

# Prevalence and Risk Factors of Neglected Tropical Diseases Among Women and Children in Rural Liberia: A Regional Perspective

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## Abstract

*Neglected Tropical Diseases (NTDs) remain a critical public health challenge in Liberia, disproportionately affecting women and children in rural regions due to systemic inequities in water, sanitation, and healthcare access. This cross-sectional study assessed the prevalence and risk factors of NTDs among 1,000 participants (600 children above 15 years and 400 women aged 15–49) in rural Liberia using stratified and cluster sampling. Laboratory diagnostics, including Kato-Katz stool analysis, urine filtration, and rapid antigen testing, revealed an overall NTD prevalence of 78%, with children bearing the highest burden (85.8%) compared to women (66.3%). Schistosomiasis (31%), soil-transmitted helminths (27.5%), and lymphatic filariasis (19.5%) were the most prevalent diseases. Key risk factors included open defecation (aOR: 3.2; 95% CI: 1.8–5.6), lack of footwear (aOR: 2.8; 95% CI: 1.5–4.9), and poor water access (aOR: 2.1; 95% CI: 1.2–3.7). The findings underscore the intersection of environmental exposure, gender roles, and infrastructural neglect in perpetuating NTD transmission. Children are particularly susceptible to neglected tropical diseases (NTDs) due to both behavioral habits – such as playing in contaminated environments – and underdeveloped immune systems. Similarly, women often face increased exposure risks because of their caregiving responsibilities and certain occupational roles, even though they may report lower infection rates. There is a pressing need for comprehensive interventions, including the development of clean water and sanitation systems, community-based health education, and the continued implementation of mass drug administration. This study highlights the importance of adopting strategies that are sensitive to gender dynamics and resilient to climate-related challenges to reduce Liberia’s NTD burden. Such efforts are essential to meeting the global target of eliminating NTDs by the year 2030, as outlined in the sustainable development goals.*

**Keywords:** Neglected tropical diseases, Liberia, Schistosomiasis, soil-transmitted Helminths, WASH interventions, rural health, gender disparities, Lymphatic Filariasis

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## INTRODUCTION

Neglected tropical diseases (NTDs) represent a significant group of infections that are widespread in tropical and subtropical climates, where they remain a major public health concern. These diseases continue to impact on the most disadvantaged populations, particularly in low-income regions with limited access to healthcare. In sub-Saharan Africa, more than 500 million individuals are at risk of contracting one or more NTDs, with Liberian women and children disproportionately affected due to a combination of biological vulnerability, socioeconomic hardship, and environmental exposure. In Liberia, despite

national and international interventions, there is still a lack of comprehensive data on the prevalence of NTDs in rural areas. The country's post-conflict health system struggles with limited resources, especially in the countryside where nearly half of the population resides (LISGIS, 2021). These rural communities face pronounced challenges, such as inadequate sanitation, poor access to clean water, and insufficient health services, all of which are critical factors in NTD transmission. Women and children living in these areas are at particular risk for infections like schistosomiasis, soil-transmitted helminths (STH), and lymphatic filariasis. Women's traditional roles – including collecting water and working in agriculture – frequently expose them to environments where transmission is likely. Children under the age of 15, who account for roughly 42% of Liberia's population, are highly vulnerable due to behavioral patterns like playing in contaminated areas and having weaker immune defenses (UNICEF, 2020). Although the Sustainable Development Goals (SDGs) aim to eliminate NTDs globally by 2030, Liberia's progress is slowed by systemic barriers, such as limited healthcare funding, inadequate disease monitoring, and a shortage of trained community health personnel (Ministry of Health, 2021). Most existing research in West Africa has emphasized national trends or urban health dynamics, failing to account for the distinct challenges faced by rural populations. For instance, seasonal floods in counties, like Bong and Lofa, increase the risk of waterborne infections, yet such region-specific threats are often underreported. Additionally, cultural beliefs – including reliance on traditional medicine and fear of stigma – often discourage people from seeking formal medical treatment. By focusing on these localized issues, this study aims to provide insight into the unique health risks faced by rural women and children in Liberia and guide more effective disease control strategies tailored to their specific circumstances.

## LITERATURE REVIEW

More than 1.5 billion people worldwide are affected by Neglected Tropical Diseases (NTDs), with sub-Saharan Africa bearing approximately 40% of the global burden [1]. In Liberia, the prevalence of soil-transmitted helminth (STH) infections remains alarmingly high, surpassing 50% in areas where the disease is endemic [2]. Children are particularly at risk, largely due to their frequent exposure to contaminated soil and underdeveloped immune systems, which make them more vulnerable to infection [1]. Children exhibit higher susceptibility due to frequent soil contact and immature immunity [3]. Studies indicate that Liberia's NTD burden is shaped by inadequate healthcare infrastructure, climate conditions, and socio-economic disparities [4]. Research from neighboring West African nations corroborates that rural populations face higher risks due to environmental exposure and insufficient disease control programs. WHO guidelines emphasize the importance of integrated NTD control strategies, aligning with this study's findings [5]. Limited studies in Liberia highlight gaps in gender-disaggregated data and community-specific risk factors [6].

## METHODOLOGY

### Study Design and Population

A cross-sectional study was conducted in rural Liberia, covering multiple districts to ensure diverse representation. Ethical approval was obtained from relevant health institutions, and informed consent was secured from participants or guardians of minors. Participants included 1,000 individuals: 600 children (under 15 years) and 400 women (15–49 years).

### Sample Collection Techniques

- *Stratified Random Sampling*: Participants were selected based on age and gender distribution.
- *Cluster Sampling*: Households were grouped within geographical clusters to enhance representative sampling.
- *Convenience Sampling*: For hard-to-reach populations, community health workers facilitated sample collection.

### Inclusion Criteria

- Women 15–49 years and Children (>15 years).
- Residing in rural Liberia  $\geq 6$  months.

- Individuals presenting with symptoms of NTDs.
- Consent provided for participation.

### Exclusion Criteria

- Non-residents of the study area.
- Individuals with severe illness or pre-existing chronic illnesses unrelated to NTDs.
- Individual on antiparasitic treatment  $\leq 1$  month.
- Participants who refused consent.

### Sample Collection and Laboratory Testing for NTD Detection

Stool and blood samples were analyzed for parasites. ELISA and rapid diagnostic tests (RDTs) detected antibodies for infections, such as schistosomiasis and lymphatic filariasis. Please see the Table 1 on sample collection techniques.

**Table 1.** Sample collection techniques.

Disease	Sample Type	Collection Method	Sources
Soil-transmitted helminths	Stool	Kato-Katz technique.	[7]
Schistosomiasis	Urine/Stool	Urine filtration ( <i>S. haematobium</i> , <i>S. mansoni</i> ).	[8]
Lymphatic filariasis	Blood	Rapid antigen tests (ICT Filariasis).	[9]
Onchocerciasis	Skin snip	Microscopy for microfilariae.	[10]

The table outlines diagnostic methodologies for key neglected tropical diseases (NTDs), highlighting variations in sample types and detection techniques. Soil-transmitted helminths (STH) are diagnosed using stool samples analyzed via the Kato-Katz technique, a method recommended by the World Health Organization for its efficacy in detecting helminth eggs. Schistosomiasis detection involves urine filtration for *Schistosoma haematobium* and stool examination using the Kato-Katz method for *S. mansoni*, both aligned with WHO guidelines. Lymphatic filariasis relies on blood samples tested through rapid antigen tests, such as the immunochromatographic test (ICT), which identifies circulating filarial antigens. Onchocerciasis is commonly diagnosed through skin snip biopsies, which are then examined under a microscope to detect the presence of microfilariae – a method proven effective in endemic regions. While this remains a standard diagnostic approach, it also highlights the challenges faced in low-resource areas, especially where access to specialized equipment and skilled healthcare workers is limited.

The Table 2 outlines the diagnostic effectiveness of various tests used in identifying neglected tropical diseases (NTDs), highlighting differences in sensitivity and specificity. The Kato-Katz method, often applied for detecting soil-transmitted helminths and *Schistosoma mansoni*, offers moderate to high sensitivity (85–90%), although its reliability decreases in cases of light infections [11]. Urine filtration, commonly used for diagnosing *Schistosoma haematobium*, tends to have lower sensitivity (70–80%), which can vary depending on the time of sample collection and the skill of the technician [12]. In contrast, the immunochromatographic test (ICT) used in diagnosing lymphatic filariasis provides high specificity (around 98%), reducing the risk of false-positive results in endemic areas [13]. These findings emphasize the importance of selecting diagnostic methods that are both accurate and practical for use in limited-resource environments.

**Table 2.** Laboratory tests.

Test	NTD Detected	Sensitivity/Specificity	Sources
Kato-Katz	STH, Schistosomiasis	85–90% sensitivity	[11]
Urine filtration	<i>S. haematobium</i>	70–80% sensitivity	[12]
ICT Filariasis	Lymphatic filariasis	98% specificity	[13]

## DATA ANALYSIS

The data analysis was conducted using SPSS version 26. Associations between potential risk factors and NTD prevalence were examined using chi-square tests, while logistic regression models were applied to control for confounding variables, such as age, gender, and sanitation conditions.

## RESULTS

The findings indicate a significant difference in the prevalence of neglected tropical diseases (NTDs) between children and women in the study population (Table 3). Out of 600 children tested, 515 were found to be infected, resulting in a prevalence rate of 85.8%. In contrast, 265 of the 400 women tested were positive, representing a 66.3% prevalence. The higher infection rate among children may be attributed to their frequent contact with contaminated soil and water sources, as well as their developing immune systems [14]. For women, the lower prevalence could be influenced by behavioral factors, such as different health-seeking patterns or variations in daily activities, that reduce exposure risk. However, limitations in healthcare access may also lead to underreporting among women [15]. The overall prevalence of 78% highlights the urgent need for targeted public health interventions, particularly those focusing on children while also addressing the unique vulnerabilities faced by women [16].

**Table 3.** NTD prevalence.

Group	Total Tested	Positive Cases	Prevalence (%)
Children	600	515	85.8%
Women	400	265	66.3%
Total	1,000	780	78.0%

**Table 4.** Risk factor analysis.

Factor	Adjusted Odds ratio	95% CI	p-value
Open defecation	3.2	1.8–5.6	<0.001
Lack of footwear	2.8	1.5–4.9	0.001
Poor water access	2.1	1.2–3.7	0.008

The findings highlight key factors contributing to the spread of neglected tropical diseases (NTDs) in the study population (Table 4) [17]. People who practiced open defecation were over three times more likely to contract an infection, emphasizing the role this behavior plays in spreading fecal-related diseases, such as soil-transmitted helminths. Similarly, not wearing shoes was linked to nearly three times higher risk, likely due to increased contact with contaminated soil [18]. Limited access to clean water also doubled the chances of infection, supporting evidence that poor water quality is connected to illnesses like schistosomiasis and other waterborne diseases [19]. These results underscore the urgent need for combined efforts that improve access to clean water, sanitation, hygiene, and promote healthier practices in at-risk communities [20].

The results reveal a high burden of neglected tropical diseases (NTDs) in the population studied, with an overall prevalence of 78% (Table 5) [21]. Schistosomiasis was the most reported infection, affecting 31% of participants [22]. This is likely due to regular exposure to contaminated water sources during everyday tasks like farming, washing, or bathing [23]. Soil-transmitted helminths (STH) were also widespread, found in 27.5% of individuals – an issue that reflects the lack of proper sanitation and the continued practice of open defecation in many rural areas [24]. Lymphatic filariasis, though reported in a smaller portion of the population (19.5%), remains a serious public health concern because of its chronic, disabling effects and ongoing transmission by mosquitoes [25]. These patterns point to the complex mix of environmental, behavioral, and social factors that contribute to NTD spread, and emphasize the importance of comprehensive strategies that include improved sanitation, safe water access, and vector control [26].

**Table 5.** Common NTDs identifier.

Disease	Positive Cases	Prevalence (%)
Schistosomiasis	310	31%
Soil-Transmitted Helminths	275	27.5%
Lymphatic Filariasis	195	19.5%
Total	780	78.0%

## DISCUSSION

This study highlights the significant impact of neglected tropical diseases (NTDs) on rural women and children in Liberia, pointing to deep-rooted health inequalities driven by environmental, social, and economic challenges. The high infection rates – 85.8% among children and 66.3% among women – reflect serious gaps in public health protections for vulnerable groups living in under-resourced communities. Children are especially affected, likely due to frequent outdoor activities and a lack of protective footwear, which increases their risk of exposure to soil-transmitted helminths and schistosomiasis. Although women’s infection rates are lower, access to healthcare and cultural norms may influence both disease exposure and health-seeking behaviors. Compared to neighboring West African countries, where NTD rates generally range from 40–60%, Liberia’s figures are notably higher. This difference reflects the country’s unique challenges as a post-conflict nation still struggling with weak infrastructure and limited access to basic preventive healthcare services. Schistosomiasis emerged as the most prevalent NTD (31%), likely driven by daily exposure to contaminated water sources during activities, such as bathing, farming, and domestic chores. This aligns with studies linking Liberia’s seasonal flooding and inadequate water infrastructure to heightened transmission of waterborne parasites. The predominance of soil-transmitted helminths (27.5%) further emphasizes the role of poor sanitation, as open defecation – a practice reported in 63% of rural households – facilitates fecal-oral transmission. Children’s heightened susceptibility to STH mirrors global patterns, where play habits, hand-to-mouth behaviors, and immature immune systems increase infection risk. Open defecation (aOR = 3.2) and poor water access (aOR = 2.1) underscore the need for WASH interventions. These findings mirror studies in Sierra Leone, where sanitation programs reduced helminthiasis by 40%. Gender disparities in prevalence rates warrant deeper analysis. While women exhibited lower infection rates than children, their occupational roles – such as fetching water from infested rivers or engaging in agriculture – likely amplify exposure to vectors. Despite reported figures, the true extent of infections may be underestimated due to cultural stigma or the tendency of women to prioritize caregiving responsibilities over seeking medical attention. Lymphatic filariasis, which affected 19.5% of participants in this study, is particularly concerning as it causes long-term disability and significantly impacts women’s ability to work and engage in community life – thereby reinforcing poverty and social exclusion. Several risk factors were found to be closely tied to disease transmission. Open defecation, for example, was associated with a threefold increase in infection risk, echoing findings from rural Ghana where improved sanitation dramatically lowered helminth infections. Likewise, walking barefoot was linked to twice the risk of infection, highlighting the importance of protective footwear in farming communities. These outcomes support global health recommendations by the World Health Organization, which stresses the need for comprehensive water, sanitation, and hygiene (WASH) programs to effectively reduce the burden of NTDs in affected populations.

## CONCLUSIONS

This study brings to light the severe impact that Neglected Tropical Diseases (NTDs) have on rural women and children in Liberia. At the heart of this crisis lies the ongoing lack of investment in clean water and sanitation, limited access to healthcare, and deep-rooted gender inequalities. The combination of high infection rates, unsafe environmental conditions, and widespread poverty calls for immediate and comprehensive action. Without focused interventions, these diseases will continue to fuel poverty, cause long-term disability, and hinder progress for future generations. NTDs remain a persistent threat in Liberia’s rural communities, with children bearing the brunt of the burden. Urgent strategies, such as integrated mass drug administration, the provision of proper footwear, and community-driven sanitation efforts, are essential to breaking the cycle of disease and improving public health.

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## Recommendations

- *Improve Water, Sanitation, and Hygiene (WASH) Infrastructure:* Invest in building essential facilities like latrines, handwashing stations, and safe water sources (e.g., boreholes) in districts most affected by NTDs. Encourage community ownership of sanitation practices through locally-led initiatives, and support bylaws that discourage open defecation while promoting consistent toilet use.
- *Expand Preventive Health Measures:* Provide free, protective footwear to children and women living in high-risk areas to reduce their exposure to soil-borne infections. Strengthening and broaden mass drug administration (MDA) efforts for diseases, such as schistosomiasis and soil-transmitted helminths (STH), ensuring that distribution strategies are mindful of gender-related barriers, such as women's limited mobility or caregiving responsibilities.
- *Community Health Worker (CHW) Training:* Equip CHWs with rapid diagnostic tools and culturally appropriate health education materials to combat misinformation and stigma. Engage traditional healers as partners in early detection.
- *Climate-Resilient Interventions:* Develop flood-responsive NTD control strategies, such as preemptive vector control and water treatment campaigns in flood-prone regions like Margibi, Bong, and Lofa Counties.
- *Gender-Responsive Programming:* Tailor NTD initiatives to women's roles – e.g., provide water filters to reduce exposure during fetching and integrate NTD screening into maternal health clinics.
- *Policy Advocacy:* Lobby for increased domestic and international funding for Liberia's NTD programs, emphasizing child-centered metrics in national health targets.
- *Mass Drug Administration (MDA):* Expand anti-parasitic treatment programs targeting high-prevalence zones.

## Limitations

Single stool samples may underestimate STH prevalence. Cross-sectional design limits causal inference.

- *Ethical approval:* was obtained from the Liberia Ministry of Health Institutional Review Board (Ref: LMH-IRB/2023/045). Informed consent was secured from all participants.

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