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Impact of a School-Based Health Education Programme on Hygiene Practices, Soil-Transmitted Helminth Infection, and School Attendance Among Primary School Pupils in Nigeria: A Systematic Review and Meta-Analysis

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Abstract

Background: Soil-transmitted helminth (STH) infections remain endemic among Nigerian schoolchildren despite mass deworming, and school-based health education is widely promoted to prevent reinfection, improve hygiene, and keep children in class. Nigerian evidence has not previously been synthesised.

Objective: To synthesise the effect of school-based health education on hygiene practices, STH infection, and school attendance among Nigerian primary school pupils.

Methods: Following PRISMA 2020, we screened 56 records from a curated evidence library (51 after removing five duplicates), applied pre-specified criteria, extracted outcome data, appraised risk of bias, and, where outcomes allowed, pooled school-level proportions with DerSimonian–Laird random-effects models. Two Nigerian studies met the criteria: a pair-matched cluster-randomised trial in Kogi State (10 schools; deworming plus health education versus deworming alone) and a controlled quasi-experimental study in Osun State (404 pupils; 12 schools).

Results: In Kogi East, 12-month STH incidence was 7.2% (12/167) with health education and 6.4% (10/157) with deworming alone (odds ratio 1.09, 95% CI 0.45–2.62; $I^2 = 0\%$ within arms); incidence in both arms was about 80% below baseline prevalence (36.1% and 32.0%). In Osun State, the proportion of pupils with good schistosomiasis knowledge rose from 27.9% to 95.0%, and the prevalence of Schistosoma haematobium fell from 16.9% to 3.5% in the intervention group, whereas it stayed near 15.8% in the comparison group; risky practices did not change significantly (88.1% to 83.1%). Neither study measured school attendance. Overall certainty of evidence was very low.

Conclusions: Current Nigerian evidence shows that school-based health education reliably improves

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knowledge and attitudes but has not been shown to reduce STH reinfection beyond deworming alone, and its effect on hygiene practice and attendance is unproven. Adequately powered, cluster-randomised trials that measure observed hygiene behaviour and school attendance, alongside improved school and community sanitation, are needed.

Keywords: Health Education, School Health, Soil-Transmitted Helminths, Hygiene, School Attendance, Nigeria, Systematic Review, Meta-Analysis

INTRODUCTION

Burden of soil-transmitted helminth infection

Soil-transmitted helminths (STH), the roundworm *Ascaris lumbricoides*, the whipworm *Trichuris trichiura*, and the hookworms *Necator americanus* and *Ancylostoma duodenale*, are among the most common human infections worldwide, and they fall hardest on the poorest and most deprived communities. The World Health Organisation (WHO, n.d.) estimates that about 1.5 billion people, or 24% of the world's population, are infected, and that infected children are nutritionally and physically impaired. Because school-aged children carry some of the heaviest worm burdens, they are the main target of control. According to WHO (2025), more than 883 million children required preventive chemotherapy for STH in 2024; about 505 million received it, for a global coverage of 57.2%; and only 20 countries met the World Health Assembly target of treating at least 75% of school-aged children in need. The consequences extend into the classroom. A meta-analysis of 36 studies involving 12,920 children found that infected or untreated children performed worse than uninfected or dewormed children in learning, memory, and intelligence tests, with standardised mean differences between −0.44 and −0.27 (Pabalan et al., 2018).

The situation in Nigeria

Nigeria carries a substantial share of this burden. Geostatistical modelling of 2011 national survey data estimated that STH infections were endemic in 20 of the 36 states and the Federal Capital Territory, that 5.7 million school-aged children (13.8%) were infected, and that annual or twice-yearly treatment of this age group would require about 10.2 million tablets; prevalence at individual survey locations reached 83% for roundworm and 50% for hookworm (Oluwole et al., 2015). Programme data for 2021 show that transmission was active in all six geopolitical zones, that preventive chemotherapy reached school-aged children in only 177 of 774 implementation units (22.9%), and that effective coverage (at least 75%) averaged just 19.3%, far below the WHO benchmark; 41.5%, 41.6%, and 13.4% of children lived in areas of low, moderate, and high infection, respectively (Oyeyemi & Okunlola, 2023). At the local level, a survey of 1,295 pupils in 45 rural schools of Kogi East found an overall STH prevalence of 17.1%, driven mainly by hookworm (12.7%) (Yaro et al., 2020). In the same state, baseline prevalence in the ten highest-prevalence schools was 32.0% to 36.1% (Yaro et al., 2022). Schistosomiasis is a second, overlapping problem: in riverine primary schools of Osun State, 16.9% of intervention-group pupils were infected with *Schistosoma haematobium* before an education programme began (Adeyemo et al., 2026).

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Why deworming alone is not enough

Periodic deworming is the backbone of control, but it treats infection without changing the conditions that produce it. Children are reinfected when they return to contaminated soil and water; in Kogi East, reinfection after albendazole was first detected in the seventh month of follow-up, in both study arms (Yaro et al., 2022). A recent meta-analysis of community-based interventions confirmed that school-based and community-wide treatment reduce STH prevalence. However, it also found that few studies examined water, sanitation, and hygiene (WASH) or health education, which may be essential to prevent reinfection after treatment (Ugwu et al., 2024). For this reason, WHO recommends delivering school-based deworming alongside health and hygiene education to promote behaviours that reduce reinfection after deworming (Thériault et al., 2014). These behaviours are concrete and teachable: washing hands with soap before eating and after using the toilet or playing in soil; wearing footwear outdoors; using latrines rather than open defecation; washing fruit and vegetables; drinking clean water; and keeping nails short (Yaro et al., 2022).

Hygiene, infection, and school attendance

Schools are a logical platform for this education because they reach children daily, and the outcomes of interest extend beyond parasitology. Illness removes children from classrooms. In a cluster-randomised trial in the Peruvian Amazon, pupils with moderate-to-heavy *Ascaris* infection and with light hookworm infection missed 2.4% (95% CI 0.1%–4.7%) and 4.6% (95% CI 1.9%–7.4%) more school days, respectively, than uninfected classmates (Thériault et al., 2014). It remains unclear whether school-based programmes can recover these lost days. Large trials of school WASH programmes with behaviour-change components found no effect on pupil absence in 100 schools in Lao PDR (Chard et al., 2019) or in 60 schools and 6,229 pupils in Addis Ababa, Ethiopia (Bick et al., 2024). In contrast, a systematic review of 39 school-based hygiene trials from 22 countries concluded, with low to very low certainty, that hand, body, and genital hygiene interventions may improve knowledge, practices, and infection-related absenteeism (Ismail et al., 2024). A review of handwashing promotion targeted at children in low- and middle-income countries found eight studies so heterogeneous that no approach could be recommended as most effective (Watson et al., 2017).

Nigerian evidence gap

The Nigerian evidence base is both small and divergent. Most Nigerian school studies are descriptive cross-sectional surveys of infection, teachers' knowledge, or school hygiene conditions (Ekpo et al., 2008; Egbuche et al., 2025; Obi et al., 2024). Only two evaluations of a school-based education intervention with a comparison group appear in the evidence set assembled for this review: a cluster-randomised trial in Kogi East that found no added benefit of health education over deworming alone for STH reinfection (Yaro et al., 2022), and a controlled quasi-experimental study in Osun State in which knowledge, attitudes, and *S. haematobium* prevalence improved markedly after education and treatment (Adeyemo et al., 2026). Neither reported school attendance. The reviews in the evidence set are global or regional in scope (Ismail et al., 2024; Ugwu et al., 2024; Watson et al., 2017), and none isolates the Nigerian context, where school infrastructure, deworming coverage, security constraints, and community sanitation differ from those of the settings in which most trials were conducted.

LITERATURE REVIEW

School-based health education is expected to work through a chain of linked steps. Lessons and materials are meant to raise knowledge, which shapes attitudes and intentions, which in turn change practices such as handwashing with soap, wearing footwear, and using latrines; changed practices reduce exposure to

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eggs and larvae in soil, which lowers infection and reinfection; and lower infection should lead to fewer illness-related absences and better learning. Each link can fail. Knowledge may not become practice when soap, water, latrines, or shoes are unavailable; school-level behaviour change may matter little if transmission is driven at home and in the community; and absence has many causes beyond helminth infection (Bick et al., 2024; Chard et al., 2019; Yaro et al., 2022). A synthesis therefore needs to examine each outcome in the chain separately, which is why this review treats hygiene practices, infection, and attendance as distinct endpoints.

The review focuses on Nigeria for three reasons. The country ranks among the most affected in sub-Saharan Africa, and effective deworming coverage is low, so the marginal value of any complementary measure is potentially high (Oluwole et al., 2015; Oyeyemi & Okunlola, 2023). Education is inexpensive and can be delivered by teachers within existing school structures, as the Kogi East programme showed by combining pupil lessons with a half-day teacher workshop (Yaro et al., 2022). The two Nigerian controlled studies have not been combined or compared with international evidence. By tabulating every record in a defined evidence library, extracting study-level data, and quantifying effects at the correct unit of analysis wherever possible, this review aims to give a transparent account of what is, and is not, known.

Statement of the problem and objectives

Statement of the problem. Despite the heavy and persistent burden of STH among Nigerian schoolchildren and the widespread promotion of school-based health education as a complement to deworming, it is not known whether such programmes improve hygiene practices, reduce STH infection, and increase school attendance among Nigerian primary school pupils, because the few available studies are small, methodologically heterogeneous, and have never been systematically synthesised.

Objectives. The general objective was to synthesise the evidence on the impact of school-based health education programmes on hygiene practices, STH infection, and school attendance among primary school pupils in Nigeria. The specific objectives were (i) to estimate the effect of school-based health education on hygiene-related knowledge, attitudes, and practices; (ii) to estimate its effect on the prevalence or incidence of STH infection; (iii) to estimate its effect on school attendance or absenteeism; and (iv) to appraise the risk of bias and certainty of the evidence and identify gaps for future research.

Effect on infection. Evidence on whether education changes infection outcomes is mixed. In the Peruvian Amazon trial, 517 grade 5 pupils received four months of health hygiene education after deworming, and 571 control pupils followed the usual curriculum (Thériault et al., 2014). A comprehensive school WASH package in Lao PDR, delivered to 50 of 100 randomised schools, had no impact on STH infection (Chard et al., 2019), and the Kogi East trial likewise found no significant difference in reinfection between schools receiving education plus deworming and those receiving deworming alone (Yaro et al., 2022). A review of community-based interventions found that treatment, rather than education, accounted for most of the measurable reduction in STH prevalence (Ugwu et al., 2024).

Effect on hygiene knowledge and practice. Education reliably changes what children know. In Osun State, knowledge of schistosomiasis rose from 27.9% to 95.0% after a five-week programme, while risky water-contact and sanitation practices fell only from 88.1% to 83.1% (Adeyemo et al., 2026). The wider hygiene review found that interventions targeting hand, body, and genital hygiene may improve knowledge and practices. However, the trials had low or very low certainty because of methodological limitations and imprecision (Ismail et al., 2024). Barriers outside the classroom, such as lack of footwear and sanitation infrastructure at school and at home, are repeatedly invoked to explain the gap between knowledge and behaviour (Yaro et al., 2022).

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Effect on attendance and learning. The attendance case rests on two links: that infection reduces attendance and learning, and that education reduces infection. Trial-based analyses (Thériault et al., 2014) and cross-sectional work in Ghana support the first link, where schoolchildren with STH had poorer academic performance than uninfected children, regardless of nutritional status (Donkoh et al., 2023). The second link is weak, and school WASH trials with behaviour-change components have not shown that attendance improves (Bick et al., 2024; Chard et al., 2019).

Synthesis. Taken together, the global literature suggests that school-based education is necessary but insufficient for STH control. Nigerian studies add contextual detail on infection patterns, school hygiene, and teacher knowledge, but controlled evaluations are scarce, which is the gap this review addresses.

METHODS

Design and reporting standard

This systematic review and meta-analysis followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement (Page et al., 2021) and the Cochrane Handbook methods guidance (Higgins et al., 2023). [Registration: to be completed by the authors. The review was not prospectively registered in the version reported here.

Eligibility criteria

We defined eligibility using the PICOS framework. *Population:* children enrolled in primary schools in Nigeria. *Intervention:* a school-based health education or hygiene-promotion programme, delivered alone or with deworming or treatment. *Comparator:* no intervention, usual curriculum, or deworming/treatment alone. *Outcomes:* (i) hygiene knowledge, attitudes, or practices; (ii) prevalence or incidence of STH infection; (iii) school attendance or absenteeism. *Study design:* randomised, cluster-randomised, non-randomised controlled, or controlled before–after studies. Cross-sectional surveys, reviews, protocols, studies outside Nigeria, and interventions not delivered in schools were excluded from the primary synthesis; reviews and non-Nigerian trials were retained as contextual evidence.

Information sources and selection

We drew records from a curated evidence library of 56 references on school-based health education. We exported STH as a CSV file with eight fields (authors, title, publication, volume, number, pages, year, publisher). The records spanned 2008 to 2026. We did not run an independent, multi-database search; we discuss the reproducibility and limitations of this approach in Section 4.4. We identified duplicate records by matching titles and authors. We then classified each unique record by record type and country using its title and bibliographic details, and screened it against the criteria in Section 2.2. For records that met the criteria, we retrieved abstracts, open-access full texts, and preprint versions from publisher and preprint servers in October 2026 for data extraction.

Data extraction

For each included study, we extracted the design, setting, participants, intervention content and intensity, comparator, follow-up, and outcome data (events and denominators at the school or group level, test statistics, and reported p-values). Quantitative data for the Kogi East trial were taken from the tables of the open-access preprint of the study (Yaro et al., 2020), and those for the Osun State study from the open-access preprint of the article published as Adeyemo et al. (2026; preprint DOI 10.21203/rs.3.rs-7466555/v1), because the full text of the final published versions was not accessible during extraction. Extracted values should be verified against the versions of record before publication.

Risk of bias and certainty of evidence

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The reviewers assessed risk of bias using domain-based criteria adapted from the Cochrane approach: randomisation or confounding, participant selection, deviations from the intended intervention, missing outcome data, outcome measurement, and selective reporting. We rated each domain as low, some concerns, or high. We graded overall certainty qualitatively using GRADE principles (risk of bias, inconsistency, indirectness, imprecision, and publication bias). Publication bias could not be assessed formally because fewer than ten studies were eligible.

Synthesis methods

Because the Nigerian studies measured different outcomes (STH reinfection in Kogi State; schistosomiasis and knowledge, attitudes, and practices in Osun State), no outcome was reported by two or more studies, so pooling across studies would not have been meaningful. We therefore (i) tabulated study-level data, (ii) performed within-study quantitative synthesis of the Kogi East trial at the school level, which is the unit of randomisation, and (iii) summarised the non-Nigerian evidence descriptively. For (ii), school-level proportions of newly detected STH infection were transformed to the logit scale (with 0.5 added to cells with zero events) and pooled within each arm using the DerSimonian–Laird random-effects method (DerSimonian & Laird, 1986). We compared the arms using the difference in pooled logits, expressed as an odds ratio with a 95% confidence interval and a Wald z-test. Heterogeneity was quantified with Cochran's Q, τ^2, and I^2 (Higgins et al., 2003). We computed crude risk ratios from arm totals for comparison, and we reproduced the school-level t-tests reported by the original authors as a check. We ran analyses in Python 3 with SciPy; we took two-sided $p < 0.05$ as significant.

RESULTS

Study selection

The evidence library contained 56 records (Table 1). Five were duplicates: four additional records of the Kogi East trial (two from 2020, including a preprint, and two from 2022, in addition to the journal article) and one repeated record of the Ghanaian academic-performance study. After deduplication, 51 unique records remained. We excluded eight reviews and three trial protocols from the primary synthesis, leaving 40 primary studies. Twenty-seven of these were observational or evaluated interventions that were not school-based health education (Table 2), leaving 13 evaluations of school-based education or hygiene interventions. Two were conducted in Nigeria and included in the synthesis; the remaining eleven were conducted elsewhere and used for context (Tables 3 and 10). The full screening log is provided in Appendix Table S1.

Table 1

Record flow and screening results

Stage	Records	Detail
Records in evidence library	56	Publication years 2008–2026
Duplicates removed	5	Four additional records of Yaro et al.; one of Donkoh et al.
Unique records screened	51	
Reviews excluded (background only)	8	Systematic, scoping, and narrative reviews

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Protocols excluded	3	No outcome data
Primary studies assessed	40	
Excluded: observational or not school-based education	27	22 observational/cross-sectional; 5 other intervention evaluations (chemotherapy, sanitation, community-based)
School-based education/hygiene intervention evaluations	13	Global evidence
Excluded: conducted outside Nigeria (context only)	11	Lao PDR, Ethiopia, Peru, Kenya, Bangladesh and others
Included in Nigerian synthesis	2	Yaro et al. (2022); Adeyemo et al. (2026)

Classification used titles and bibliographic details supplied in the evidence library; abstracts were retrieved for studies that met the criteria.

Characteristics of the evidence library

Observational and cross-sectional studies were the most common record type (22 of 56, 39.3%), followed by evaluations of school-based education or hygiene interventions (13, 23.2%) and reviews (8, 14.3%) (Table 2). Twenty-five of the 56 records (44.6%) were published in 2023–2026, indicating growing recent attention. Among the 40 primary studies, Ethiopia (9 studies) and Kenya (7) contributed the largest numbers, followed by Nigeria (5) (Table 3). Of the five Nigerian primary studies, two were intervention evaluations, and three were cross-sectional.

Table 2: ***Records in the evidence library by type and publication period***

Record type	2008–2014	2015–2019	2020–2022	2023–2026	Total
School-based education/hygiene intervention evaluation	1	3	1	8	13
Other intervention/programme evaluation	1	3	0	1	5
Observational/cross-sectional	1	4	6	11	22
Review (systematic, scoping, narrative)	0	2	1	5	8
Trial protocol	0	2	1	0	3
Duplicate record	0	0	5	0	5
Total	3	14	14	25	56

n = 56 records. Duplicate records are those that repeat another entry in the library.

Table 3: ***Country and design of the 40 primary studies***

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Country	Region	School-based education/hygiene evaluations	Other intervention evaluations	Observational studies	Total
Ethiopia	East Africa	2	0	7	9
Kenya	East Africa	1	1	5	7
Nigeria	West Africa	2	0	3	5
Bangladesh	Asia–Pacific	1	0	2	3
Lao PDR	Asia–Pacific	2	0	0	2
Not stated	Not stated	2	0	0	2
Philippines	Asia–Pacific	0	0	2	2
Tanzania	East Africa	0	1	1	2
Angola	Southern Africa	0	1	0	1
Cambodia, Indonesia, Lao PDR	Asia–Pacific	1	0	0	1
Cameroon	Central Africa	0	1	0	1
Côte d'Ivoire	West Africa	0	1	0	1
Ghana	West Africa	0	0	1	1
Peru	Americas	1	0	0	1
Timor-Leste	Asia–Pacific	1	0	0	1
Uganda	East Africa	0	0	1	1
Total		13	5	22	40

"Not stated" indicates that the country could not be determined from the bibliographic record. The reviewers assign a region.

Characteristics of the included Nigerian studies

Two studies met the criteria (Table 4). The Kogi East study was an open-label, pair-matched, cluster-randomised trial in ten rural public primary schools; all pupils received a single 400 mg dose of albendazole, and five schools also received health education (Yaro et al., 2022). The Osun State study was a controlled quasi-experimental before-and-after study among 404 pupils in primary 4–6 in 12 public riverine schools (Adeyemo et al., 2026).

Table 4: ***Characteristics of included Nigerian studies***

Study	Design and setting	Participants and intervention	Comparator, follow-up, and outcomes

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Yaro et al. (2022)	Open-label pair-matched cluster-randomised trial; Kogi East, North Central Nigeria; 10 rural schools selected from 45 surveyed (baseline n = 1,295; STH prevalence 17.1%); study period January 2018–December 2019	Pupils aged 5–14; 2,331 pupils dewormed. Five schools received health education at every visit: lessons based on the WHO Urban School Health Kit on STH transmission and prevention, a half-day teacher workshop, and posters (handwashing, footwear, latrine use, clean water, food hygiene)	Five schools dewormed only. Stool examined monthly for 12 months (formalin-ether sedimentation). Outcome: STH incidence/reinfection by species; no hygiene-practice or attendance outcome
Adeyemo et al. (2026)	Controlled quasi-experimental before–after study; riverine communities, Osun State, South-West Nigeria; 12 public primary schools in six LGAs (March–October 2024)	201 intervention and 203 comparison pupils (primary 4–6). Four 30-minute sessions per class over five weeks, in English and Yoruba, with pamphlets and posters; praziquantel for infected pupils in the intervention group	Comparison group received the package after endline. Follow-up three months after intervention (response 95%). Outcomes: knowledge, attitude, risky practices, *S. haematobium* prevalence; no attendance outcome

LGA = local government area. STH = soil-transmitted helminth. Details are from the study reports and their preprint versions.

Effect on hygiene practices

Only the Osun State study measured hygiene-related outcomes (Table 5). At baseline, the groups were comparable (all socio-demographic differences $p > 0.05$). After the intervention, good overall knowledge increased from 27.9% (56/201) to 95.0% (191/201) in the intervention group ($\chi^2 = 215.72$, $p < 0.01$), with no significant change in the comparison group (36.0% at baseline). A favourable overall attitude rose from 57.7% (116/201) to 76.7% (154/201) ($\chi^2 = 7.418$, $p = 0.006$), compared with 56.7% to 57.6% in the comparison group ($p = 0.819$). Several individual attitude items improved significantly only in the intervention group (Table 6): accepting responsibility for preventing infection (76.6% to 83.6%, $p = 0.01$), considering it important to know one's infection status (89.6% to 94.0%, $p < 0.001$), and intending to consult a traditional practitioner if infected (37.8% to 24.9%, $p = 0.01$).

Reported practice changed far less. Risky practices (for example, open defecation and contact with infected water) decreased from 88.1% (177/201) to 83.1% (167/201) in the intervention group and increased from 82.3% to 83.9% in the comparison group; neither change was statistically significant. Among intervention pupils, open defecation in bushes fell from 58.4% to 54.8%, which suggests that education improved understanding more than it changed behaviour. The Kogi East trial did not report hygiene behaviour.

Table 5: ***Primary outcomes in the Osun State study (intervention n = 201; comparison n = 203)***

Outcome	Intervention: baseline	Intervention: post	Test (intervention)	Comparison: baseline	Comparison: post

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S.haematobium prevalence	34 (16.9%)	7 (3.5%)	$\chi^2 = 18.505$, $p < 0.001$	32 (15.7%)	15.8% (no reduction)
Good overall knowledge	56 (27.9%)	191 (95.0%)	$\chi^2 = 215.72$, $p < 0.01$	73 (36.0%)	No significant change
Favourable overall attitude	116 (57.7%)	154 (76.7%)	$\chi^2 = 7.418$, $p = 0.006$	115 (56.7%)	117 (57.6%), $p = 0.819$
Risky practices	177 (88.1%)	167 (83.1%)	Not significant	167 (82.3%)	161 (83.9%)

Note. Counts are n (%) as reported in the study. Percentages for the intervention group use a denominator of 201, and comparison-group follow-up percentages use 192 respondents, as reported. The report gives a baseline knowledge count of 57 (28.4%) in one section and 56 (27.9%) in another, and an abstract post-intervention knowledge value of 99.5% that differs from the 95.0% in the results; the results-section values are shown. The post-intervention count for the comparison group's prevalence and knowledge was not reported.

Table 6: ***Selected attitude items in the Osun State study, n (%) agreeing***

Item	Intervention: pre	Intervention: post	p	Comparison: pre	Comparison: post	p
Schistosomiasis is a very serious disease	144 (71.6)	153 (76.1)	0.06	162 (79.8)	158 (82.3)	0.53
It is my responsibility to prevent infection	154 (76.6)	168 (83.6)	0.01	154 (75.9)	144 (75.0)	0.84
Important to know whether I have schistosomiasis	180 (89.6)	189 (94.0)	<0.001	174 (85.7)	162 (84.4)	0.71
Would see a traditional practitioner if infected	76 (37.8)	50 (24.9)	0.01	62 (30.5)	56 (29.2)	0.77
Defecating in the toilet is important for my health	190 (94.5)	191 (95.0)	0.06	197 (97.0)	184 (95.8)	0.52

Values as reported in the preprint table of the study; p-values are from chi-square tests of pre- versus post-intervention responses within each group.

Effect on soil-transmitted helminth infection

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The Kogi East trial dewormed 2,331 pupils in ten schools and followed them for 12 months. No infection was detected up to 24 weeks. At 36 weeks, incidence was 4.8% (8/167) in the education-plus-deworming (DHE) schools and 3.2% (5/157) in the deworming-only (DO) schools ($t = -0.840$, $p = 0.426$). At 48 weeks, incidence was 7.2% (12/167) in DHE schools and 6.4% (10/157) in DO schools ($t = -0.346$, $p = 0.738$) (Table 7). Our reproduction of the school-level t-tests gave identical statistics ($t = -0.346$, $p = 0.738$ at 48 weeks; $t = -0.841$, $p = 0.425$ at 36 weeks). Hookworm accounted for almost all new infections (6.6% in DHE schools and 6.4% in DO schools); one *A. lumbricoides* infection occurred in a DHE school, and *Strongyloides stercoralis* was not detected (Table 8).

Incidence at 48 weeks was far below baseline prevalence in both arms (Table 8): from 32.0% (41/128) to 6.4% in DO schools and from 36.1% (61/169) to 7.2% in DHE schools (the authors' paired comparisons $p = 0.002$ in each arm). The relative reduction was almost identical, with a risk ratio of post-treatment incidence to baseline prevalence of 0.20 (95% CI 0.10–0.38) in DO schools and 0.20 (0.11–0.36) in DHE schools; the ratio of these ratios was 1.00 (0.42–2.39). The fall therefore reflects deworming rather than education.

Table 7: ***School-level incidence of STH infection during follow-up in the Kogi East trial***

School (LGA)	Pupils examined at 48 wk	Infected at 36 wk, n (%)	Infected at 48 wk, n (%)
Deworming only (DO)			
Ikanekpo (Ankpa)	42	2 (4.8)	4 (9.5)
Ukwaja (Idah)	32	0 (0.0)	1 (3.1)
Alome-Umomi (Ofu)	24	1 (4.2)	2 (8.3)
Opada (Omala)	24	1 (4.2)	2 (8.3)
Central Abejukolo (Omala)	35	1 (2.9)	1 (2.9)
DO total	157	5 (3.2)	10 (6.4)
Deworming + health education (DHE)			
Olubojo (Dekina)	26	0 (0.0)	1 (3.8)
Ogbogbo 2 (Igalamela)	30	2 (6.7)	3 (10.0)
Ejule 2 (Ofu)	40	1 (2.5)	2 (5.0)
Agbenema-Ife (Omala)	36	3 (8.3)	4 (11.1)
Islamiya Abejukolo (Omala)	35	2 (5.7)	2 (5.7)
DHE total	167	8 (4.8)	12 (7.2)

Note. No infections were detected in any school at weeks 12 and 24. Weeks 36 and 48 correspond to months 9 and 12. School-level t-test, DHE versus DO: week 36 $t = -0.840$, $df = 8$, $p = 0.426$; week 48 $t = -0.346$, $df = 8$, $p = 0.738$. Data

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from Yaro et al. (2020, 2022). n at week 36 may differ slightly from n at week 48 because of loss to follow-up.

Table 8: ***Baseline prevalence and 48-week incidence by arm and species in the Kogi East trial***

Measure	DO schools	DHE schools	Comparison (p)
Pupils at baseline survey	128	169	
Baseline STH prevalence, n (%)	41 (32.0)	61 (36.1)	Not significant
Baseline: hookworm, n (%)	33 (25.8)	46 (27.2)	p = 0.927
Baseline: *A. lumbricoides*, n (%)	8 (6.3)	15 (8.9)	p = 0.991
Pupils examined at 48 weeks	157	167	
Incidence at 48 weeks (any STH), n (%)	10 (6.4)	12 (7.2)	t = −0.346, p = 0.738
Hookworm, n (%)	10 (6.4)	11 (6.6)	t = −0.089, p = 0.932
A. lumbricoides, n (%)	0 (0.0)	1 (0.6)	t = −1.000, p = 0.347
S. stercoralis, n (%)	0 (0.0)	0 (0.0)	Not applicable
Change from baseline (paired school-level t)	t = 7.320, p = 0.002	t = 6.771, p = 0.002	

Percentages are as reported by the original authors. All pupils received albendazole 400 mg at baseline. We summed hookworm baseline counts across schools from the study's species tables.

Quantitative synthesis

Random-effects pooling of school-level proportions gave a pooled 48-week incidence of 7.1% (95% CI 3.9%–12.8%) in DO schools and 7.7% (4.4%–13.1%) in DHE schools, with no heterogeneity within either arm (I^2 = 0%, τ^2 = 0) (Table 9, Figure 1). The odds of infection in DHE relative to DO schools were 1.09 (95% CI 0.45–2.62; p = 0.846), and the crude risk ratio from arm totals was 1.13 (0.50–2.54). At 36 weeks, the odds ratio was 1.57 (0.52–4.72; p = 0.421). The confidence intervals are wide: they are compatible with more than halving the odds of reinfection and with more than doubling, so the trial is inconclusive about modest effects and consistent with no effect.

Table 9: ***Random-effects meta-analysis of school-level STH incidence, Kogi East trial***

Time point	Arm	Events/pupils	Pooled incidence, % (95% CI)	I^2	DHE vs DO: OR (95% CI)	p
Week 48	DO	10/157	7.1 (3.9–12.8)	0%		
	DHE	12/167	7.7 (4.4–13.1)	0%	1.09 (0.45–2.62)	0.846
Week 36	DO	5/157	3.7 (1.6–8.3)	0%		
	DHE	8/167	5.7 (2.9–10.8)	0%	1.57 (0.52–4.72)	0.421

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Week 48 crude	DHE vs DO	12/167 vs 10/157	Risk ratio 1.13 (0.50–2.54)			
Change from baseline	Ratio of risk ratios		1.00 (0.42–2.39)			
Osun State (descriptive, not pooled)	Intervention, pre vs post	34/201 vs 7/201	Risk ratio 0.21 (0.09–0.45)			

Note. DO = deworming only; DHE = deworming plus health education; OR = odds ratio. Pooling uses the DerSimonian–Laird method on the logit scale, with school as the unit of analysis (5 schools per arm). The Osun State row shows an unadjusted within-group comparison of pre- and post-intervention prevalence using reported counts; it ignores clustering and the paired nature of the data and should be read descriptively only.

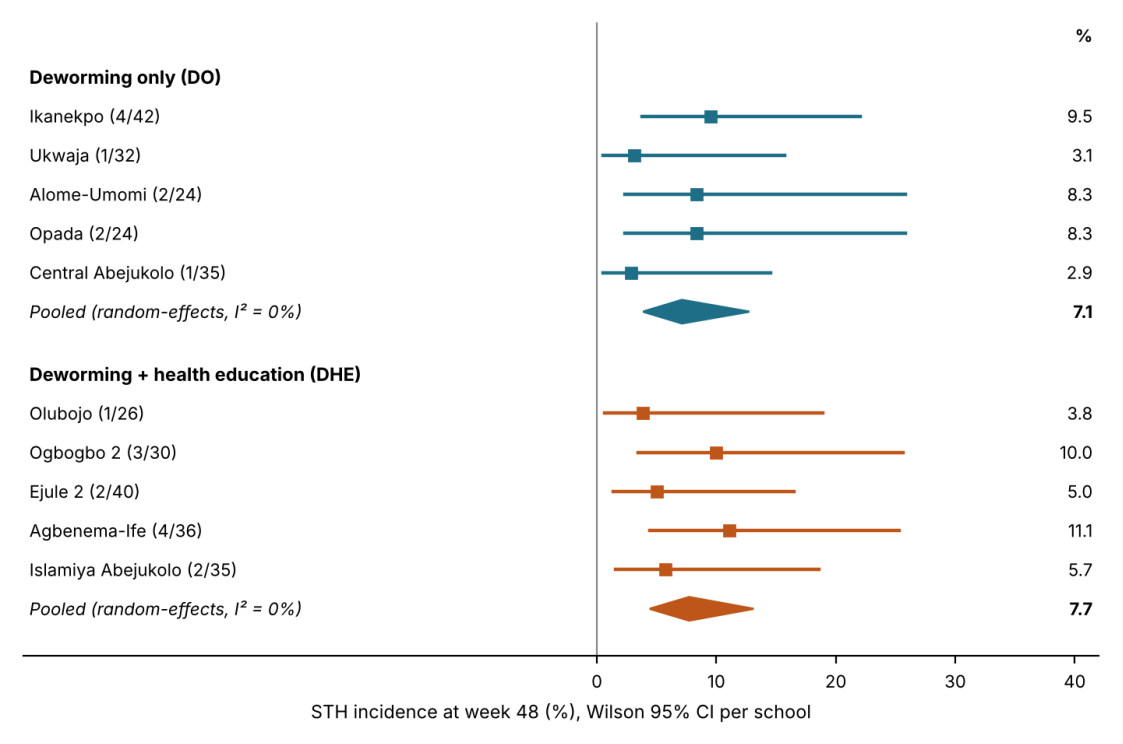


Figure 1. School-level incidence of STH infection at week 48 in the Kogi East trial, by arm. Squares show school-level incidence with Wilson 95% confidence intervals; diamonds show random-effects pooled incidence in each arm. The arms overlap completely.

Effect on school attendance

Neither Nigerian study measured school attendance or absenteeism, so we cannot provide no Nigerian estimate of the effect of school-based health education on attendance. In the non-Nigerian evaluations summarised in Table 10, school-based programmes with behaviour-change components did not reduce absence in Lao PDR (Chard et al., 2019) or Ethiopia (Bick et al., 2024). However, infection itself was associated with more days missed in Peru (Thériault et al., 2014) and a systematic review suggested possible benefits for infection-related absenteeism (Ismail et al., 2024).

Table 10: ***Non-Nigerian and review evidence relevant to the three outcomes***

Source	Design and setting	Intervention	Main findings

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Chard et al. (2019)	Cluster-RCT; 100 primary schools (50/50), Saravane Province, Lao PDR, 2014–2017	School water supply, sanitation and handwashing facilities, drinking-water filters, behaviour-change education	No impact on pupil absence (primary outcome), enrolment, diarrhoea, respiratory infection, or STH infection
Bick et al. (2024)	Cluster-RCT; 60 public primary schools, 6,229 pupils, Addis Ababa, Ethiopia	Water storage and filtration, handwashing stations, behaviour-change promotion	Borderline effect on pupil-reported respiratory illness; no effect on diarrhoea or absence
Thériault et al. (2014)	Cluster-RCT; 18 schools, Peruvian Amazon; 517 intervention and 571 control pupils	Four months of health hygiene education after deworming	Absenteeism recorded from attendance logs; moderate-to-heavy *Ascaris* and light hookworm infection were associated with 2.4% and 4.6% more days missed
Ismail et al. (2024).	Systematic review; 39 trials from 22 countries (23 in meta-analysis)	School-based hygiene interventions vs standard curriculum	Hand, body, and genital hygiene programmes may improve knowledge, practices, and infection-related absenteeism; certainty low to very low
Watson et al. (2017)	Systematic review; 8 studies (7 cluster-RCTs, 1 non-randomised), children 5–12 years	Handwashing promotion targeted at children	Results heterogeneous and synthesised narratively; no approach was most effective
Ugwu et al. (2024)	Systematic review and meta-analysis; 28 studies (14 community-wide, 11 school-based, 3 both)	Community-based interventions for STH	School-based and community-wide treatment reduce prevalence; few studies tested WASH or health education
Pabalan et al. (2018).	Systematic review and meta-analysis; 36 studies, 12,920 children	Infection or deworming status vs educational and cognitive outcomes	Infected or non-dewormed children had deficits in learning, memory, and intelligence (SMD −0.44 to −0.27)

Summaries are from the study abstracts and reports. RCT = randomised controlled trial; SMD = standardised mean difference.

Risk of bias and certainty of evidence

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Both Nigerian studies had important limitations (Table 11). The Kogi East trial randomised only ten schools, was open-label, selected the highest-prevalence schools, used a single stool sample examined by formalin-ether sedimentation, and lost pupils to follow-up (192 and 196 examined at 12 weeks versus 157 and 167 at 48 weeks). However, the school-level analysis was appropriate. The Osun study allocated groups non-randomly, relied on self-reported knowledge and practices, and its preprint contains internally inconsistent figures. Overall certainty of evidence was rated very low for hygiene practices and for STH infection, and no evidence was available for attendance.

Table 11: ***Risk-of-bias judgements for the included Nigerian studies (reviewer assessment)***

Domain	Yaro et al. (2022)	Adeyemo et al. (2026)
Randomisation/confounding	Some concerns: school-pair randomisation, but only 10 schools and highest-prevalence selection	High: non-random allocation of schools; baseline groups comparable
Selection of participants	Some concerns	Some concerns: multistage sampling, 95% retention
Deviations from intended intervention	Some concerns: open-label; education delivered at visits	Low to some concerns
Missing outcome data	Some concerns: fall from 192/196 to 157/167 examined	Low: 95% response at follow-up
Outcome measurement	Some concerns: single stool sample, lower-sensitivity method	Some concerns: self-reported knowledge and practice; microscopy for prevalence
Selective reporting	Some concerns: no hygiene or attendance outcomes	Some concerns: inconsistencies between abstract and results
Overall	Some concerns to high	High (serious)

Judgements are the reviewers' own, based on the study reports, and have not been independently verified by a second reviewer.

DISCUSSION

Principal findings

This review found only two controlled evaluations of school-based health education in Nigerian primary schools. They point in different directions, and the difference largely reflects what each measured. The Kogi East trial, which measured STH reinfection, showed no benefit of education over deworming alone: incidence at 12 months was 7.2% with education and 6.4% without, and both arms fell by about 80% from baseline. The Osun State study, which measured knowledge, attitudes, and schistosomiasis prevalence, showed large improvements in knowledge (27.9% to 95.0%) and a fall in prevalence (16.9% to 3.5%) in the intervention group. Still, it paired education with praziquantel treatment of infected pupils and was not randomised, so the prevalence fall cannot be attributed to education. No Nigerian study measured school attendance.

Interpretation in the context of existing evidence

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The null result for reinfection in Kogi East is consistent with the Lao PDR trial, in which a far more comprehensive package with water, sanitation, and behaviour-change education did not change STH infection or absence (Chard et al., 2019), and with the Addis Ababa trial, which found no effect on absence (Bick et al., 2024). This is also consistent with the community-intervention review's conclusion that most measurable benefit comes from treatment (Ugwu et al., 2024). Several explanations are plausible for why school-based education did not reduce reinfection. First, the intervention was delivered only at study visits and in school; as the Kogi authors argued, pupils return to households and communities where untreated people continue to contaminate the environment. Second, hookworm accounted for nearly all reinfections, and its prevention depends on footwear, which pupils may not own or may not be allowed to wear outside school. Third, the trial was small. With five schools per arm, the confidence interval for the odds ratio (0.45–2.62) cannot rule out either a substantial benefit or substantial harm. Fourth, only 12 months of follow-up were available, and the first infections appeared only after six months.

The Osun findings illustrate a familiar knowledge–practice gap. Knowledge rose from 27.9% to 95.0%, yet reported risky practices barely moved (88.1% to 83.1%, not significant). The authors themselves note that education alone is insufficient without alternative water sources and sanitation infrastructure. This aligns with the broader hygiene literature, where evidence on practice is low or very low (Ismail et al., 2024). It reinforces the point from Nigerian programme data that effective deworming coverage is itself very low (Oyeyemi & Okunlola, 2023), so that schoolchildren are exposed to reinfection from a large untreated reservoir.

On attendance, the logical chain from education to infection to attendance is intact in principle, because infection reduces attendance (Thériault et al., 2014) and infection also affects learning (Pabalan et al., 2018; Donkoh et al., 2023), but it has not been tested in Nigeria, and the available non-Nigerian trials are discouraging.

Implications for policy and practice

Three implications follow. First, deworming remains a proven control component and should be expanded: effective coverage of school-aged children in Nigeria was 19.3% in 2021, against a target of 75% (Oyeyemi & Okunlola, 2023). Second, health education should be seen as improving knowledge and attitudes, which is valuable in itself, but not as a substitute for treatment, latrines, handwashing stations, and safe water; it should be integrated with WASH rather than offered alone. Third, because school education did not reduce reinfection where adults and out-of-school children remained untreated, school programmes should be complemented by community-based deworming and household-level hygiene promotion.

Strengths and limitations

Strengths include a transparent, fully tabulated screening log; extraction of arm- and school-level counts rather than reliance on reported conclusions; reproduction of the original t-tests; and quantitative analysis at the correct unit of randomisation. The review also has important limitations. The evidence base was a supplied library of 56 records rather than the output of a documented multi-database search, so relevant Nigerian studies may be missing, and the search is not reproducible; a single reviewer performed screening and risk-of-bias judgements; and quantitative values were taken from preprint versions and should be verified against the versions of record. With only two eligible studies measuring different outcomes, we could not perform a between-study meta-analysis, assess publication bias or pool within-study results across five schools per arm. Finally, we classified non-Nigerian records based on titles and abstracts.

Recommendations for future research

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Future Nigerian trials should (i) randomise at least 20–30 schools per arm to give adequate power under realistic intracluster correlation; (ii) measure observed hygiene behaviour, such as handwashing with soap and footwear use, rather than self-reported knowledge only; (iii) record school attendance from registers using unannounced checks, as was done in Addis Ababa (Bick et al., 2024); (iv) follow pupils for at least two school years; (v) pair education with improvements in school and household sanitation; and (vi) report STH and schistosome infection with intensity measured by Kato–Katz or equivalent methods.

CONCLUSION

In Nigerian primary schools, health education improves knowledge and attitudes about parasitic infection. However, the available evidence does not show that it reduces STH reinfection beyond what deworming already achieves, and its effect on hygiene practices and school attendance is unproven. Because the evidence is limited to two small studies of very low certainty, decision-makers should prioritise effective deworming coverage and school WASH infrastructure while commissioning properly powered trials that measure behaviour and attendance.

Declarations

Ethics. This review used only published and preprint data; no ethical approval was required.

Data availability. Extracted data are reported in the tables; the screening log is in Appendix Table S1.

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Appendix

Table S1: ***Screening log for all 56 records in the evidence library***

#	First author, year	Record type	Country	Decision
1	Chard et al., 2019	School-based education/hygiene intervention evaluation	Lao PDR	Excluded: outside Nigeria (context only)
2	Okoyo et al., 2026	Review (systematic, scoping, narrative)	Multi-country	Excluded: review (used as background)
3	Xaybouaphanh et al., 2025	School-based education/hygiene intervention evaluation	Lao PDR	Excluded: outside Nigeria (context only)
4	Adeyemo et al., 2026	School-based education/hygiene intervention evaluation	Nigeria	INCLUDED (Nigeria)
5	Clarke et al., 2018	School-based education/hygiene intervention evaluation	Timor-Leste	Excluded: outside Nigeria (context only)
6	Ismail et al., 2024	Review (systematic, scoping, narrative)	Multi-country	Excluded: review (used as background)
7	Tadesse et al., 2024	School-based education/hygiene intervention evaluation	Ethiopia	Excluded: outside Nigeria (context only)
8	Ugwu et al., 2024	Review (systematic, scoping, narrative)	Multi-country	Excluded: review (used as background)

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9	Yaro et al., 2022	School-based education/hygiene intervention evaluation	Nigeria	INCLUDED (Nigeria)
10	Obi et al., 2024	Observational/cross-sectional	Nigeria	Excluded: no school-based education intervention
11	Bokicho et al., 2023	Observational/cross-sectional	Ethiopia	Excluded: no school-based education intervention
12	Pabalan et al., 2018	Review (systematic, scoping, narrative)	Multi-country	Excluded: review (used as background)
13	Yunusa, 2020	Duplicate record	Nigeria	Excluded: duplicate record
14	de Freitas & Madeira, 2024	School-based education/hygiene intervention evaluation	Not stated	Excluded: outside Nigeria (context only)
15	Thériault et al., 2014	School-based education/hygiene intervention evaluation	Peru	Excluded: outside Nigeria (context only)
16	Watson et al., 2017	Review (systematic, scoping, narrative)	Multi-country	Excluded: review (used as background)
17	Massa et al., 2009	Other intervention/programme evaluation	Tanzania	Excluded: intervention not school-based health education
18	Tabi et al., 2018	Other intervention/programme evaluation	Cameroon	Excluded: intervention not school-based health education
19	Bick et al., 2024	School-based education/hygiene intervention evaluation	Ethiopia	Excluded: outside Nigeria (context only)
20	Gholamrezaee-Sarvelat et al., 2025	Review (systematic, scoping, narrative)	Multi-country	Excluded: review (used as background)
21	Wube et al., 2025	Observational/cross-sectional	Ethiopia	Excluded: no school-based education intervention
22	Yaro (thesis), 2022	Duplicate record	Nigeria	Excluded: duplicate record

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23	Oswald et al., 2019	Observational/cross-sectional	Kenya	Excluded: no school-based education intervention
24	Mationg et al. (protocol), 2020	Trial protocol	Philippines	Excluded: protocol, no outcome data
25	Yaro et al. (preprint), 2020	Duplicate record	Nigeria	Excluded: duplicate record
26	Mationg et al., 2021	Observational/cross-sectional	Philippines	Excluded: no school-based education intervention
27	Bartlett et al., 2023	Other intervention/programme evaluation	Angola	Excluded: intervention not school-based health education
28	Gitore et al., 2020	Observational/cross-sectional	Ethiopia	Excluded: no school-based education intervention
29	Matowo, 2025	Observational / cross-sectional	Tanzania	Excluded: no school-based education intervention
30	Kimiri, 2024	Observational / cross-sectional	Kenya	Excluded: no school-based education intervention
31	Rohmah et al., 2022	Review (systematic, scoping, narrative)	Multi-country	Excluded: review (used as background)
32	Ansah, 2022	Duplicate record	Ghana	Excluded: duplicate record
33	Grimes et al., 2017	Observational/cross-sectional	Ethiopia	Excluded: no school-based education intervention
34	Steinbaum et al., 2019	Other intervention/programme evaluation	Kenya	Excluded: intervention not school-based health education
35	Asfaw et al., 2020	Observational/cross-sectional	Ethiopia	Excluded: no school-based education intervention
36	Lebu et al., 2023	Review (systematic, scoping, narrative)	Multi-country	Excluded: review (used as background)

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37	Ogombo et al., 2026	School-based education/hygiene intervention evaluation	Kenya	Excluded: outside Nigeria (context only)
38	Zeleke et al., 2021	Observational/cross-sectional	Ethiopia	Excluded: no school-based education intervention
39	Raso et al. (protocol), 2018	Trial protocol	Côte d'Ivoire	Excluded: protocol, no outcome data
40	Yaro (research article), 2022	Duplicate record	Nigeria	Excluded: duplicate record
41	Byagamy et al., 2025	Observational / cross-sectional	Uganda	Excluded: no school-based education intervention
42	Liza, 2025	Observational / cross-sectional	Bangladesh	Excluded: no school-based education intervention
43	Nargis et al., 2024	School-based education/hygiene intervention evaluation	Not stated	Excluded: outside Nigeria (context only)
44	Halliday et al., 2019	Observational / cross-sectional	Kenya	Excluded: no school-based education intervention
45	Duijster et al., 2017	School-based education/hygiene intervention evaluation	Cambodia, Indonesia, Lao PDR	Excluded: outside Nigeria (context only)
46	Egbuche et al., 2025	Observational/cross-sectional	Nigeria	Excluded: no school-based education intervention
47	Donkoh et al., 2023	Observational / cross-sectional	Ghana	Excluded: no school-based education intervention
48	Mekonnen et al., 2020	Observational / cross-sectional	Ethiopia	Excluded: no school-based education intervention
49	Labana et al., 2019	Observational / cross-sectional	Philippines	Excluded: no school-based education intervention
50	Aivey et al., 2024	School-based education/hygiene intervention evaluation	Bangladesh	Excluded: outside Nigeria (context only)

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51	Ekpo et al., 2008	Observational/cross-sectional	Nigeria	Excluded: no school-based education intervention
52	Sujan et al., 2020	Observational / cross-sectional	Bangladesh	Excluded: no school-based education intervention
53	Kihoro et al., 2024	Observational/cross-sectional	Kenya	Excluded: no school-based education intervention
54	Clarke et al. (protocol), 2019	Trial protocol	Vietnam	Excluded: protocol, no outcome data
55	Masaku et al., 2023	Observational/cross-sectional	Kenya	Excluded: no school-based education intervention
56	Hürlimann et al., 2018	Other intervention/programme evaluation	Côte d'Ivoire	Excluded: intervention not school-based health education

Note. Reviewers assigned the record type and country from titles and bibliographic details. "Not stated" = country not determinable from the record.

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