Knowledge and Hygiene Practices Regarding Soil Transmitted Helminths Infections in Ijebu Division, Ogun State, South-West Nigeria

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Abstract Behaviour is one of the risk factors considered during the transmission of Soil Transmitted Helminth (STH) infections. Our study examined behavioural practices and identified the practices that aid the transmission of STH infections amongst parts of the Ijebu people in Ogun State, Nigeria. A cross-sectional study across six communities was conducted among 571 consented participants. Study participants were administered close-ended questionnaires which assessed demographic factors, knowledge on STH infections and their practices towards health, water, sanitation and hygiene. Responses were subjected to statistical analysis and chi-square was performed with significance set at $p<0.05$. Results revealed that majority (95.6%) of the participants had access to a water source with tap water being the most. For toilet facilities, water-closet frequently cleaned was used by 86% of the participants, thus the washing of hands after the use of the toilet facility was done by 89% of the participants. However, significant differences of ($p = 0.006$) and ($p = 0.009$) showed that hygiene practices such as biting of fingernails and walking barefoot indulged in by the participants could aid the transmission of STH infections in the study area. Across the communities, observations showed that more than 50% of the participants were not aware of STH infections. Based on the poor knowledge on STH infections in the study area, we recommend that bi-annual sensitization health programmes on STH infections be carried out in the study area by health stakeholders.

Keywords: Behavioural factors, Infections, Practices, Nigeria, Soil-transmitted helminths

Introduction

Soil-transmitted helminth (STH) infections remain a persistent public health burden, especially in tropical and subtropical regions with limited access to clean water, inadequate sanitation infrastructure, and poor hygiene practices. According to an estimate from the World Health Organisation (WHO), approximately 1.5 billion people worldwide are currently affected by this disease, with the highest prevalence observed in sub-Saharan Africa, the Americas, China, and East Asia (WHO 2023). The populations most at risk of infection include children, pregnant women, and women of reproductive age, with about 914 million individuals and 138.8 million pregnant women considered vulnerable to infection (WHO 2023). Transmission occurs through contact with, or the ingestion of contaminated soil, faeces, or vegetables that harbour the infective stages of parasitic worms (Akinsanya et al., 2021). Roundworms (*Ascaris lumbricoides*), hookworms (*Ancylostoma*

duodenale and *Necator americanus*), and whipworms (*Trichuris trichiura*) are among the most common and account for the majority of soil-transmitted helminth (STH) infections worldwide and in Nigeria (Adekunle et al., 2020; WHO 2023). After infection, the adult worms migrate to and reside in the intestines of their hosts (Mascarini-Serra 2011). The morbidities associated with STH infections include diarrhoea and abdominal pain, malnutrition, general malaise and weakness, iron deficiency, anaemia, intestinal obstruction, impaired physical and cognitive development (Echazú et al. 2015; Yaro et al., 2021).

The WHO recommends periodic preventive chemotherapy (Mass Drug Administration), using anti-helmintic drugs such as albendazole (400 mg) and mebendazole (500 mg) to deworm all individuals at risk living in endemic areas (WHO 2023). These deworming campaigns are conducted either once a year or twice a year, depending on the level of prevalence (Mogaji et al., 2022). Although this mass deworming campaign and preventive chemotherapy have been widely implemented, Nigeria, like many low- and middle-income countries, continues to grapple with high STH prevalence rates due to re-infections, often driven by environmental factors, poor sanitation, behavioural practices and knowledge gaps that sustain the cycle of transmission (Gass et al., 2014).

Climatic and soil conditions, including factors such as soil organic carbon, clay content, soil pH, moisture content, elevation, temperature, and precipitation, as well as socio-economic factors, have been documented in various studies as predisposing elements that contribute to the prevalence, distribution, and transmission of soil-transmitted helminth (STH) infections. These factors are exacerbated by a lack of access to water supply and sanitation facilities (Aemiro et al., 2022; Lebu et al., 2023; Chen et al., 2024). However, limited attention has been paid to the behavioural dimensions of infection risk. Practices such as walking barefoot, poor hand hygiene, inadequate sanitation, and improper food handling are strongly associated with the endemic nature of STH in affected communities (Oyebamiji et al., 2018; Akinsanya et al., 2021; Oyewole and Simon-Oke 2022). Specifically, hookworms (N*ecator americanus and Ancylostoma duodenale*) are contracted by walking barefoot on contaminated sites, while infection with *Trichuris trichiura and Ascaris lumbricoides* is usually through ingestion of infective eggs (Zacharia et al., 2023). While infrastructure is improving in some peri-urban areas, the behavioural aspects linked to cultural norms, educational levels and health awareness remain underexplored.

Ijebu-North Local Government Area, one of the Local Government Areas (LGAs) in the Ogun East Zone of Ogun State, Nigeria, is endemic for STHs (Oluwole et al., 2018). A study by Oluwole et al,. (2018) showed that Ijebu-North LGA reported a prevalence rate of 49.2% for soil-transmitted helminth species. However, to date there is a lack of information regarding the behavioural risk factors associated with this high level of prevalence. Therefore, this study aims to investigate the behavioural practices that may contribute to the transmission of STHs across the six communities within the Ijebu-North LGA of Ogun State, South-West Nigeria. By examining knowledge and hygiene behaviours in relation to environmental exposure, the study aims to provide evidence for the behavioural factors that aid STH transmission.

Materials and Methods

Study Area

The cross-sectional study was carried out across all the six major (6) communities (Ago-Iwoye, Ijebu-Igbo, Ilaporu, Oru/Awa and Mamu) of Ijebu-North LGA of Ogun State, South-West Nigeria. All communities in the study area were selected based on (1) previous reports of STH infections by Oluwole et al,. (2018) and Mogaji et al., (2022) and (2) high migration of residents due to the presence of tertiary institutions in the study area. The LGA has an area of 967 km² with an estimated population of 460,339 in the year 2023. Considering the peri-urban nature of the LGA, farming is the major occupation of most of the indigenes who are known as Ijebus. Various tiers of infrastructures such as health facilities, schools, financial and higher institutions that serve the indigenes and non-indigenes are found across the study area.

Sample Size

This was determined using Kish (1965)

$$N = \frac{Z^2pq}{d^2}$$

$=(1.96)^2$ X 0.492 X (1-0.492)/$(0.05)^2$ = 3.8 X 0.492 X 0.508/0.0025
=383.9
N = size of sample when population is greater than 10,000
Z = level of statistical certainty chosen, or confidence interval: 95 % => Z = 1.96
d = degree of accuracy set at 0.05
p = Prevalence of 49.2% was previously reported by Oluwole et al., (2018) for STH infections for Ijebu-North LGA.
q = 1 – p

With a target of meeting the calculated sample size of 384 study participants, a total of 571 residents of Ijebu-North LGA who had been living there at least two years were successfully recruited and enrolled into the study.

Consents of Participants and Questionnaire Administration

After obtaining approval from the Ethics Review Committee of the Department at Olabisi Onabanjo University, Ago-Iwoye, Ogun State Nigeria (OOU/FS/ZOO/16/100), entry into the communities and sensitization in the study area were conducted. Our study participants were recruited through verbal communication in English and Ijebu dialect. Potential participants were approached and information on the purpose of the study, procedures and benefits associated with its participation were provided. Informed verbal consents were obtained from all study participants prior to their participation in the study.

The survey was conducted using a pre-tested questionnaire that was administered to a sample of population in Ijebu-Ode Local Government Area, Ogun State Nigeria. The structured close-ended questionnaire included; questions on the individual's demographic characteristics, knowledge on STH infections and their practices towards their health, water, hygiene and sanitation.

Statistical Analysis

Data obtained from this study were entered into Microsoft Excel and imported into R software for analysis. All demographic data, data on awareness, knowledge, hygiene practices and health seeking behaviour were categorised and set as factors. Furthermore, dataset on access to and type of water and toilet facilities were used to characterize the access to WASH resources among the study participants. All the variables were used as explanatory variables and compared across gender of study participants. Univariate chi-square statistic was performed with significant associations established when $p<0.05$.

Results

Demographic Characteristics of Study Participants

The analysis of demographic characteristics across the study communities, as depicted in Table 1, revealed notable variations with statistically significant differences. Overall, in terms of gender, it was observed that females were more 340 (59.5%) than the males who were 231 (40.5%). The distribution of gender exhibited significant disparities ($p = 0.005$), with females being the major participants across all the communities. Age distribution also demonstrated significant differences ($p<0.001$), with the majority falling within the 12-25 years age group across all communities.

Table 1. Demographic characteristics of study participants in the study area

Characteristic	N = 571	Study Communities					p-value
		Ijebu-Igbo N = 110	Oru/Awa N = 109	Ago-Iwoye N = 113	Mamu N = 120	Ilaporu N = 119	
Gender, n (%)							0.005
Male	231 (40.5%)	33 (30.0%)	48 (44.0%)	48 (42.5%)	40 (33.3%)	62 (52.1%)	
Female	340 (59.5%)	77 (70.0%)	61 (56.0%)	65 (57.5%)	80 (66.7%)	57 (47.9%)	
Age in years, n (%)							<0.001
12-25	510 (89.3%)	83 (75.5%)	100 (91.7%)	109 (96.5%)	120 (100.0%)	98 (82.4%)	
26-40	52 (9.1%)	19 (17.3%)	9 (8.3%)	4 (3.5%)	0 (0.0%)	20 (16.8%)	
41-65	9 (1.6%)	8 (7.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.8%)	

N/n – Number of study participants; (%) – Percentage

Water, Sanitation and Hygiene (WASH) Access among Study Participants

The examination of water and sanitation-related characteristics across communities, as presented in Table 2, revealed noteworthy variations with statistically significant differences. Access to water sources exhibited significant disparities across communities ($p<0.001$), with Mamu (100.0%) and Ilaporu (89.1%) having the highest and lowest percentage of individuals with access to water, respectively. Most participants in the communities had access to tap water which was statistically significant ($p<0.001$) except in Mamu where only 23.3% could access tap water. The type of toilet facility varied significantly among communities ($p<0.001$), with Ago-Iwoye having the highest percentage using water-closets (93.3%), while participants from Mamu stood out for having the highest proportions relying on pit toilets (21.7%) and bushes (14.2%). Cleanliness of toilet facilities also showed significant differences ($p<0.001$), with Ago-Iwoye (91.2%) and Oru/Awa (20.2%) having the highest percentages reported for always and only once in a while respectively.

Hygienic Practices among Study Participants

The examination of hygiene practices across the surveyed communities, as outlined in Table 3, revealed substantial variations in personal habits. The practice of washing hands after using the toilet significantly differed across communities ($p<0.001$), with Ilaporu showing a notably higher percentage of individuals engaging in this practice (6.7%). The method of washing hands, whether with soap and water or water only, demonstrated some variability, which showed no statistically significant difference ($p = 0.15$). Most of the participants (75.8%) mentioned that they washed their hands with soap and water after using the toilet while 134 (24.2%) used water only for hand washing. The biting of fingernails ($p = 0.006$) and walking barefooted ($p = 0.009$) displayed significant variations across communities. Interestingly, the habit of washing hands before eating exhibited some community-specific differences ($p = 0.094$), as it was observed that most participants (90.9%) in all the sampled communities engaged in hand-washing before eating emphasizing the importance of considering localized practices in public health interventions.

Table 2. Water, Sanitation and Hygiene (WASH) access among study participants in the study area

Characteristic	N = 571	Study Communities					p-value
		Ijebu-Igbo N = 110	Oru/Awa N = 109	Ago-Iwoye N = 113	Mamu N = 120	Ilaporu N = 119	
Have access to water source, n (%)							<0.001
Yes	546 (95.6%)	104 (94.5%)	104 (95.4%)	112 (99.1%)	120 (100.0%)	106 (89.1%)	
No	25 (4.4%)	6 (5.5%)	5 (4.6%)	1 (0.9%)	0 (0.0%)	13 (10.9%)	
Source of water, n (%)							<0.001
Tap	250 (43.8%)	64 (58.2%)	53 (48.6%)	54 (47.8%)	28 (23.3%)	51 (42.9%)	
Borehole	138 (24.2%)	24 (21.8%)	24 (22.0%)	22 (19.5%)	36 (30.0%)	32 (26.9%)	
Hand dug wells	103 (18.0%)	16 (14.5%)	10 (9.2%)	27 (23.9%)	34 (28.3%)	16 (13.4%)	
Bottle	72 (12.6%)	6 (5.5%)	22 (20.2%)	10 (8.8%)	20 (16.7%)	14 (11.8%)	
Stream/Others	8 (1.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (1.7%)	6 (5.0%)	
Type of Toilet facility, n (%)							**<0.001**
Water-closet	491 (86.0%)	99 (90.0%)	98 (89.9%)	106 (93.8%)	77 (64.2%)	111 (93.3%)	
Pit	56 (9.8%)	8 (7.3%)	11 (10.1%)	5 (4.4%)	26 (21.7%)	6 (5.0%)	
Bush	24 (4.2%)	3 (2.7%)	0 (0.0%)	2 (1.8%)	17 (14.2%)	2 (1.7%)	
Cleanliness of Toilet Facility, n (%)							**<0.001**
Always	453 (79.3%)	91 (82.7%)	69 (63.3%)	103 (91.2%)	91 (75.8%)	99 (83.2%)	
Once a while	50 (8.8%)	13 (11.8%)	22 (20.2%)	3 (2.7%)	6 (5.0%)	6 (5.0%)	
Sometimes	68 (11.9%)	6 (5.5%)	18 (16.5%)	7 (6.2%)	23 (19.2%)	14 (11.8%)	

N/n – Number of study participants; (%) – Percentage

Table 3. Hygienic practices among study participants in the study area

Characteristic	N = 571	Study communities					p-value
		Ijebu-Igbo N = 110	Oru/Awa N = 109	Ago-Iwoye N = 113	Mamu N = 120	Ilaporu N = 119	
Wash hands after using the toilet, n (%)							<0.001
Yes	508 (89.0%)	97 (88.2%)	86 (78.9%)	104 (92.0%)	119 (99.2%)	102 (85.7%)	
No	17 (3.0%)	2 (1.8%)	5 (4.6%)	2 (1.8%)	0 (0.0%)	8 (6.7%)	
Sometimes	46 (8.1%)	11 (10.0%)	18 (16.5%)	7 (6.2%)	1 (0.8%)	9 (7.6%)	
Wash hand with, n (%)							0.150
Soap and water	419 (75.8%)	81 (73.6%)	71 (68.3%)	92 (82.9%)	91 (75.8%)	84 (77.8%)	
Water only	134 (24.2%)	29 (26.4%)	33 (31.7%)	19 (17.1%)	29 (24.2%)	24 (22.2%)	
Suck fingernails, n (%)							0.250
Yes	161 (28.2%)	24 (21.8%)	39 (35.8%)	31 (27.4%)	33 (27.5%)	34 (28.6%)	
No	410 (71.8%)	86 (78.2%)	70 (64.2%)	82 (72.6%)	87 (72.5%)	85 (71.4%)	
Bite fingernails, n (%)							0.006
Yes	350 (61.3%)	60 (54.5%)	56 (51.4%)	77 (68.1%)	86 (71.7%)	71 (59.7%)	
No	221 (38.7%)	50 (45.5%)	53 (48.6%)	36 (31.9%)	34 (28.3%)	48 (40.3%)	
Walk barefooted, n (%)							0.009
Yes	352 (61.6%)	57 (51.8%)	59 (54.1%)	81 (71.7%)	75 (62.5%)	80 (67.2%)	
No	219 (38.4%)	53 (48.2%)	50 (45.9%)	32 (28.3%)	45 (37.5%)	39 (32.8%)	
Wash vegetables before cooking, n (%)							0.410
Yes	536 (93.9%)	104 (94.5%)	99 (90.8%)	107 (94.7%)	111 (92.5%)	115 (96.6%)	
No	35 (6.1%)	6 (5.5%)	10 (9.2%)	6 (5.3%)	9 (7.5%)	4 (3.4%)	
Wash hands before eating, n (%)							0.094
Yes	519 (90.9%)	101 (91.8%)	99 (90.8%)	104 (92.0%)	114 (95.0%)	101 (84.9%)	
No	52 (9.1%)	9 (8.2%)	10 (9.2%)	9 (8.0%)	6 (5.0%)	18 (15.1%)	

N/n – Number of study participants; (%) – Percentage

Knowledge and health-seeking patterns of study participants

The awareness of STH infections varied significantly across communities (p<0.001). Three of the study communities reported very poor awareness of STH (<30%), while sub-optimal awareness (~50%) were reported in the other three communities. (Figure 1). In Table 4, in terms of health-seeking behaviours, the practice of visiting hospitals for medical checkups differed significantly among communities (p = 0.004), with Ilaporu had a lower percentage of individuals engaging in this behaviour (60.5%). Similarly, the history of having stool samples examined (p<0.001) and the usage of deworming medicine (p<0.001) showed significant community-specific variations.

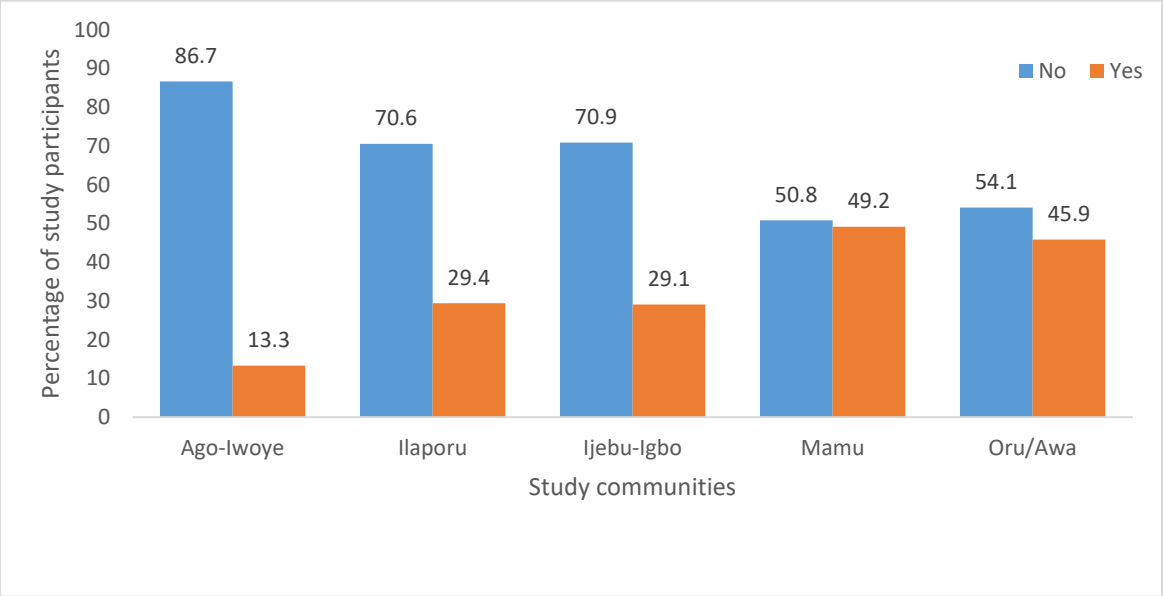

Figure 1: Awareness of STH among the study participants across the study communities

Table 4. Knowledge and health-seeking patterns of study participants

Characteristic	N = 571	**Study communities** **Ijebu-Igbo** N = 110	**Oru/Awa** N = 109	**Ago-Iwoye** N = 113	**Mamu** N = 120	**Ilaporu** N = 119	**p-value**
Ever visited hospital for medical checkup, n (%)							**0.004**
Yes	398 (69.7%)	78 (70.9%)	72 (66.1%)	94 (83.2%)	82 (68.3%)	72 (60.5%)	
No	173 (30.3%)	32 (29.1%)	37 (33.9%)	19 (16.8%)	38 (31.7%)	47 (39.5%)	
Ever had stool-sample examined before, n (%)							**<0.001**
Yes	118 (20.7%)	16 (14.5%)	6 (5.5%)	30 (26.5%)	51 (42.5%)	15 (12.6%)	
No	453 (79.3%)	94 (85.5%)	103 (94.5%)	83 (73.5%)	69 (57.5%)	104 (87.4%)	
Ever used anti-helminthic medicine, n (%)							**<0.001**
Yes	346 (60.6%)	52 (47.3%)	57 (52.3%)	75 (66.4%)	86 (71.7%)	76 (63.9%)	
No	225 (39.4%)	58 (52.7%)	52 (47.7%)	38 (33.6%)	34 (28.3%)	43 (36.1%)	

N/n – Number of study participants; % - Percentage

Discussion

Soil-transmitted helminth (STH) infections are largely driven by behavioural practices, hygiene gaps, and low disease awareness. These factors synergistically sustain the transmission cycle, despite the implementation of deworming programmes and the availability of basic Water, Sanitation and Hygiene (WASH) resources. It is encouraging that a significant majority of the participants (95.6%) in our study reported having access to water sources, with tap water being the most common, and only very few relying on stream water. As reported by Phillips et al. (2022), the availability of safe water sources may indicate lower odds of STH infections in communities, particularly those involving the orally ingested worms *A. lumbricoides* and *T. trichiura*. In our study, a notable 86.0% of the study population utilised water-closet toilet facilities, while 9.8% of participants relied on pit latrines. However, the practice of open defecation, observed in a small yet significant portion of the participants, raises serious epidemiological concerns, especially in communities such as Mamu, where 14.2% resorted to defecating in the bush. This issue poses risks not only to those who engage in it but also to the wider community, as heavy rainfall can disperse and wash the infective eggs of helminths into children's playgrounds, streams and hand-dug wells. Previous studies have indicated that open defecation exposes humans to STH infection while the use of latrines significantly reduces infection risk (Adewale et al., 2023). There is also evidence indicating that these parasites can be transferred from infected faeces or contaminated sites to other locations by insects, such as houseflies (Adekunle et al., 2023). This heightens the risk of STH infection in humans when individuals come into contact with these flies or when the flies interact with environments frequented by humans. Although participants claimed their toilets were always cleaned (79.3%), the uncleanliness of some toilet facilities (20.7%) reported in Oru/Awa and Mamu further poses the risk of environmental contamination and indirect transmission. Phillips et al. (2022) noted that unclean toilets are risk factors for infection. Improved WASH facilities are a notable strategy to address STH infections and should be provided (Strunz et al., 2014).

Despite generally good access to sanitation, this study found that behavioural practices remain suboptimal. Notably, 61.6% of participants admitted to walking barefoot, and 61.3% reported biting their fingernails, both statistically significant risk behaviours ($p=0.009$ and $p=0.006$, respectively) that directly facilitate STH infections. Walking barefoot is a known route for hookworm infections, which attach to the host's skin upon contact before invading the skin (Loukas et al. 2016; Phillips et al. 2022). Fingernail biting increases the risk of ingesting parasite eggs, especially when proper handwashing practices are inconsistent (Muoghalu et al. 2025). Although the majority of participants reported handwashing after using the toilet, nearly a quarter (24.2%) relied solely on water without soap. This practice is insufficient for protecting against infectious ova according to Strunz et al. (2014) and WHO (2023). The WHO Guidelines on Hand Hygiene in Healthcare emphasise the importance of soap use in disrupting the transmission of pathogens. Handwashing hygiene with water alone cannot dissolve fatty materials and remove some pathogens from the hands (WHO 2009). Consequently, individuals may unintentionally ingest soil-transmitted helminth (STH) ova that they might have contracted from contaminated soil or surfaces. The study participants widely practised vegetable washing and handwashing before eating, practices that have been found to reduce risks of STHs infection (Strunz et al. 2014). However, these practices may not be sufficient if other high-risk habits, such as fingernail biting, remain unchecked.

This study also revealed a knowledge gap regarding STH infections among the participants. A lack of awareness about STH infections could hinder individuals' ability to protect themselves from these infections. For instance, only 20.7% of participants had ever undergone stool sample testing, and 39.4% had never used anti-helminthic medications. The knowledge gap is a likely contributor to delayed or inappropriate health-seeking behaviours, which can in turn contribute to sustained infections (Oyebamiji et al., 2018). This high percentage of individuals who have never undergone stool sample testing and have never used anti-helminthic medications may reveal a significant implementation and surveillance gap in the study area, as suggested by Campbell et al. (2014). It is also possible that some participants are

unable to identify anti-helminthic drugs. The disparity was high in Ijebu-Igbo, where 52.7% of the population had never received deworming treatment. Such a substantial segment of the population being untreated poses a significant risk, as they can serve as reservoirs for these soil helminths, re-contaminate the environment and perpetuate the cycle of transmission.

Conclusions

The findings from this study demonstrate that while WASH infrastructure is critical, behavioural determinants such as barefoot walking, fingernail biting, inconsistent hand hygiene and low disease knowledge may serve as major sustaining forces for STH transmission in Ijebu-North LGA. Interventions must extend beyond annual mass deworming campaigns to include health education campaigns that address these behavioural gaps and also improve on available WASH resources.

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Conflicts of Interest

No potential conflict of interest was reported by the author(s).

Author Contributions

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References

Adekunle, O. N., Surakat, O. A., Awoyale, A. K., & Sam-Wobo, S. O. (2020). Cross-sectional study of efficacy of albendazole in the treatment of soil helminthes infected school age children in parts of Odeda, Ogun State, Nigeria. *FULafia Journal of Science & Technology*, 6 (3), 15 - 20. https://lafiascijournals.org.ng/index.php/fjst/article/view/171.

Adekunle, O., Mogaji, H., Adeleke, M., Adesetan, T., Abimbola-Okuneye, W., Ogunniran, D., Ogunade, A., & Agbolade, O. (2023). Parasitic infestations in houseflies and soils collected from garbage dumps in parts of Ijebu-North, Ogun State Nigeria: A cross-sectional study. *Zimbabwe Journal of Science and Technology*, 17(1), 58 – 66. https://journals.nust.ac.zw/index.php/zjst/article/view/207.

Adewale, B., Mogaji, H., Balogun, J., Balogun, E., Olamiju, F., & Herbert, D. (2023). Monitoring the status of Soil-Transmitted Helminthiases in non-endemic implementation units: a case study of Borgu in Northcentral Nigeria. *Pathogens*, 12: 491. https://doi.org/10.3390/pathogens12030491.

Aemiro, A., Menkir, S., Tegen, D., & Tola, G. (2022). Prevalence of Soil-Transmitted Helminthes and Associated Risk Factors among People of Ethiopia: A Systematic Review and Meta-Analysis. *Infectious Diseases: Research and Treatment*, 15, 1 – 20. https://doi.org/10.1177/11786337211055437.

Akinsanya, B., Adubi, T., Macauley A., & Okonofua C. (2021). An investigation on the epidemiology and risk factors associated with soil-transmitted helminth infections in Ijebu East Local Government Area, Ogun State,

Nigeria. *Scientific African,* 12 (2021), e00757. https://doi.org/10.1016/j.sciaf.2021.e00757.

Campbell, S. J., Savage, G. B., Gray, D. J., Atkinson, J. M., Magalhães, R. J. S., Nery, S. V., McCarthy, J. S., Velleman, Y., Wicken, J. H., Traub, R. J., Williams, G. M., Andrews, R. M., & Clements, A. C. A. (2014). Water, Sanitation, and Hygiene (WASH): a critical component for sustainable Soil-Transmitted helminth and Schistosomiasis control. *PLoS Neglected Tropical Diseases*, *8*(4), e2651. https://doi.org/10.1371/journal.pntd.0002651.

Chen, J., Gong, Y., Chen, Q., Li, S., & Zhou, Y. (2024). Global burden of soil-transmitted helminth infections, 1990–2021. *Infectious Diseases of Poverty*, *13*, 77. https://doi.org/10.1186/s40249-024-01238-9

Echazú, A., Bonanno, D., Juarez, M., Cajal, S. P., Heredia, V., Caropresi, S., Cimino, R. O., Caro, N., Vargas, P. A., Paredes, G., & Krolewiecki, A. J. (2015). Effect of poor access to water and sanitation as risk factors for Soil-Transmitted helminth infection: selectiveness by the infective route. *PLoS Neglected Tropical Diseases*, *9*(9), e0004111. https://doi.org/10.1371/journal.pntd.0004111.

Gass, K., Addiss, D. G., & Freeman, M. C. (2014). Exploring the Relationship between Access to Water, Sanitation and Hygiene and Soil-Transmitted Helminth Infection: A Demonstration of Two Recursive Partitioning Tools. *PLoS Neglected Tropical Diseases*, *8*(6), e2945. https://doi.org/10.1371/journal.pntd .0002945.

Kish, L. (1965). Survey Sampling. John Wiley and Sons, Inc., New York, London.

Lebu, S., Kibone, W., Muoghalu, C.C., Ochaya, S., Salzberg, A., Bongomin, F., & Manga, M. (2023). Soil-transmitted helminths: A critical review of the impact of co-infections and implications for control and elimination. *PLoS Neglected Tropical Diseases*, 17(8), e0011496. https://doi.org/10.1371/journal.pntd.0011496.

Loukas, A., Hotez, P. J., Diemert, D., Yazdanbakhsh, M., McCarthy, J. S., Correa-Oliveira, R., Croese, J., & Bethony, J. M. (2016). Hookworm infection. *Nature Reviews Disease Primers*, *8*(2), 16088. https://doi.org/10.1038/nrdp.2016.88.

Mascarini-Serra, L. (2011). Prevention of soil-transmitted helminth infection. *Journal of Global Infectious Diseases,* 3(2), 175 - 182. https://doi.org/10.4103/0974-777x.81696

Mogaji, H. O., Johnson, O. O., Adigun, A. B., Adekunle, O. N., Bankole, S., Dedeke, G. A., Bada, B. S., & Ekpo, U. F. (2022). Estimating the population at risk with soil transmitted helminthiasis and annual drug requirements for preventive chemotherapy in Ogun State, Nigeria. *Scientific Reports*, 12, 2027. https://doi.org/10.1038/s41598-022-06012-1.

Muoghalu, C., Lebu, S., Kaboggoza, H., Bongomin, F., Ochaya, S., & Manga, M. (2025). Soil-transmitted helminth infections among preschool- and school-aged children in India: A systematic review and meta-analysis of prevalence, risk factors and intervention strategies. *Hygiene and Environmental Health Advances*, 13, 100118. https://doi.org/10.101 6/j.heha.2025.100118.

Ohiolei, J. A., Isaac, C., & Omorodion, O. A. (2017). A review of soil-transmitted helminthiasis in Nigeria. *Asian Pacific Journal of Tropical Disease*, 7, 930 – 937. https://doi.org/10.12980/apjtd.7.2017D7-235.

Oluwole, A. S., Adeniran, A. A., Mogaji, H. O., Olabinke, D. B., Abe, E. M., Bankole, S. O., Sam-Wobo, S. O., & Ekpo, U. F. (2018). Prevalence, intensity and spatial co-distribution of schistosomiasis and soil transmitted helminths infections in Ogun State, Nigeria. *Parasitology Open*, 4, e8. https://doi.org/ 10.1017/pao.2018.4.

Oyebamiji, D.A., Ebisike, A.N., Egede, J.O., & Hassan, A.A. (2018). Knowledge, attitude and practice with respect to soil contamination by Soil-Transmitted Helminths in Ibadan, Southwestern Nigeria. *Parasite Epidemiology and Control*, 3(4), e00075. https://doi.org/10.1016/j.parepi.2018.e00075.

Oyewole, O. E., & Simon-Oke, I. A. (2022). Ecological risk factors of soil-transmitted helminths infections in Ifedore district, Southwest Nigeria. *Bulletin of the National Research Centre/Bulletin of the National Research Center*, 46, 13. https://doi.org/10.1186/s42269-022-00700-8

Phillips, A. E., Ower, A. K., Mekete, K., Liyew, E. F., Maddren, R., Belay, H., Chernet, M., Anjulo, U., Mengistu, B., Salasibew, M., Tasew, G., & Anderson, R. (2022). Association between water, sanitation, and hygiene access

and the prevalence of soil-transmitted helminth and schistosome infections in Wolayita, Ethiopia. *Parasites & Vectors*, 15(1), 410. https://doi.org/10.1186/s13071-022-05465-7

Safety, W. P., & World Health Organization (2009). WHO guidelines on hand hygiene in health care (No. WHO/IER/PSP/2009/01). World Health Organization. Available at: https://iris.who.int/bitstream/handle/10665/44102/9789241597906_eng.pdf?sequence=1

Strunz, E. C., Addiss, D. G., Stocks, M. E., Ogden, S., Utzinger, J., & Freeman, M. C. (2014). Water, Sanitation, Hygiene, and Soil-Transmitted Helminth Infection: A Systematic Review and Meta-Analysis. *PLoS Medicine*, *11*(3), e1001620. https://doi.org/10.1371/journal.pmed.1001620.

World Health Organization (2023). *Soil-transmitted helminth infections*. https://www.who.int/news-room/fact-sheets/detail/soil-transmitted-helminth-infections.

World Health Organization (2023). Soil Transmitted Helminthiasis (2022). Fact Sheet. 2024. Available online: https://www.who.int/newsroom/fact-sheets/detail/soil-transmitted-helminth-infections (accessed on 22 August 2024).

Yaro, C. A., Kogi, E., Luka, S. A., Nassan, M. A., Kabir, J., Opara, K. N., Hetta, H. F., & Batiha, G. E. (2021). Edaphic and climatic factors influence on the distribution of soil transmitted helminths in Kogi East, Nigeria. *Scientific Reports*, 11 (8490), 1 -12. https://doi.org/10.1038/s41598-021-88020-1.

Zacharia, F., Silvestri, V., Mushi, V., Ogweno, G., Makene, T., & Mhamilawa, L. E. (2023). Burden and factors associated with ongoing transmission of soil-transmitted helminths infections among the adult population: A community-based cross-sectional survey in Muleba district, Tanzania. *PLoS ONE*, 18(7), e0288936. https://doi.org/10.1371/journal.pone.028893.