Impact of School-Based Health Education Intervention on the Incidence of Soil-transmitted Helminths in Pupils of Rural Schools, Kogi East, North Central Nigeria.

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Abstract

Background: The negative impact of soil-transmitted helminths (STHs) in Nigeria is enormous posing serious public health issues. This study was undertaken to investigate the impact of health education intervention on re-infection of STHs in pupils of rural schools of Kogi East, North Central Nigeria.

Methods: A cross-sectional survey was carried out in 45 schools to determine the prevalence of STHs in the 9 local government areas of Kogi East. Stool samples were collected and examined for STHs. A total of 10 schools with the highest prevalence were selected for the follow-up study, 5 schools were dewormed and given health education (DHE) intervention while the other 5 schools were dewormed only (DO). Reassessment of schools for re-infection was carried out for a period of 12 months. Data obtained were analyzed using descriptive statistics. Student t-test was used to make comparison between interventions in the incidence of infections. Analysis was carried out at $p<0.05$.

Results: Re-infection with STHs was observed from the 7th month of both interventions. In the 36th week (9th month), incidence observed in schools given DHE schools (4.79%, 8 pupils) were higher than in DO schools (3.19%, 5 pupils), no significant difference ($t = -0.840$, $p = 0.426$) between the interventions. Also, at the 48th week (12th month), no significant difference ($t = -0.346$, $p = 0.738$) between the DHE schools (7.19%, 12 pupils) and DO schools (6.37%, 10 pupils). Hookworms had the highest incidence in DHE (6.6%, 11 pupils) and DO (6.4%, 10 pupils) schools among the STHs. *A. lumbricoides* incidence was low and was observed in a school given DHE (0.6%, 1 pupil). *S. stercoralis* was not observed throughout. At 48th (12th month), an incidence of 6.37% was observed compared to 32.03% prevalence at baseline in the DO schools and an incidence of 7.11% and prevalence of 36.09% in the DHE schools. Significant difference ($p<0.05$) exist between baseline and intervention.

Conclusion: Non-dewormed individuals at the community levels may have contributed to the poor performance of health education. Community-based deworming should be encouraged alongside improvement in the water, sanitation and hygiene infrastructures at both school and home.

1. Introduction

Soil-transmitted helminths (STHs) are among the foremost causes of global health problems especially in underprivileged and deprived populations where implementation and control are challenging to maintain. Soil-transmitted helminthiasis are caused by parasitic nematodes transmitted through contact with parasites eggs (*Ascaris lumbricoides* and *Trichuris trichiura*) or larvae (hookworms) and are responsible for more than 40% of worldwide morbidity from all tropical infections [1, 2, 3]. An estimated 2 billion people are infected worldwide with 819, 439 and 439 million people infected with *A. lumbricoides*, *T. trichiura* and hookworms respectively [3, 4].

Soil-transmitted helminthiasis is the most widespread Neglected Tropical Diseases (NTDs) in Nigeria [2]. Children in rural areas lacking clean water and sanitation infrastructures are the most affected [5]. Infection with these parasites leads to hampered cognitive and physical development, and nutritional effects [6, 7, 8]. Infections with *A. lumbricoides* can cause abdominal pain, lactose intolerance and decreased absorption of vitamin A and other nutrients. Severe infection with whipworm leads to inflammation at the site of attachment in the intestines and result in colitis and rectal prolapse. Infections with hookworms may lead to intestinal blood loss that results in iron-deficiency anaemia [7, 9].

Preventive chemotherapy is recommended by WHO as means of controlling STH infections which involves consistent administration of drugs to population at-risk. The WHO recommends annual deworming of pre-school aged children and school-aged children in areas where the prevalence of STH is between 20% and 50% and semi-annual if above 50% are infected [10]. Despite this repetitive treatment, infection prevalence and intensity have rapidly bounce back. This lack of sustainability lessens the effectiveness of MDA.

In Nigeria, the main strategy for control of soil-transmitted helminth (STH) infections is the periodic mass drug administration (MDA) of antihelminthics to the population at risk [2]. MDA alone as an intervention does not prevent re-infection of STHs [11, 12]. Therefore, there is need for a complementary measures to prevent re-infection, such as health education and improved sanitation. This will help augment the control approach and hence the effectiveness of MDA for optimal productivity and sustainability [12]. This integrative approach will help reduce the number of treatment rounds, lessen the disease burden and create a long-standing sustainable control.

Health education is a vital, low-cost and simple component of most interventions for prevention and control of many NTDs. Since NTD transmission is enabled by human activities and behaviour, education on sanitation, personal and cooking hygiene can prevent re-infection within the school and community. Increasing their knowledge on self-care, skills, resources and support to practise self-care every day can prevent the development of disabilities and further reduce the disease progression [13].

2. Methods

2.1 Study area

Kogi East is located in Kogi State, North Central Nigeria. It is a geographical region comprising of nine (9) Local Government Areas (LGAs); Ankpa, Bassa, Dekina, Ibaji, Idah, Igalamela/Odolu, Ofu, Olamaboro and Omala (Figure 1). The District is located between latitude 6º32'33.8"N to 8º02'44.8"N and longitude 6º42'08.5"E to 7º51'50.3"E [14]. The District occupies an area of 26,197 square kilometres sharing boundaries with six (6) states of Nigeria. To the North; it shares boundaries with Nassarawa, to the West with Edo and Delta States, while to the East by Benue, Anambra and Enugu States [15].

2.2. Ethical approval

Ethical clearance was obtained from Research Ethics Committee, Kogi State Ministry of Health (KSMoH), Lokoja with reference number MOH/KGS/1376/1/82 and permission was obtained from the State Universal Basic Education Board (SUBEB), Lokoja with reference number KG/SUBEB/GEN/04/'T' which was conveyed to the Education Secretaries of the 9 LGAs and the Headmasters (mistress) of the schools.

2.3. Inclusion and exclusion criteria

Children attending schools in rural communities of Kogi East with ages from 5 to 14 years were included in this study. Preschool-aged children (<5 years) and children older than 14 years attending rural schools in Kogi East were excluded from this study.

2.4. School mobilization and sensitization

Advocacy visits were paid to the Honourable Commissioner for Health and this was preceded by letters from the KSMoH and also the SUBEB to the Education Secretaries of the Local Government Education Authorities (LGEAs).

2.5. Study design

The study was carried out between January 2018 and December, 2019. District-wide mapping for STH infections was conducted in all the nine (9) LGAs of Kogi East (Ankpa, Bassa, Dekina, Ibaji, Idah, Igalamela/Odolu, Ofu, Olamaboro and Omala LGAs) in a coordinated manner using WHO National protocol framework [16] and was in line with the Federal Ministry of Health (FMoH) protocol on integrated epidemiological mapping and baseline survey for STHs [2]. Randomised selection of schools was done followed by a randomised systematic selection of children in the schools to be surveyed. Enrolled school age children were targeted from the surveyed schools (Figure 2).

2.6. Sample size

During the baseline survey, a total of 100 pupils were sampled in each LGA according to the WHO national protocol framework [16]. This study sampled 36 pupils per school, that is, 36 pupils in five schools (180 samples) per LGA, which gave a sample size of 1620. However, with the minimum sample size of 100 pupils per LGA, the minimum sample size of 900 was reached.

2.7. Statement of consent of participants

Written consents were obtained from the guardians/parents of study participants, informing them of their rights and granting permission for their children to participate in the study.

2.8. Selection of participating schools and children

In all the LGAs, five (5) schools were randomly selected from different communities in the rural areas of the LGAs, that is, a total of 45 schools were sampled. A sampling frame developed was used for selection of pupils in each selected school. A total of 36 pupils of both sexes, males and females were selected on pro-rata basis from 5 – 16 years old (class one to class six) from each school sampled.

2.9. Sample collection and parasitological examination

Stool samples were collected from selected schoolchildren using sterile specimen bottles. Each child in the study was given a sterile specimen bottle to take home after which instruction on how sample collection was explained to them. A single faecal sample was collected from each child and preserved using 10% formalin. Stool samples were taken to the Department of Animal and Environmental Biology, Kogi State University, Anyigba for parasitological examination using formal ether sedimentation technique [17].

In a suitable container, 1 g of stool sample was mixed thoroughly with 10ml of saline solution to form an emulsion which was then filtered through fine mesh gauze into a conical centrifuge tube. Suspension was centrifuged at Relative Centrifuge Force (RCF) of 600 g (about 2000 rpm) for about 10 minutes yielding about 0.5 ml of sediment. After supernatant was discarded, the sediment was washed with 10 ml of saline solution, and then recentrifuged. This was done repeatedly until supernatant became clear. After the last wash, supernatant was discarded and 10 ml of 10% formalin was added, mixed, and then the mixture was allowed to stand for 5 minutes to effect fixation. About 2 ml of ethyl acetate was added; tube was stoppered and vigorously mixed. The mixture was centrifuged at 450 g RCF (about 1500 rpm) for 10 minutes which gave four results; a top layer of ethyl acetate, plug of debris, layer of formalin, and sediment. Plug of debris from the side of the tube were removed using the applicator stick, and the top three layers were carefully discarded. With a pipette, the remaining sediment was mixed with the small amount of fluid and a drop each was transferred to a drop of saline and iodine on a glass side, covered with coverslip and examined microscopically for the presence of parasitic forms.

2.10. Selection of endemic schools for intervention studies

The results obtained from the survey served as the baseline assessment. A total of 10 schools were selected from the baseline study, the criteria for selection was based on highest infection rate. Five schools each were paired with another five schools with the closest proximity. The five (5) schools with the highest infection rate served as the intervention group while the other five (5) schools served as the control group. An open-label pair-matched cluster-randomized controlled trial study design was used (Figure 3).

2.11. Randomization and masking

The unit of randomization was the school. To ensure a balanced proportion of children in each group and comparison between intervention and control schools with regard to expected baseline STH prevalence, schools were matched according to geographical zone. Within each pair, one school was randomly allocated to deworming and health education (intervention school) and the other to deworming alone (control school) (Figure 3).

2.12. Deworming of endemic schools for follow-up studies

Following baseline assessment, all children in the 10 selected schools were given a 400 mg chewable albendazole tablet (Manufactured and Donated by GlaxoSmithKline to World Health Organization). The tablets used for this study were obtained from NTDs Unit, Kogi State Ministry of Health, Lokoja, Nigeria and each child was monitored to ensure that the tablet is chewed and swallowed. Efficacy of the albendazole treatment was assessed in a random sampling of 60 pupils each from 3 schools dewormed to check for the presence of at least one of the STH species [18].

2.13. Health education intervention

The health education intervention was administered during every visit at each intervention school and it consist of two components.

First, pupils were taught on STH acquisition, transmission and prevention. Urban School Health Kit by WHO [19] was adopted during this component. During this intervention, pupils were taught on ways to improve their personal hygiene and understand the importance of preventing STH infection.

Secondly, a half-day workshop was organized for teachers with the goal of promoting an integrated health curriculum. These workshops was held following deworming.

Posters highlighting key health messages were distributed and displayed in strategic locations around the school. The key messages for prevention used in this study are; washing hands before eating, washing hands with soap after playing with soil, washing hands with soap after using the toilet, wearing slippers or shoes when going outside, avoiding open (indiscriminate) defecation, washing vegetables and fruits before consumption, drinking clean (boiled) water, covering food from flies and cutting nails periodically.

2.14. Follow-up studies

The follow-up assessments commenced one month after deworming and was carried out monthly until re-infection of STHs was observed (Figure 4). The stool specimens collected on every visit were transported to the laboratory where they were examined within 48 hours. Similar procedure used in parasitological examination of samples as stated above was used.

2.15. Statistical Analyses

Data were entered using Microsoft Excel version 2013. Descriptive statistics were used to compute prevalence and incidence. The student t-test was used to determine the level of significant between the intervention group and the control group. All analyses were performed using Statistical Package for Social Sciences (SPSS) software (Version 22.0 for Windows; SPSS Inc., Chicago, IL, USA).

$$\text{Prevalence (\%)} = \frac{\text{Number of positive}}{\text{Number of Examined}} \text{ x } 100$$

$$\text{Incidence (\%)} = \frac{\text{Number of new infection during a specified time interval}}{\text{Number of Examined}} \text{ x } 100$$

3. Results

A total of 2331 pupils were dewormed in 10 schools across Kogi East (Table 2). Five of the dewormed schools were subjected to health education. The effect of both interventions were assessed over a 12 months period. No parasitic infection was observed upto to the 24th week (6th month) of stool examination. Infection with soil-transmitted helminths was observed from the 7th month after the administration of both interventions i.e. deworming only (DO) and deworming and health education (DHE).

Comparison of incidence in DO schools to DHE schools revealed no significant difference ($p > 0.05$) (Table 3). Although, higher incidence of infection were observed in DHE schools than DO schools. In the 36th week (9th month), incidence observed in schools given DHE schools (4.79%, 8 pupils) was higher than in DO schools (3.19%, 5 pupils), no significant difference ($t = -0.840$, $p = 0.426$) exist between the interventions. Also, at the 48th week (12th month), no significant difference ($t = -0.346$, $p = 0.738$) was also observed in the incidence between the DHE schools (7.19%, 12 pupils) and DO schools (6.37%, 10 pupils).

The incidence of individual parasites at the 48th week (12th month) revealed no significant difference ($p > 0.05$) in the parasite species found. Hookworms had the highest re-infection rate with incidence of 6.6% (11 pupils) and 6.4% (10 pupils) in DHE and DO schools respectively. *A. lumbricoides* re-infection was low and was observed only in a school given DHE with incidence of 0.6% (1 pupil). *S. stercoralis* was not observed throughout the follow-up study over the one year period (Table 4).

Comparison of incidence of infection between DHE and DO schools at 12th, 24th, 36th and 48th weeks revealed no significant difference ($p > 0.05$). Although, the incidence was higher in the DHE schools than DO schools (Table 5).

Comparison of baseline prevalence and incidence at 48th week (12th month) of follow-up revealed significant variation ($p \leq 0.05$) in both intervention. In DO schools, an incidence of 6.37% was observed compared to 32.03% prevalence at baseline while in DHE, an incidence of 7.11% was observed which was significant from baseline prevalence of 36.09% (Table 6).

4. Discussion

The present study assessed the effect of health education on pupils of rural primary schools in Kogi East, North Central Nigeria. The study revealed that health education has no significant effect on the re-infection of soil-transmitted helminths in the region. Chemotherapy proves effective than health education.

The observation of this study is a complete deviation from series of studies previously on the effect of health education on STHs [18, 20, 21] but similar to the observation of a study in Ethiopia [22] where a prevalence of 25.8% was observed at baseline and incidence of 23.8% at endline. The prevalence of intestinal parasitic infections was not significantly decreased at the endline compared with the baseline [PR = 0.92, 95% CI = (0.62, 1.38)]. They [22] also reported that that water, sanitation and hygiene (WASH) education was significantly associated with households' sanitation performance. They stated that health education increases the awareness on good WASH practices and encourages behavioural change but that it needs to be carried out at the household level rather than at school level for better performance. The health education intervention in India [20] and Mali [21] were effective been a community-based total sanitation approaches while in this study, school-based approach was used. A study in Malaysia [23] and low and middle-income countries [24] stated that community-based health education intervention is one of the effective WASH promotion approaches to empower rural communities. A study in Peruvian Amazon [18] recommended that school-based periodic deworming programs are likely to perform better when enhanced with a sustained health hygiene education in an integrated manner.

Health education increases awareness about the potential health implications, the implementation barriers at household level are important factors that needs proper consideration as this will influence subsequently affects the reinfection of these parasites. Several household barrier factors such as financial status, parent education level, culture, willingness to adhere to instructions etc. should be put under consideration [25, 26, 27].

Hookworms was the main parasites that was observed to have higher incidence compared to *A. lumbricoides* and *S. stercoralis*. Previous studies have found that health education has only a minimal, insignificant effect on hookworm infections [18, 28]. These studies reported that children in underprivileged communities are faced with several barriers which affects the positive change provided by the health education. Such factors includes lack of financial resources to purchase a pair of shoes [29, 30]. Oral interview revealed that some of the pupils had only one pair of shoes which was used when going to school and were prevented by their parents from using such shoes at home or when moving around in the village. Thereby predisposing them to infections with hookworms.

The significant reduction in incidence during follow-up observed in this study might be due to chemotherapy administered prior to follow-up study. Series of studies have reported the effectiveness of chemotherapy in control STHs infection especially when done annually. A study in Gurage Zone, Ethiopia [31] reported that chemotherapy results in substantial reduction in overall prevalence and infection intensity of STHs. The residual infections with STHs in this study is a reflection of the maintenance of transmission among the untreated populations in the community which are constantly in contact with the dewormed children. Some studies in Kenya reported low infection of STHs among all age groups given school-based deworming [32, 33, 34].

Conclusions

Health education had no significant effect on the re-infection of soil-transmitted helminths in the Kogi East, North Central Nigeria. Inclusion of health education alongside with both school-based deworming proved not effective than school-based deworming alone. The use of community-based deworming alongside improvement in the water, sanitation and hygiene infrastructures both at schools and home will help provide a better opportunity to put the knowledge acquired through health education programmes to use. Rather than acquire health education without basic amenities to put such education to use.

Abbreviations

STHs: soil-transmitted helminths; DHE: dewormed and health education; DO: Dewormed only; STH: soil-transmitted helminthiasis; MDA: mass drug administration; NTDs: neglected tropical diseases; LGEAs: local government education authorities; SUBEB: State Universal Basic Education Board (SUBEB); LGA: local government area; RCF: relative centrifuge force; CI: Confidence interval.

Declarations

Ethics approval and consent to participate

This study follows guidelines for the care and use of experimental animals established by the Animal Care and Use Committee of the Ahmadu Bello University, Zaria for the purpose of control and supervision of experiments on animals and ethical permission for the study was obtained from the ethical Board of Kogi State Ministry of Health, Lokoja with reference number: MOH/KGS/1376/1/82.

Consent for publication

Not applicable.

Availability of data and material

The data sets in this study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Conceptualization, C.A.Y., E.K. and S.A.K.; methodology, C.A.Y., E.K., S.A.K. and J.K.; formal analysis, C.A.Y. and E.K.; investigation, C.A.Y., E.K., S.A.K. and J.K.; writing original draft, C.A.Y.; resources; C.A.Y., E.K., S.A.K., J.K., G.E.-S.B., O.N., S.A.A.; review and editing, E.K., S.A.K., J.K., K.N.O., G.E.-S.B., O.N., S.A.A., A.B.A. and S.I.Y.; supervision, E.K., S.A.K. and J.K.; project administration, C.A.Y., E.K. and S.A.K.

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Tables

Table 1
Prevalence of STHs in Rural Primary Schools of Kogi East, Nigeria during Baseline Survey

LGAs	Communities (n)	Number Positive (Prevalence in %)			
		STHs	A. lumbricoides	Hookworms	S. stercoralis
Ankpa	Ikanekpo (21)	8 (38.1)	8 (38.1)	0 (0)	0 (0)
	Opulega (25)	5 (20.0)	0 (0)	5 (20.0)	0 (0)
	Ogodo (37)	6 (16.2)	1 (2.7)	4 (10.8)	1 (2.7)
	Enokpoli (11)	1 (9.1)	0 (0)	1 (9.1)	0 (0)
	Enjema (18)	3 (16.7)	3 (16.7)	0 (0)	0 (0)
Bassa	Akakana (29)	3 (10.3)	2 (6.9)	1 (3.4)	0 (0)
	Oguma (31)	6 (19.4)	1 (3.2)	5 (16.1)	0 (0)
	Sheria 1 (36)	3 (8.3)	1 (2.8)	2 (5.6)	0 (0)
	Sheria 2 (26)	4 (15.4)	4 (15.4)	0 (0)	0 (0)
	Londu (28)	6 (21.4)	5 (17.9)	4 (14.3)	0 (0)
Dekina	Olubojo (27)	7 (25.9)	0 (0)	7 (25.9)	2 (7.4)
	Ojofu (20)	0 (0)	0 (0)	0 (0)	0 (0)
	Ajiyolo-Akabe (30)	0 (0)	0 (0)	0 (0)	0 (0)
	Odu-Ogbaloto (35)	5 (14.3)	2 (5.7)	5 (14.3)	2 (5.7)
	Olofu (31)	6 (19.4)	0 (0)	6 (19.4)	0 (0)
Ibaji	Itoduma (36)	2 (5.6)	0 (0)	1 (2.8)	1 (2.8)
	Onyedega (40)	5 (12.5)	2 (5.0)	3 (7.5)	0 (0)
	Unale (40)	3 (7.5)	1 (2.5)	1 (2.5)	1 (2.5)
	Ejule-Ojebe (40)	2 (5.0)	2 (5.0)	0 (0)	0 (0)
	Odogwu (41)	2 (4.9)	0 (0)	2 (4.9)	0 (0)
Idah	Ukwaja (26)	11 (42.3)	0 (0)	11 (42.3)	1 (3.8)
	Igalogba (24)	3 (12.5)	0 (0)	3 (12.5)	0 (0)
	Sabon Gari (21)	4 (19.0)	0 (0)	4 (19.0)	0 (0)
	Ede (29)	2 (6.9)	0 (0)	3 (10.3)	1 (3.4)
	Ubomu (24)	2 (8.3)	0 (0)	2 (8.3)	0 (0)
Igalamela/Odolu	Ogbogbo 1 (29)	2 (6.9)	0 (0)	1 (3.4)	0 (0)
	Ogbogbo 2 (22)	6 (27.3)	0 (0)	5 (22.7)	1 (4.5)
	Etutu (36)	5 (13.9)	1 (2.8)	4 (11.1)	0 (0)
	Ofuloko (20)	7 (3.2)	1 (5.0)	6 (30.0)	0 (0)
	Ujagba (9)	2 (22.2)	0 (0)	0 (0)	2 (22.2)
Ofu	Ejule 1 (25)	4 (16.0)	1 (4.0)	3 (12.0)	1 (4.0)
	Alome (22)	6 (27.3)	0 (0)	6 (27.3)	0 (0)
	Ejule 2 (40)	16 (40.0)	14 (35.0)	3 (7.5)	0 (0)
	Ikpokejo-Umomi (20)	2 (10.0)	0 (0)	2 (10.0)	0 (0)
	Ofakaga (30)	4 (13.3)	2 (6.7)	2 (6.7)	0 (0)
Olamaboro	Ogugu 1 (35)	1 (2.9)	1 (2.9)	0 (0)	0 (0)
	Ogugu (36)	3 (8.3)	1 (2.8)	2 (5.6)	0 (0)
	Okpo (39)	8 (20.5)	2 (5.1)	4 (10.3)	1 (2.6)
	Ugbamaka-Igah (24)	5 (20.8)	0 (0)	5 (20.8)	0 (0)

n – Number examined, ns – Not significant at $p > 0.05$, * - Significant at $p < 0.05$.

LGAs	Communities (n)	Number Positive (Prevalence in %)			
		STHs	A. lumbricoides	Hookworms	S. stercoralis
	Igah-Ikeje (20)	4 (20.0)	0 (0)	4 (20.0)	0 (0)
Omala	Abejukolo (40)	9 (22.5)	0 (0)	9 (22.5)	0 (0)
	Opada (19)	7 (36.8)	0 (0)	7 (36.8)	0 (0)
	Agbenema-Ife (40)	20 (50.0)	0 (0)	20 (50.0)	0 (0)
	Abejukolo (40)	12 (30.0)	1 (2.5)	11 (27.5)	0 (0)
	Ajiyolo-Ife (23)	0 (0)	0 (0)	0 (0)	0 (0)
	Overall (1295)	**222 (17.1)**	**56 (4.3)**	**164 (12.7)**	**14 (1.1)**
	χ^2	132.77	206.257	167.926	76.62
	Df	44	44	44	44
	p Value	< 0.001*	< 0.001*	< 0.001*	0.002*

n – Number examined, ns – Not significant at p > 0.05, * - Significant at p < 0.05.

Table 2
Number of Pupils Dewormed at Schools

S/No	School Name	LGA	Number of Pupils Dewormed	Interventions
1	Agbenema-Ife	Omala	235	HE + SBD
2	Opada	Omala	128	SBD
3	Islamiya Abejukolo	Omala	132	HE + SBD
4	Central Abejukolo	Omala	371	SBD
5	Ejule 2	Ofu	326	HE + SBD
6	Alome-Umomi	Ofu	190	SBD
7	Ogbogbo 2	Igalamela	234	HE + SBD
8	Ukwaja	Idah	184	SBD
9	Olubojo	Dekina	128	HE + SBD
10	Ikanekpo	Ankpa	403	SBD
Total			**2,331**	

HE + SBD = Health Education and School Based Deworming

SBD = School Based Deworming

Table 3
Incidence of STHs during Follow-up at 12th, 24th, 36th and 48th Week for Both Intervention

LGAs/ Intervention	Schools	n	Incidence of STHs (%): Follow-up			
			12th Week (3 months)	24th Week (6 months)	36th Week (9 months)	48th Week (12 months)
Deworming Only (DO)						
Ankpa	Ikanekpo	42	0 (0.00)	0 (0.00)	2 (4.76)	4 (9.52)
Idah	Ukwaja	32	0 (0.00)	0 (0.00)	0 (0.00)	1 (3.13)
Ofu	Alome-Umomi	24	0 (0.00)	0 (0.00)	1 (4.17)	2 (8.33)
Omala	Opada	24	0 (0.00)	0 (0.00)	1 (4.17)	2 (8.33)
Omala	Central Abejukolo	35	0 (0.00)	0 (0.00)	1 (2.86)	1 (2.86)
	Total	**157**	**0 (0.00)**	**0 (0.00)**	**5 (3.19)**	**10 (6.37)**
Deworming and Health Education (DHE)						
Dekina	Olubojo	26	0 (0.00)	0 (0.00)	0 (0.00)	1 (3.85)
Igalamela	Ogbogbo 2	30	0 (0.00)	0 (0.00)	2 (6.67)	3 (10.00)
Ofu	Ejule 2	40	0 (0.00)	0 (0.00)	1 (2.50)	2 (5.00)
Omala	Agbenema-Ife	36	0 (0.00)	0 (0.00)	3 (8.33)	4 (11.11)
Omala	Islamiya Abejukolo	35	0 (0.00)	0 (0.00)	2 (5.71)	2 (5.71)
	Total	**167**	**0 (0.00)**	**0 (0.00)**	**8 (4.79)**	**12 (7.19)**
	T - test was calculated between the two interventions	t	NA	NA	-0.840	-0.346
		df	NA	NA	8	8
		p Value	NA	NA	0.426 ns	0.738 ns

n = Number examined, STHs = Soil-transmitted helminths, ns – Not significant at p > 0.05, NA – Not available.

Table 4
Comparison of Incidence of STHs at 48th Week for Both Intervention

LGAs	Schools	Incidence at 48th Week of Follow-up				
		n	STHs	A	H	S
Deworming Only (DO)						
Ankpa	Ikanekpo	42	4 (9.52)	0 (0.0)	4 (9.5)	0 (0.0)
Idah	Ukwaja	32	1 (3.13)	0 (0.0)	1 (3.1)	0 (0.0)
Ofu	Alome-Umomi	24	2 (8.33)	0 (0.0)	2 (8.3)	0 (0.0)
Omala	Opada	24	2 (8.33)	0 (0.0)	2 (8.3)	0 (0.0)
Omala	Central Abejukolo	35	1 (2.86)	0 (0.0)	1 (2.9)	0 (0.0)
		157	**10 (6.37)**	**0 (0.0)**	**10 (6.4)**	**0 (0.0)**
Deworming and Health Education (DHE)						
Dekina	Olubojo	26	1 (3.85)	0 (0.0)	1 (3.9)	0 (0.0)
Igalamela	Ogbogbo 2	30	3 (10.00)	0 (0.0)	3 (10.0)	0 (0.0)
Ofu	Ejule 2	40	2 (5.00)	0 (0.0)	2 (5.0)	0 (0.0)
Omala	Agbenema-Ife	36	4 (11.11)	1 (2.8)	3 (8.3)	0 (0.0)
Omala	Islamiya Abejukolo	35	2 (5.71)	0 (0.0)	2 (5.7)	0 (0.0)
		167	**12 (7.19)**	**1 (0.6)**	**11 (6.6)**	**0 (0.0)**
	t-test		-0.346	-1	-0.089	NA
	df		8	8	8	NA
	p Value		0.738 ns	0.347 ns	0.932 ns	NA

n = Number examined, STHs = Soil-transmitted helminths, A = *Ascaris lumbricoides*, H = Hookworms, S = *Strongyloides stercoralis*.

ns – Not significant at p > 0.05, NA – Not available.

Table 5

Comparison between Baseline Prevalence and Incidence of STHs at 12th, 24th, 36th and 48th Weeks in Kogi Eas

LGAs	Schools	Prevalence at Baseline				Incidence at 12th Week				Incidence at 24th Week				Incidence at 36th Wee		
		n	A	H	S	n	A	H	S	n	A	H	S	n	A	H
Deworming Only (DO)																
Ankpa	Ikanekpo	21	8 (38.1)	0 (0)	0 (0)	42	0 (0.0)	0 (0.0)	0 (0.0)	37	0 (0.0)	0 (0.0)	0 (0.0)	39	0 (0.0)	2 (
Idah	Ukwaja	26	0 (0)	11 (42.3)	1 (3.8)	38	0 (0.0)	0 (0.0)	0 (0.0)	34	0 (0.0)	0 (0.0)	0 (0.0)	34	0 (0.0)	0 (
Ofu	Alome-Umomi	22	0 (0)	6 (27.3)	0 (0)	34	0 (0.0)	0 (0.0)	0 (0.0)	34	0 (0.0)	0 (0.0)	0 (0.0)	28	0 (0.0)	1 (
Omala	Opada	19	0 (0)	7 (36.8)	0 (0)	38	0 (0.0)	0 (0.0)	0 (0.0)	36	0 (0.0)	0 (0.0)	0 (0.0)	36	0 (0.0)	1 (
Omala	Central Abejukolo	40	0 (0)	9 (22.5)	0 (0)	40	0 (0.0)	0 (0.0)	0 (0.0)	35	0 (0.0)	0 (0.0)	0 (0.0)	35	0 (0.0)	1 (
		128	**8 (6.3)**	**33 (25.8)**	**1 (0.8)**	**192**	**0 (0.0)**	**0 (0.0)**	**0 (0.0)**	**176**	**0 (0.0)**	**0 (0.0)**	**0 (0.0)**	**172**	**0 (0.0)**	**5 (**
Deworming and Health Education (DHE)																
Dekina	Olubojo	27	0 (0)	7 (25.9)	2 (7.4)	38	0 (0.0)	0 (0.0)	0 (0.0)	38	0 (0.0)	0 (0.0)	0 (0.0)	32	0 (0.0)	0 (
Igalamela	Ogbogbo 2	22	0 (0)	5 (22.7)	1 (4.5)	38	0 (0.0)	0 (0.0)	0 (0.0)	32	0 (0.0)	0 (0.0)	0 (0.0)	32	0 (0.0)	2 (
Ofu	Ejule 2	40	14 (35.0)	3 (7.5)	0 (0)	40	0 (0.0)	0 (0.0)	0 (0.0)	40	0 (0.0)	0 (0.0)	0 (0.0)	40	0 (0.0)	1 (
Omala	Agbenema-Ife	40	0 (0)	20 (50.0)	0 (0)	40	0 (0.0)	0 (0.0)	0 (0.0)	37	0 (0.0)	0 (0.0)	0 (0.0)	37	1 (2.7)	2 (
Omala	Islamiya-Abejukolo	40	1 (2.5)	11 (27.5)	0 (0)	40	0 (0.0)	0 (0.0)	0 (0.0)	38	0 (0.0)	0 (0.0)	0 (0.0)	36	0 (0.0)	2 (
		169	**15 (8.9)**	**46 (27.2)**	**3 (1.8)**	**196**	**0 (0.0)**	**0 (0.0)**	**0 (0.0)**	**185**	**0 (0.0)**	**0 (0.0)**	**0 (0.0)**	**177**	**1 (0.6)**	**7 (**
	t-test		0.012	-0.094	-0.949		NA	NA	NA		NA	NA	NA		-1.000	-0.
	df		8	8	8		NA	NA	NA		NA	NA	NA		8	8
	p Value		0.991 ns	0.927 ns	0.370 ns		NA	NA	NA		NA	NA	NA		0.347 ns	0.4

n = Number examined, A = *Ascaris lumbricoides*, H = Hookworms, S = *Strongyloides stercoralis*.

ns – Not significant at p > 0.05, NA – Not available.

Table 6
Comparison between Baseline Prevalence and Incidence of STHs at 48th Week

LGAs/ Intervention	Schools	Baseline		Follow-up	
		n	**Prevalence (%)**	**n**	**Incidence (%) at 48th Week (12 months)**
Deworming Only (DO)					
Ankpa	Ikanekpo	21	8 (38.1)	42	4 (9.52)
Idah	Ukwaja	26	11 (42.3)	32	1 (3.13)
Ofu	Alome-Umomi	22	6 (27.3)	24	2 (8.33)
Omala	Opada	19	7 (36.8)	24	2 (8.33)
Omala	Central Abejukolo	40	9 (22.5)	35	1 (2.86)
	Total	**128**	**41 (32.03)**	**157**	**10 (6.37)**
	t	7.320			
	df	4			
	p Value	0.002*			
Deworming and Health Education (DHE)					
Dekina	Olubojo	27	7 (25.9)	26	1 (3.85)
Igalamela	Ogbogbo 2	22	6 (27.3)	30	3 (10.00)
Ofu	Ejule 2	40	16 (40.0)	40	2 (5.00)
Omala	Agbenema-Ife	40	20 (50.0)	36	4 (11.11)
Omala	Islamiya Abejukolo	40	12 (30.0)	35	2 (5.71)
	Total	**169**	**61 (36.09)**	**167**	**12 (7.19)**
	t	6.771			
	df	4			
	p Value	0.002*			

n = Number examined, STHs = Soil-transmitted helminths, * − Significant at p ≤ 0.05.

Figures

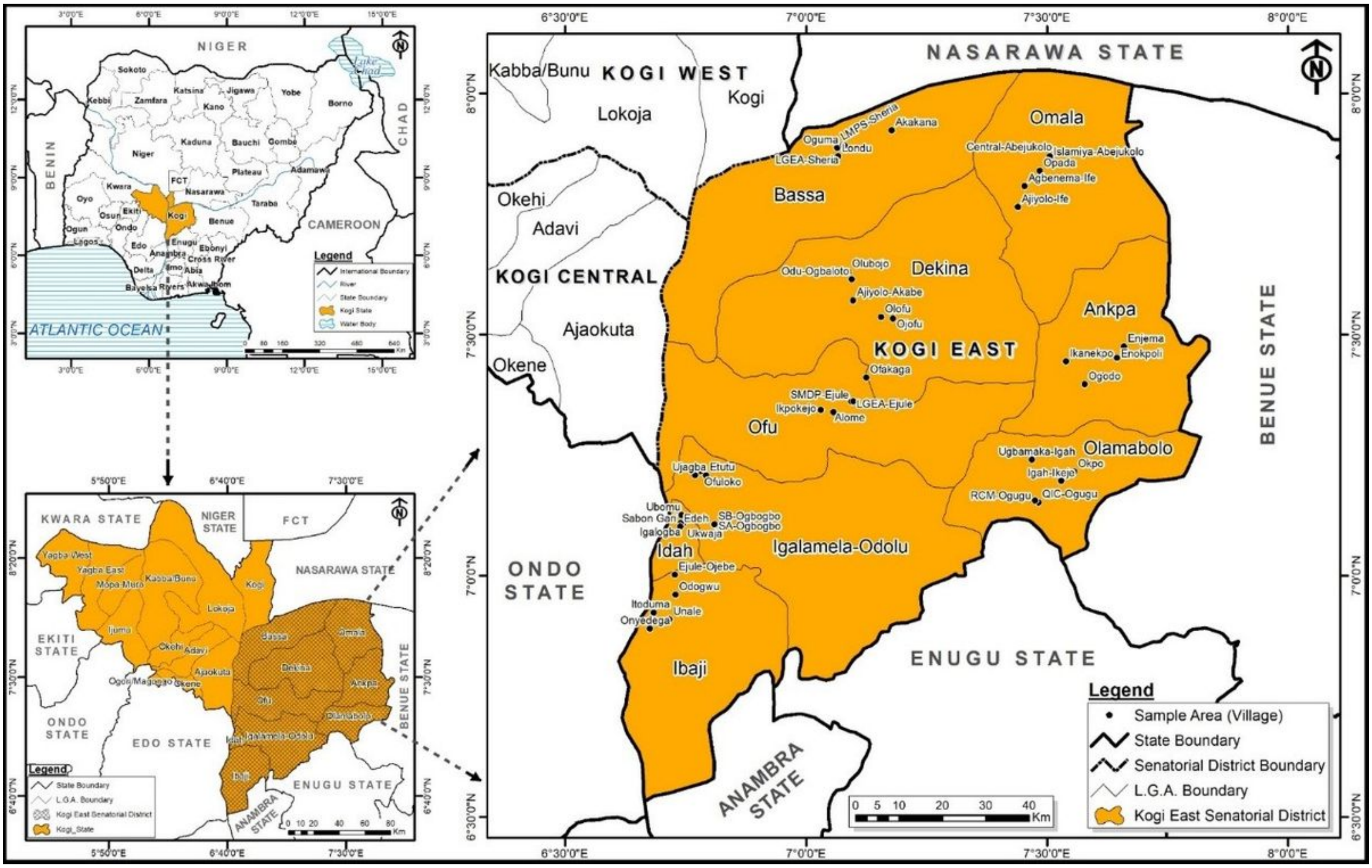

Figure 1

Sampling Villages in Kogi East Senatorial District, Nigeria Source: Map Gallery, Geography Department, Ahmadu Bello University, Zaria. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

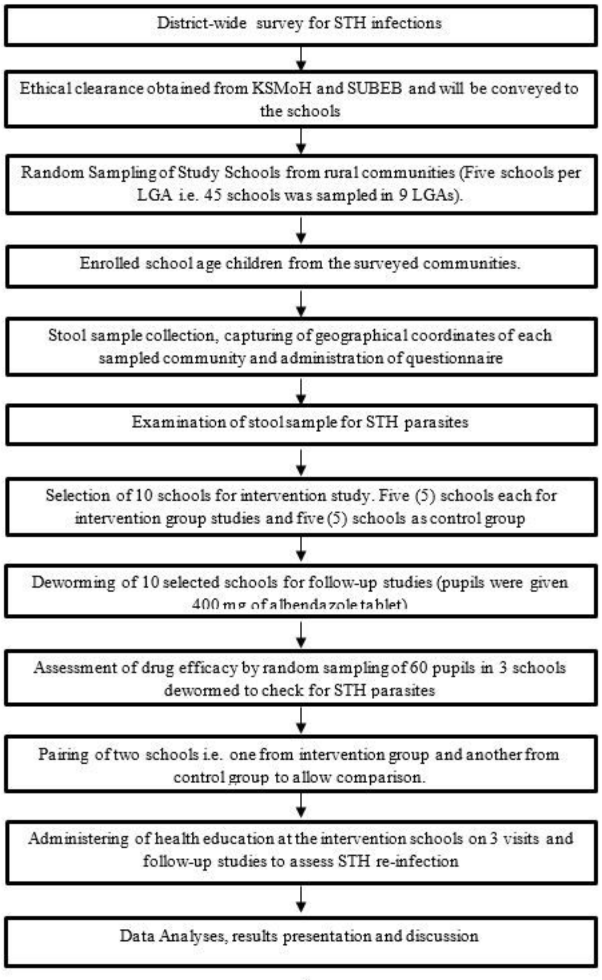

Figure 2

Flow Chart of Study Procedure.

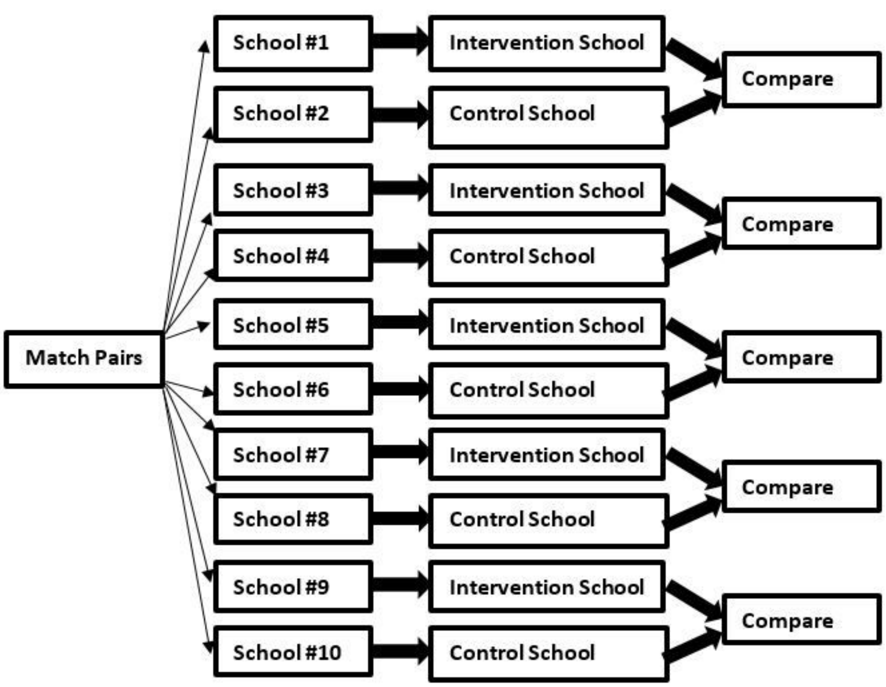

Figure 3

Matched Pair Design for the Allocation of Schools for Intervention and Control Studies.

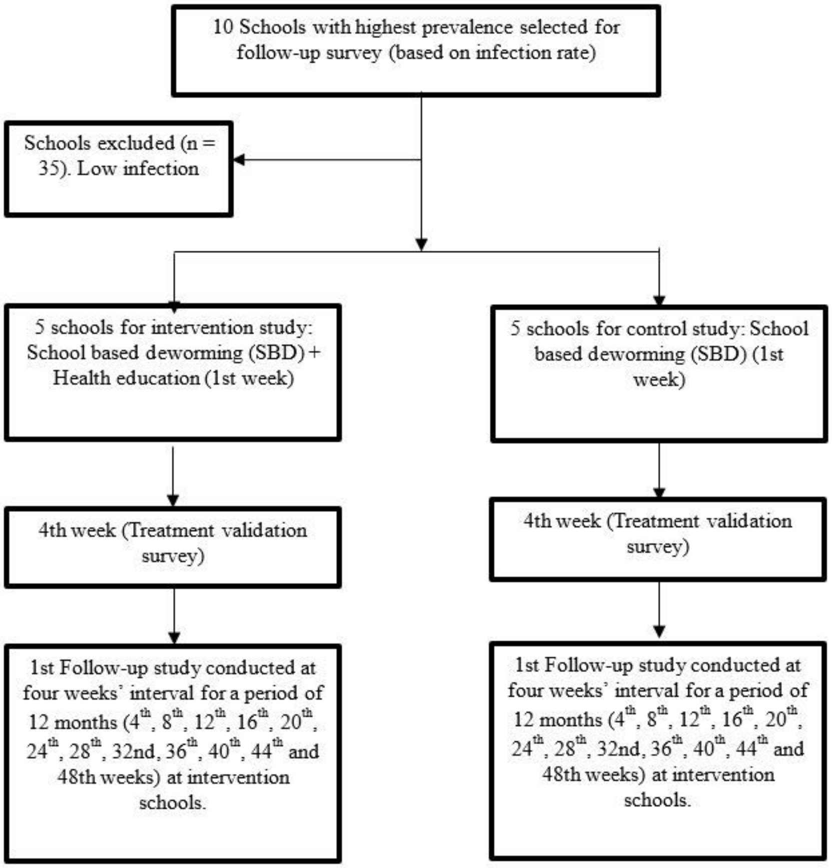

Figure 4

Flow Chart of Intervention Procedure Note: During each follow-up study, stool specimens were collected and examined. At the intervention schools, health education rehearsal was carried out.

Supplementary Files

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