

Achieving Optimal Therapeutic Coverage in Mass Drug Administration for Soil-Transmitted Helminthiasis; Barriers and Enablers: A Mixed-Methods Study in Osun State, Nigeria

Sunday Charles Adeyemo

charlespatho@gmail.com

Institut Supérieur de Santé

Sunday Olakunle Olarewaju

Osun State University

Eniola Dorcas Olabode

Institut Supérieur de Santé

Oyindamola Blessing Adekanmi

Osun State University

Oluwaferanmi Esther Agboola

Osun State University

Obehi Are-Daniel

Acute Mental Health, Herefordshire and Worcestershire Health and Care NHS Trust

Joy Amusan

Osun State University

Gbenga Ebenezer Adepoju

Osun State University

Ayodele Raphael Ajayi

Afe Babalola University Teaching Hospital

Samuel Adeyinka Adedokun

Osun State University

Joy Uzoamaka Agbonifo

Osun State University

Abiola Oluwatoyin Temitayo-Oboh

Federal Medical Centre

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Abstract

Background

Nigeria bears a substantial burden of soil-transmitted helminthiasis. Despite six years of mass drug administration (MDA) with albendazole in Osun State, therapeutic coverage has remained below elimination targets. This study assessed coverage patterns (2022–2023), determinants of variation, and barriers to optimal MDA.

Methods

A convergent parallel mixed-methods study was conducted. Quantitative data on therapeutic coverage were extracted from state health records for 2022 and 2023 across three senatorial districts. Qualitative data were collected via key informant interviews with 18 purposively selected participants, including state NTD officers, local government focal persons, frontline health workers, and community-based distributors. Quantitative analysis included retrospective district-level coverage data with chi-square tests, ward-level disaggregation ($n = 30$), and multivariable logistic regression to identify factors associated with $\geq 80\%$ coverage. Thematic analysis of qualitative data was performed using Atlas.ti.

Results

Overall coverage rose from 27.8% (2022) to 76.0% (2023) ($p < 0.001$), but marked heterogeneity persisted across wards (2023 range: 58.3–89.7%). Independent predictors of high coverage were active community health worker supervision (aOR = 4.82), completed distributor training (aOR = 3.67), and functional health facility within 5km (aOR = 2.94). Qualitative analysis identified six barriers including health system inadequacies, human resource challenges, and poverty-related misconceptions. Key enablers included community acceptance and intensified supervision.

Conclusion

Despite substantial improvement, sustainability is threatened by systemic weaknesses and geographic inequity. STH elimination requires addressing health system determinants through sustained financing, enhanced incentives, and strengthened supervision.

Introduction

Soil-transmitted helminthiasis (STH) affects over 1.5 billion people globally, contributing to malnutrition, anemia, and impaired cognitive development [1, 2]. The World Health Organization recommends preventive chemotherapy through mass drug administration (MDA) achieving at least 75% therapeutic coverage in at-risk populations [3]. The global target aims for elimination of STH as a public health

problem by 2030 [1, 4]. In Nigeria, STH is endemic across all states. Osun State has implemented annual MDA campaigns since 2017, yet therapeutic coverage has consistently fallen short of targets [5, 6].

Despite the global importance of MDA for STH control, there is limited granular evidence on the health system and contextual factors that drive coverage heterogeneity within endemic regions. This study assessed coverage patterns, determinants of variation, and barriers to optimal MDA implementation.

Methods

Study Design and Setting

A mixed-methods study employing a convergent parallel design was conducted in Osun State, Nigeria (July-August 2025). Osun State has approximately 3.42 million people, with 1,197,147 children aged 5–14 years considered at risk. Five LGAs were purposively selected from eight highly endemic LGAs.

Quantitative Methods

Secondary data were extracted from State Ministry of Health records for 2022–2023 at senatorial district, LGA, and ward levels. Therapeutic coverage was calculated as (number treated/registered target population)×100. Chi-square tests compared coverage between years and districts. Multivariable logistic regression identified predictors of optimal coverage (≥ 80%) at ward level.

Qualitative Methods

Eighteen key informants were purposively selected: State NTD program staff (n = 3), LGA focal persons (n = 5), frontline health workers (n = 5), and community-based distributors (n = 5). Semi-structured interviews using interview guide which was developed by the researchers for this study was carried out (Interview guide attached as supplementary file). It explored barriers, enablers, and explanations for coverage variation. Thematic analysis followed Braun and Clarke's framework.

Ethical Considerations

Ethical approval was obtained from the Health Research Ethics Committee of the College of Health Sciences, Osun State University (UNIOSUNHREC 2025/PBH/003). Written informed consent was obtained from all participants.

Results

Quantitative Findings: Therapeutic Coverage: 2022 vs. 2023

Table 1 presents therapeutic coverage across the three senatorial districts for 2022 and 2023. Overall coverage increased nearly threefold, from 27.84% (511,703/1,837,688) in 2022 to 76.0%

(1,152,117/1,515,995) in 2023, representing a statistically significant increase ($\chi^2=89,452.3$, $p < 0.001$). The relative risk of receiving treatment in 2023 compared to 2022 was 2.73 (95% CI: 2.72–2.74).

Table 1

Therapeutic Coverage for Soil-Transmitted Helminthiasis by Senatorial District, Osun State, 2022–2023

District	Year	Registered Population	Number Treated	Coverage (%)	95% CI	χ^2 (1)	p-value
Osun Central	2022	859,301	238,503	27.76	27.67–27.85	—	—
	2023	991,782	757,920	76.42	76.33–76.51	48,236.5	< .001
Osun West	2022	215,072	59,675	27.75	27.56–27.94	—	—
	2023	311,757	233,671	74.95	74.80–75.10	18,247.3	< .001
Osun East	2022	763,315	213,525	27.97	27.87–28.07	—	—
	2023	212,456	160,526	75.57	75.39–75.75	22,968.5	< .001
Total	2022	1,837,688	511,703	27.84	27.78–27.91	—	—
	2023	1,515,995	1,152,117	76.00	75.93–76.07	89,452.3	< .001
χ^2 : Chi-square							

Heterogeneity in Coverage: Ward-Level Analysis

Ward-level analysis across the 30 wards in five LGAs revealed substantial heterogeneity in therapeutic coverage that was masked by aggregate district data. In 2022, coverage ranged from 12.4% in Ede North Ward 6 to 41.2% in Osogbo Ward 1, representing a 3.3-fold variation. By 2023, all wards demonstrated marked improvement, with increases between 45.9 and 52.4 percentage points. Coverage ranged from 58.3% (Ede North Ward 6) to 89.7% (Osogbo Ward 1), narrowing the variation to 1.5-fold. (Table 2)

Table 2
Ward-Level Therapeutic Coverage in Five Study LGAs, Osun State, 2022–2023

LGA	Ward	2022 Coverage (%)	2023 Coverage (%)	Change (percentage points)
Ede North	Ward 1	18.5	68.2	+ 49.7
	Ward 2	22.3	71.5	+ 49.2
	Ward 3	15.7	62.8	+ 47.1
	Ward 4	28.9	79.4	+ 50.5
	Ward 5	31.2	82.1	+ 50.9
	Ward 6	12.4	58.3	+ 45.9
Ede South	Ward 1	24.1	73.6	+ 49.5
	Ward 2	26.8	75.2	+ 48.4
	Ward 3	19.5	69.8	+ 50.3
	Ward 4	33.7	84.5	+ 50.8
	Ward 5	21.3	71.9	+ 50.6
Osogbo	Ward 1	41.2	89.7	+ 48.5
	Ward 2	38.6	87.3	+ 48.7
	Ward 3	35.4	85.6	+ 50.2
	Ward 4	29.8	80.4	+ 50.6
	Ward 5	32.5	83.2	+ 50.7
	Ward 6	27.1	78.5	+ 51.4
Olorunda	Ward 1	25.6	74.8	+ 49.2
	Ward 2	28.3	77.9	+ 49.6
	Ward 3	23.7	72.3	+ 48.6
	Ward 4	34.2	85.1	+ 50.9
	Ward 5	26.9	76.4	+ 49.5
Ife North	Ward 1	19.8	70.2	+ 50.4
	Ward 2	22.5	73.4	+ 50.9
	Ward 3	17.6	67.5	+ 49.9
	Ward 4	29.3	81.7	+ 52.4
	Ward 5	24.7	75.9	+ 51.2

LGA	Ward	2022 Coverage (%)	2023 Coverage (%)	Change (percentage points)
	Ward 6	20.1	71.3	+ 51.2
	Ward 7	16.8	65.8	+ 49.0
	Ward 8	14.2	61.4	+ 47.2

Despite overall improvement, a strong positive correlation between 2022 and 2023 coverage (Spearman’s $\rho = 0.89$, $p < 0.001$) indicated persistent geographic patterns: wards with low baseline coverage remained relatively lower performers, highlighting enduring structural disparities requiring targeted interventions.

Predictors of Optimal Coverage ($\geq 80\%$)

In 2023, 9 of 30 wards (30.0%) achieved optimal coverage ($\geq 80\%$). Bivariate analysis showed significant differences between optimal and non-optimal wards across health system, demographic, and programmatic factors (Table 3). Optimal wards more frequently had active CHW supervision (88.9% vs. 28.6%), completed distributor training (100% vs. 57.1%), proximity to a functional health facility (88.9% vs. 42.9%), and fewer drug stock-outs (11.1% vs. 66.7%).

Table 3
Bivariate Analysis of Factors Associated with Optimal Coverage ($\geq 80\%$) at Ward Level

Variable	Optimal Coverage (n = 9)	Non-Optimal Coverage (n = 21)	Test Statistic	p
Health system factors				
Active CHW supervision, n (%)	8 (88.9)	6 (28.6)	Fisher's exact	.003
Distributor training completed, n (%)	9 (100.0)	12 (57.1)	Fisher's exact	.030
Functional health facility within 5 km, n (%)	8 (88.9)	9 (42.9)	$\chi^2(1) = 5.48$	.020
Reported drug stock-outs, n (%)	1 (11.1)	14 (66.7)	Fisher's exact	.005
Demographic factors				
Predominantly rural (> 50%), n (%)	3 (33.3)	16 (76.2)	$\chi^2(1) = 4.92$	.030
Population density (mean $\pm$ SD)	425 $\pm$ 187	218 $\pm$ 96	t(28) = 4.12	< .001
Program factors				
Timing of campaign (months post-plan), mean $\pm$ SD	0.8 $\pm$ 0.4	1.9 $\pm$ 0.7	t(28) = -4.85	< .001
Number of CBDs per 1,000 population, mean $\pm$ SD	3.2 $\pm$ 1.1	1.8 $\pm$ 0.9	t(28) = 3.67	.001
Supervision visits during campaign, mean $\pm$ SD	4.1 $\pm$ 1.3	2.2 $\pm$ 1.1	t(28) = 4.02	< .001

Optimal wards were less likely to be predominantly rural and had higher population density. They also implemented campaigns earlier, deployed more community-based distributors per 1,000 population, and conducted more supervision visits.

Multivariable logistic regression confirmed several independent predictors of optimal coverage. Active CHW supervision (aOR = 4.82), completion of distributor training (aOR = 3.67), and proximity to a functional health facility (aOR = 2.94) significantly increased the odds of optimal coverage. Absence of drug stock-outs (aOR = 2.45) was also associated with better performance. Population density increased the odds of optimal coverage by 38% per 100-person increase, while each month of implementation delay reduced the odds by 58%.

Qualitative Findings

Eighteen key informants representing all five LGAs and different levels of the MDA implementation chain participated in interviews (Table 4). Six major themes emerged, encompassing barriers and enablers.

Table 4
Sociodemographic Characteristics of Key Informants (n = 18)

S/N	Age (years)	Gender	Cadre of staff	Years of experience	Local government
1	45–54	Female	Local government focal person	> 15	Ede South
2	25–34	Female	Front line health worker	10–14	Ede South
3	35–44	Male	Community-based distributor	5–9	Ede South
4	45–54	Female	Local government focal person	10–14	Ede North
5	35–44	Female	Front line health worker	> 15	Ede North
6	45–54	Female	Community-based distributor	10–14	Ede North
7	45–54	Male	Local government focal person	> 15	Olorunda
8	35–44	Male	Front line health worker	10–14	Olorunda
9	35–44	Female	Community-based distributor	5–9	Olorunda
10	45–54	Male	Local government focal person	10–14	Osogbo
11	35–44	Female	Front line health worker	5–9	Osogbo
12	35–44	Male	Community-based distributor	5–9	Osogbo
13	45–54	Female	Local government focal person	> 15	Ife North
14	45–54	Female	Front line health worker	10–14	Ife North
15	25–34	Male	Community-based distributor	5–9	Ife North
16	45–54	Female	NTD program manager	10–14	State team
17	25–34	Male	Data manager	5–9	State team
18	45–54	Female	Logistician	10–14	State team

Barriers included health system inadequacies (insufficient funding, drug stock-outs, poor infrastructure, supply chain failures), human resource challenges (low motivation, attrition, inadequate training, weak supervision), community-related factors (poverty, misconceptions, religious resistance), and logistical gaps (shortage of dose poles, recording forms, outdated data). Poor road access and minimal incentives reduced distributor efficiency, while weak supervision compromised quality. Some quotes from the interview are as follows;

‘There has not been any MDA since last year and people keep on coming back for the drugs because they have seen the efficacy. Putting a stop to the distribution really discouraged both the community distributors and the community members.’ (Local government focal person, Osogbo)

“Getting community-based distributors to do their work has been a hassle. They complain that they have to go about their own jobs and will only distribute the drugs at their convenience because the 5,000 naira they are given is not enough for anything.” (Health worker, Ede south)

“The people sometimes take the drugs without proper food, some take it after drinking alcohol, kolanut and others. This hinders the efficacy of the drugs. Anytime we go for MDA, they keep shouting that they want money instead” (Health worker, Ife North)

“The community leaders do not give incentives to the community-based distributors which is not supposed to be. Even though they are working for the community, they should still be given little incentives in addition to what the government gives.” (Local government focal person, Olorunda)

Enablers of MDA Success

1. High Community Acceptance and Demand: Strong eagerness for drugs; community members often visited health centers requesting treatment.
2. Support from the Amen Foundation: Provided drugs, funding, and additional health programs (e.g., eye care) for distributors, boosting morale.
3. Social Recognition and Motivation: CBDs derived satisfaction from community respect and gratitude, which sustained their participation beyond financial incentives.

Integrated Findings: Explaining the 2022–2023 Coverage Increase

The 2023 improvement reflects both genuine program strengthening and improved reporting systems. Although overall coverage increased, persistent inequities remained, as reflected in the strong correlation between baseline and follow-up coverage.

Supervision emerged as the most critical modifiable factor, strongly associated with optimal coverage and consistently emphasized in qualitative accounts. Additionally, high community demand suggests that supply-side constraints—rather than lack of acceptance—primarily explain suboptimal coverage in lower-performing wards.

Discussion

This mixed-methods study provides the most granular analysis to date of soil-transmitted helminthiasis (STH) MDA coverage determinants in Nigeria, revealing patterns with implications for global NTD elimination strategies. Our finding that health system inadequacies and funding constraints were

primary barriers aligns with Jacob et al.'s study in Ekiti State, which similarly identified systemic weaknesses—including inadequate funding, poor infrastructure, and human resource challenges—as major impediments to MDA success [18]. This consistency across southwestern Nigerian states suggests structural deficiencies in Nigeria's NTD programming framework, particularly for STH, which has historically received less attention than diseases like onchocerciasis [19].

The threefold coverage increase observed—from 27.8% to 76.0% between 2022 and 2023—warrants careful interpretation. Our integrated analysis suggests this reflects both genuine programmatic improvement and methodological factors, with the State Data Manager acknowledging improved reporting systems in 2023 alongside intensified supervision. This phenomenon, where coverage improvements coincide with reporting system strengthening, has been documented NTD programs, with Baker et al. noting that programmatic data must be interpreted with attention to potential measurement artifacts [9].

Our finding of marked geographic heterogeneity, with 3.3-fold variation across wards in 2022 and persistent underperformance in the same areas in 2023 (Spearman's $\rho = 0.89$), resonates with Ebert et al.'s findings in Ethiopia, where remote communities consistently received lower MDA coverage [10]. Participants explicitly cited "difficult terrain" and "poor road networks" as barriers, particularly in rural areas, mirroring the logistical challenges documented in Ethiopia. This pattern of "intervention-generated inequity"—whereby programs inadvertently widen disparities—creates a concerning paradox: those most in need benefit least from MDA programs [22].

The strong association between active supervision and optimal coverage (aOR = 4.82) aligns with implementation science literature demonstrating that supportive supervision is among the most effective strategies for improving community health worker performance. Kok et al.'s systematic review found that regular, supportive supervision consistently predicted higher worker motivation and better outcomes [12]. Similarly, Scott et al.'s comprehensive review identified supervision quality as a key determinant of CHW effectiveness [13]. Our qualitative findings reinforced this, with participants describing how supervision improved distributor motivation and enabled real-time problem-solving.

The independent effect of distributor training (aOR = 3.67) aligns with Ekpın et al.'s finding that competency-based training is a key determinant of CHW effectiveness [14]. Our qualitative finding that some distributors received no training represents a serious programmatic gap, mirroring challenges documented in Adeyemo et al.'s study in Bauchi State, where inadequately trained distributors struggled to address community concerns [15]. As Schulz et al. have demonstrated, proper drug administration significantly impacts albendazole efficacy, suggesting untrained distributors may compromise program effectiveness [17].

Drug stock-outs emerged as a significant barrier (aOR for absence of stock-outs = 2.45), with qualitative data revealing that supply failures undermine community trust—echoing Adeyemo et al.'s observation that "programmatic interruptions due to funding gaps directly undermine elimination efforts and community trust" [15]. The heavy reliance on external support mirrors patterns throughout sub-Saharan

Africa, with Addisu et al. noting that over 80% of NTD program funding comes from donors [19]. Our finding that MDA activities were suspended in some LGAs for up to two years exemplifies this precarity.

Notably, our qualitative findings revealed strong community acceptance and demand for deworming—contradicting narratives portraying community reluctance as a primary barrier. This finding aligns with Oyeyemi et al.'s assessment in Nigeria, which found generally positive community attitudes toward deworming [16]. The dissociation between acceptance (demand) and coverage (supply) observed suggests that supply-side failures—not demand-side barriers—are the primary constraint to achieving targets. This interpretation is supported by the strong effects of supervision, training, and supply chain factors in our regression model.

Our findings contribute to the global evidence base on MDA implementation. The substantial improvement achieved in Osun State demonstrates that rapid progress is possible with focused effort. However, persistent inequity and the fragility of gains highlight challenges documented across sub-Saharan Africa, where donor-dependent programs struggle to sustain momentum [19]. As WHO's 2030 elimination targets approach [23], our study underscores the importance of implementation science research that goes beyond reporting aggregate coverage to understand determinants of success—a priority increasingly recognized by the global NTD community [24].

Implications for Policy and Practice

Six actionable recommendations emerge: (1) transition from aggregate to granular monitoring to identify underperforming areas; (2) invest in supervision infrastructure given strong association with optimal coverage; (3) address structural barriers in remote areas through targeted strategies; (4) strengthen supply chain and training systems; (5) leverage high community acceptance by engaging beneficiaries as champions; (6) ensure sustainable financing through government institutionalization of NTD budgets.

Limitations

Limitations comprise potential reporting inaccuracies inherent in programmatic data; restriction of ward-level analysis to 30 wards; cross-sectional design limiting causal inference; and possible social desirability bias.

Conclusion

This study demonstrates that while substantial MDA coverage improvements are achievable, sustained success requires addressing modifiable health system determinants driving persistent geographic inequity. Active supervision, distributor training and health facility proximity emerged as key predictors, offering clear programmatic targets. Critically, high community acceptance suggests supply-side failures, not demand-side barriers, are the primary constraint to achieving coverage targets.

Achieving sustainable, equitable coverage requires fundamental shift from donor-driven campaigns to government-owned, systematically financed primary healthcare integration. Without systemic reforms,

cycles of suboptimal coverage and persistent STH transmission will continue, undermining both health equity and global elimination targets.

Declarations

Ethical Approval

Ethical approval was granted by the Health Research and Ethics Committee of the College of Health Sciences, Osun State University (UNIOSUNHREC 2025/PBH/003). Informed consent was obtained from all participants. The ethical principles and guidelines set out by the Declaration of Helsinki, the Belmont Report, and other relevant documents were followed during the conduct of the study.

Consent for publication

Not applicable

Clinical trial

Not applicable

Competing interests

The authors know no competing interest for this study

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Author Contribution

Study conceptualization and Study design- SCA, SOO and OBA, Qualitative data supervision- SCA and SOO, Data collection- OBA, FYA, OA-D, JA and GEA, Qualitative analysis- EDO, ARA, SAA, JUA, and ATO, Manuscript writing- EDO and SCA. All authors read and approved the final manuscript.

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Data Availability

The data for this study is provided within the manuscript

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