reinforcing the decision to perform a qualitative synthesis rather than a quantitative meta-analysis.

4.0 Discussion

This systematic review synthesized the available evidence on the epidemiological patterns of schistosomiasis in North Central Nigeria, providing the first comprehensive regional assessment of disease prevalence, associated risk factors, diagnostic approaches, and control strategies. Unlike previous systematic reviews that examined schistosomiasis at the national level or across sub-Saharan Africa (Ezeh et al., 2019; Oluwole et al., 2022), this review highlights substantial geographical heterogeneity within North Central Nigeria and identifies persistent transmission hotspots that require targeted intervention.

The findings demonstrate that schistosomiasis remains endemic throughout the region, although prevalence varied considerably between states and communities, ranging from 2.07% to 77.4%. Such wide variation is consistent with the focal nature of schistosomiasis transmission and reflects differences in ecological conditions, freshwater exposure, sanitation infrastructure, socio-economic status, and implementation of control programmes (Klohe et al., 2021; Ogongo et al., 2022). The particularly high prevalence reported in parts of Kwara, Kogi, and Benue States suggests that transmission remains intense in communities where dependence on natural freshwater bodies for domestic, occupational, and recreational purposes is high. Conversely, lower prevalence reported in parts of Plateau and Nasarawa States may reflect differences in environmental suitability for intermediate host snails, improved access to potable water, or greater coverage of preventive chemotherapy programmes (Griswold et al., 2022).

School-aged children consistently represented the population most affected by schistosomiasis, corroborating previous reports that children experience greater exposure through swimming, bathing, fishing, and other recreational water-contact activities (Verjee, 2019; Carbonell et al., 2021). This finding further supports the continued prioritization of school-based preventive chemotherapy programmes while emphasizing the need to expand interventions to other at-risk community members who may contribute to sustained transmission.

The review also identified frequent contact with contaminated freshwater as the most consistently reported risk factor across the included studies. This observation agrees with the well-established transmission dynamics of schistosomiasis, in which repeated human contact with cercariae-infested water maintains parasite circulation between human hosts and freshwater snails (Ogongo et al., 2022). Additional determinants, including poor sanitation, inadequate access to safe water, low socioeconomic status, and limited health awareness, further illustrate that schistosomiasis is strongly influenced by environmental and social conditions rather than biological factors alone. Consequently, interventions focusing exclusively on chemotherapy are unlikely to achieve sustainable interruption of transmission.

An important observation from this review is the overwhelming predominance of Schistosoma haematobium compared with S. mansoni. Most studies investigated urinary schistosomiasis using urine filtration, whereas relatively few assessed intestinal schistosomiasis using the Kato–Katz technique. This diagnostic pattern reflects the epidemiology of the disease within North Central Nigeria but may also have influenced reported prevalence estimates. Studies relying solely on urine filtration would

be expected to underestimate intestinal schistosomiasis and mixed infections, while differences in diagnostic sensitivity between urine filtration and Kato–Katz may have contributed to the observed heterogeneity among studies. Therefore, comparisons of prevalence across studies should be interpreted cautiously, particularly where different diagnostic protocols were employed.

The methodological quality assessment indicated that all included studies were of moderate to high quality, suggesting that the available evidence is sufficiently robust to support regional epidemiological conclusions. Nevertheless, variations in study design, participant selection, sample size, diagnostic techniques, and reporting methods contributed to considerable methodological heterogeneity. This heterogeneity justified the use of narrative synthesis rather than quantitative meta-analysis and underscores the need for greater methodological standardization in future epidemiological investigations.

The findings have important public health implications. Although mass drug administration with praziquantel remains the cornerstone of schistosomiasis control in Nigeria, the persistence of moderate-to-high prevalence in several communities indicates that chemotherapy alone has not interrupted transmission. Sustainable disease control will require integrated approaches that combine preventive chemotherapy with improvements in water, sanitation and hygiene (WASH), environmental management, snail control, health education, and strengthened surveillance systems. Such integrated interventions are consistent with the World Health Organization's roadmap for neglected tropical diseases and are essential for achieving the 2030 schistosomiasis elimination targets (Lo et al., 2022).

4.1 Strengths and Limitations

This review has several strengths. It represents the first systematic synthesis focused exclusively on North Central Nigeria and was conducted in accordance with PRISMA 2020 guidelines using a comprehensive search strategy and standardized methodological quality assessment. The review also integrates epidemiological evidence from all states within the region, thereby providing valuable information for regional policy development and disease-control planning.

However, some limitations should be acknowledged. First, only English-language peer-reviewed publications were included, creating the possibility of language and publication bias. Second, substantial heterogeneity in study populations, diagnostic methods, geographical settings, and outcome reporting precluded quantitative meta-analysis. Third, the review protocol was not prospectively registered, which may reduce methodological transparency. Finally, several states remain underrepresented in the available literature, limiting the generalizability of regional estimates. Future studies employing standardized diagnostic protocols and harmonized reporting frameworks would strengthen the evidence base for regional schistosomiasis surveillance and control.

5.0 Conclusion

This systematic review demonstrates that schistosomiasis remains an important public health problem throughout North Central Nigeria, although transmission intensity varies considerably across states and communities. The available evidence indicates that urinary schistosomiasis caused by Schistosoma haematobium predominates, with school-aged children constituting the most affected population. Frequent contact with contaminated freshwater, poor sanitation, inadequate access to safe water, and socioeconomic disadvantage remain the principal drivers of disease transmission.

This review is the first to comprehensively synthesize epidemiological evidence specifically for North Central Nigeria, thereby addressing an important regional knowledge gap

overlooked by previous nationwide reviews. The findings provide evidence to support geographically targeted interventions, strengthen surveillance activities, and inform regional implementation of schistosomiasis control programmes. Nevertheless, interpretation of the findings should consider the methodological heterogeneity among included studies, which precluded quantitative meta-analysis. Future epidemiological research employing standardized diagnostic methods and reporting frameworks will improve regional disease monitoring and facilitate more robust evidence synthesis.

6.0 Recommendations

Based on the findings of this review, the following recommendations are proposed:

1. Expand integrated schistosomiasis control programmes by combining mass drug administration with improvements in water, sanitation and hygiene (WASH), health education, environmental management, and snail control.
2. Strengthen routine epidemiological surveillance, particularly in high-prevalence communities within Kwara, Kogi, and Benue States, to improve early detection of transmission hotspots and guide resource allocation.
3. Increase access to safe water and improved sanitation facilities in endemic rural communities to reduce dependence on contaminated freshwater sources and interrupt disease transmission.
4. Standardize diagnostic approaches and epidemiological reporting across future studies to improve comparability of prevalence estimates and facilitate quantitative evidence synthesis, including future meta-analyses.
5. Conduct longitudinal and implementation research to evaluate the long-term effectiveness of integrated control strategies and to monitor progress toward the World Health Organization's 2030 schistosomiasis elimination targets.

Conflicts of Interest

The authors declare no conflicts of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the article will be borne by them.

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