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2024-03-30
Journal of Education and Community Health
http://ir-library.kabianga.ac.ke/handle/123456789/902
Omari PK, Karanja SM, Mambo SN. Unveiling the path to healthy habits: the effect of school-led total sanitation intervention on sanitation and hygiene knowledge and practices among school-going children (grade 4–7) in Baringo county, Kenya. J Educ Community Health. 2024; 11(1):8-16. doi:10.34172/jech.2664

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JECH
Journal of Education and Community Health

J Educ Community Health, 2024; 11(1):8-16. doi:10.34172/jech.2664

http://jech.umsha.ac.ir

Original Article

Unveiling the Path to Healthy Habits: The Effect of School-Led Total Sanitation Intervention on Sanitation and Hygiene Knowledge and Practices Among School-Going Children (Grade 4–7) in Baringo County, Kenya

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Article history:
Received: October 22, 2023
Revised: February 24, 2024
Accepted: March 28, 2024
ePublished: March 30, 2024

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Abstract

Background: Poor hygiene and sanitation knowledge and practices pose serious health risks to vulnerable populations, such as school-going children. Kenya is among the 26 countries worldwide that account for 90% of open defecation. School-led total sanitation (SLTS) is a novel intervention that has been successfully implemented in South African countries to improve sanitation and hygiene outcomes among school-going children. Despite the intervention's success elsewhere, it has not been implemented in Kenya. The main aim of this study was to assess SLTS' effectiveness in improving sanitation and hygiene knowledge and practices among school-going children in Baringo County.

Methods: A quasi-experimental study was conducted involving 434 pupils divided into intervention and control groups across three schools in each study group. A six-month intervention included triggering, forming health clubs, training sessions, and distributing information, education, and information materials. Thereafter, an evaluation was performed 3 months post-intervention. The data were analyzed using SPSS V18. The Chi-square test was used to compare knowledge and practices in both groups, while the difference in differences (DID) method assessed intervention effectiveness.

Results: Compared to the control group (15.2%), children in the intervention group (63.2%) showed significantly high knowledge levels ($\chi^2=104.67$, $df=1$, $P<0.0001$). There was a 52.3% mean increase in knowledge among children in the intervention group. A more considerable number of pupils (85.6%) in the intervention schools washed their hands with soap compared to 65.5% ($\chi^2=23.57$, $df=1$, $P<0.0001$) in the control group, demonstrating an increase of 19.6%. In the intervention group, there was a significantly lower proportion of pupils who practiced open defecation at home (16.3%) compared to 35.4% in the control group ($\chi^2=25.0$, $df=1$, $P<0.0001$).

Conclusion: The SLTS intervention led to an increase in knowledge on sanitation and hygiene but a reduction in open defecation at home among school-going children. These findings revealed that SLTS is an effective approach that can be adopted by regional governments, national governments, and other stakeholders as an additional intervention to address the problem of poor hygiene and sanitation in Kenya.

Keywords: School-led total sanitation, Hygiene, Sanitation, Intervention

Please cite this article as follows: Omari PK, Karanja SM, Mambo SN. Unveiling the path to healthy habits: the effect of school-led total sanitation intervention on sanitation and hygiene knowledge and practices among school-going children (grade 4–7) in Baringo county, Kenya. J Educ Community Health. 2024; 11(1):8-16. doi:10.34172/jech.2664

Introduction

Inadequate sanitation practices, particularly in resource-constrained settings, pose serious health risks to vulnerable populations, including school-aged children (1). According to the World Health Organization and the United Nations Children's Fund (UNICEF), approximately 2.8 billion people worldwide will lack access to basic sanitation services by the year 2030, allowing diseases to spread and

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stifling socio-economic development (2).

As in many other developing countries, sanitation remains a major concern in Kenya, especially in rural areas (3). According to UNICEF, Kenya is one of 26 countries worldwide that account for 90% of open defecation (4). A nationwide census conducted in 2019 reported that about 10% of Kenya's population lacks sanitation facilities (5). In Kenya, 15 out of 47 counties are responsible for nearly 85% of open defecation. Six of these counties have defecation rates exceeding 40%, with Baringo being one of them (6). Poor sanitation and hygiene contribute to 90% of the approximately 19,500 annual deaths from diarrhea in Kenya, with 17 100 of these deaths being related to children under the age of five (7). In 2014, the prevalence of diarrhea among children under the age of five was estimated to be 15% in the country and 16% in Baringo County, according to the Kenya Demographic and Health Survey (8,9). Baringo County, situated within the Rift Valley region, faces many hygiene- and sanitation-related challenges, impacting its residents' health and well-being, including school-aged children.

Various interventions have been implemented to improve hygiene and sanitation practices among school children in developing countries (10-13). The school-led total sanitation (SLTS) approach is one such intervention that focuses on empowering students, teachers, and the larger school community to become change agents in promoting hygiene and sanitation practices (12). SLTS is a relatively new approach developed in 2014 in Malawi to address the challenge of poor sanitation practices among school-going children in schools as well as within the community. It entails the facilitation of school communities to analyze their current sanitation and hygiene situation, practices, and consequences, followed by putting in place improvement strategies for the challenges identified (14). The approach is based on a participatory and community-driven model focusing on behavior change and better sanitation practices (15). SLTS regards the school as an entry point and the students as the agents of change (14). By raising awareness about proper sanitation practices, promoting hand washing, and advocating for the construction and use of toilets, SLTS programs empower students with the knowledge and motivation to drive change in their communities. Students become change agents and actively engage their families, friends, and community members through these programs (16). These programs are focused on integrating hygiene education, toilet construction, and behavior change interventions in schools (17).

Few studies have shown improvements in sanitation outcomes after the implementation of the SLTS intervention in schools (15,18,19). However, SLTS being relatively new, to the best of our knowledge, there are no comprehensive studies evaluating its effectiveness in improving sanitation and hygiene knowledge in the Kenyan context, particularly among school-going children. This study aimed to evaluate the effectiveness of the SLTS intervention on hygiene and sanitation knowledge and practices among school children in grades 4–7 in Baringo County, Kenya.

Materials and Methods

Study Site

The study was conducted in Baringo County, Kenya. The county occupies an area of 11 015 km^2 with a population of 754,014 people. The climatic conditions of the county are mainly arid and semi-arid. The main inhabitants of Baringo County are the Pokot, Ilchamus, and Tugen communities, with minority groups comprising the Turkana, Endorois, Nubians, Kikuyu, and Ogiek. Their economic activities range from subsistence farming to pastoralism (20). The county is further subdivided into seven sub-counties, while the sub-counties are further subdivided into wards. *The study was performed in Baringo South and Mogotio sub-counties*. The two sub-counties have the highest levels of open defecation in the county (21). At the time of the study, no active sanitation and hygiene interventions were being conducted in the sub-counties by the county administration or non-state actors. According to KDHS 2022 sanitation key indicators, about 54% of households in Baringo County lack access to basic sanitation facilities (22).

Study Design and Sampling Procedure

A pre-and post-test quasi-experimental study was conducted among 440 pupils, with 220 pupils drawn from the intervention site and 220 pupils from the control site. The sample size was calculated using G*Power software version 3.1.9.7 using the following parameters:

- Statistical test: The difference between two independent means
- Type of power analysis: A priori
- Tails: 2
- Power: 0.95
- Allocation ratio: 1
- Design effect: 2
- Calculated minimum sample size for group 1, including a 5% non-response rate: 220
- Calculated minimum sample size for group 2, including a 5% non-response rate: 220
- Total sample size: 440

The study targeted 6 schools in Mogotio and Baringo South sub-counties. Three schools were selected from each respective sub-county, with Mogotio being the intervention group and Baringo South being the control group. In the intervention group, all children from pre-primary to primary grades were exposed to the intervention, whereas no intervention was implemented in control schools. Pupils participating in the study were selected from grades 4–7. The sample size from each school was proportional to its population size (Table 1).

Pupils in lower grades could not be selected as they were relatively young to respond to questionnaires. Pupils in grade 8 were also excluded as they were in their final year

Table 1. Population and Sample Size Selection From Each Participating School

Group	School	Total Population	Sample Size
Intervention	Lolbugo Primary School	215	60
	Kiptoim Primary School	311	70
	Sagasagik Primary School	433	90
Control	Perkerra Primary School	209	40
	Loropir Primary School	335	70
	Sintaan Primary School	477	110
	Total	1978	440

of primary school and could not be in school for the entire project period.

Study Tools

An interviewer-administered questionnaire was used to collect demographic data as well as hygiene and sanitation knowledge and practices.

Description of the Intervention

A team consisting of two teachers, a school board of management representative, a parent- teacher association representative, a community health volunteer from each school, and an area public health officer underwent training on SLTS program objectives, implementation processes, and their respective roles. Subsequently, health clubs were established, and membership in these clubs was drawn from grades 3–8. The clubs received training on various topics, including fecal contamination pathways, hand washing, safe disposal of feces, personal hygiene, menstrual hygiene, and environmental sanitation. Led by teachers responsible for health affairs, these training sessions were conducted under the guidance of the area Public Health officer. The health club members from each school then devised action plans for SLTS implementation.

Triggering of schools involved utilizing Ignition Participatory Rural Appraisal Tools that included school mapping and transect walks, determining fecal contamination pathways using the F-Diagram, and employing shit calculation (23). After triggering, there were ignition moments, leading to the emergence of natural pupil leaders who became integral members of the school health club teams.

Information, education, and communication materials, including T-shirts for Health Club members, household brochures, and thematic posters, were distributed to all pupils in each school. Additionally, health messages were painted on the walls of both boys' and girls' latrines to serve as constant reminders of proper hygiene and sanitation practices.

Continuous sensitization of pupils on SLTS objectives and activities was performed by integrating the approach into regular classroom lessons and assembly forums. Moreover, consistent emphasis on the same messages took place during assemblies before half-term and holiday breaks, led by respective Health Club teachers.

Study Tools

An interviewer-administered questionnaire was utilized to collect data from school-going children on their knowledge and practices regarding hygiene and sanitation. An observation schedule was used to record the hygiene and sanitation practices of the learners.

Sampling Procedure

The study employed a multi-stage cluster random sampling strategy to enroll participants in both the intervention and control groups. Initially, one administrative area within the subcounty, known as a ward, was randomly chosen. Subsequently, one public primary school within the selected ward was also randomly selected. Next, two public primary schools proximal to the initially chosen school were selected, resulting in a total of three participating schools. At the school level, pupils from grades 4–7 were selected for inclusion in the study. Their distribution within each school and grade was determined using the probability proportional to population size method.

Data Analysis

The data were analyzed using IBM SPSS Statistics, version 18. The demographic characteristics of the respondents were described using means and proportions. The normality of continuous data was evaluated by the Kolmogorov-Smirnov test before further analysis, while the listwise deletion method was employed to handle the missing data. The continuous data were analyzed and reported as means, while categorical data were summarized through the calculation of frequencies and proportions. The comparison of knowledge and practice proportions between the control and intervention groups was made using Chi-square statistics, while the assessment of the intervention's effect size was evaluated using the difference in difference (DID) method. Statistical significance was determined at a P value of < 0.05 with a 95% confidence interval. All tests were two-tailed.

Results

Demographic Characteristics of Pupils

Table 2 provides demographic characteristics of pupils both in the intervention and control groups at the baseline and end-line assessment. At baseline, the mean age of pupils in the intervention group was 12.5 years, slightly lower than the control group's mean age of 12.8 years. At the end-line assessment, the mean ages for the intervention and control groups were 12.7 and 12.4 years, respectively. In terms of gender distribution, at both baseline and end-line assessments, a higher proportion of males (52% at baseline and 50.2% at end-line) were interviewed in the intervention group. On the other hand, a higher proportion of females (53% at baseline and 55.3% at end-line) were interviewed in the control group.

Pupils' Knowledge About Sanitation and Hygiene

Table 3 presents a comparison of pupils' sanitation

Table 2. Demographic Characteristics of Pupils in the Study and Control Arms

Characteristic	Baseline		End line	
	Intervention	Control	Intervention	Control
	n (%)	n (%)	n (%)	n (%)
Age (y)				
Mean ± SD	12.54 ± 0.98	12.82 ± 1.83	12.71 ± 1.12	12.37 ± 0.89
Gender				
Male	115 (52)	102 (47)	105 (50.2)	100 (44.5)
Female	106 (48)	116 (53)	104 (49.8)	123 (55.2)
Grade				
4	54 (24.4)	50 (22.9)	43 (20.6)	55 (24.7)
5	54 (24.4)	53 (24.3)	44 (21.7)	52 (23.3)
6	72 (32.6)	56 (25.7)	53 (25.4)	60 (26.9)
7	41 (18.6)	59 (27.1)	69 (33)	56 (25.1)
Head of household				
Mother	25 (11.3)	31 (14.2)	35 (16.7)	36 (16.1)
Father	157 (71.1)	172 (78.9)	150 (71.8)	166 (74.4)
Guardian	39 (17.6)	15 (6.9)	24 (11.5)	21 (9.4)

Note. SD: Standard deviation; N: Number.

and hygiene knowledge at baseline and end-line. The evaluation of hand washing knowledge focused on critical times and steps, with those scoring 10 out of 15 deemed highly knowledgeable, while those scoring less than 10 were considered less knowledgeable. The analysis revealed a significantly higher proportion of pupils in the intervention group (63.2%) as highly knowledgeable compared to 15.2% in the control group ($\chi^2 = 104.67$, $df = 1$, $P < 0.0001$).

The study assessed pupils' knowledge regarding reasons for practicing hand washing, and identifying dirt removal, germ elimination, and disease prevention. At the end-line assessment, a significantly higher proportion of pupils in the intervention group (45.5%) cited all three reasons, surpassing the 32.1% reported by learners in the control group ($\chi^2 = 14.6$, $df = 1$, $P = 0.002$).

At the baseline assessment, no significant difference was observed in the reported proportion of learners perceiving open defecation as a safe method for feces disposal between the control and intervention groups (19.3% vs. 23.5%, respectively, $\chi^2 = 1.20$, $df = 1$, $P = 0.27$). However, by the end-line, a substantial decrease was evident in this proportion, with only 4.0% in the intervention group and 17.4% in the control group ($\chi^2 = 20.6$, $df = 1$, $P = 0.0001$), still considering open defecation as a safe disposal method. Moreover, 96.0% of pupils in the intervention group recognized the safety of latrine disposal compared to 82.6% in the control arm ($\chi^2 = 20.66$, $df = 1$, $P < 0.0001$).

Concerning disposal of child feces, a significantly greater proportion of pupils in the intervention group (89.0%) acknowledged the potential health hazards associated with under-five children's feces compared to 65.9% in the control group ($\chi^2 = 32.52$, $df = 1$, $P < 0.0001$) during the end-line survey.

Pupils' Sanitation and Hygiene Practices

Based on the data in Table 4, there was no statistically significant difference ($\chi^2 = 0.87$, $df = 1$, $P = 0.352$) in the proportion of children, demonstrating all the hand washing steps between the control and intervention groups at baseline. However, at the end-line, a statistically significant increase was observed, with 60.8% of children in the intervention group indicating all the hand washing steps compared to 30.5% in the control group ($\chi^2 = 39.92$, $df = 1$, $P < 0.0001$). Notably, sanitation practices also showed significant improvements. In the end-line survey, only 4.2% of pupils in intervention schools reported open defecation in comparison to 13.5% in control schools ($\chi^2 = 11.06$, $df = 1$, $P < 0.0001$).

Effect of the School-Led Total Sanitation Intervention on Hygiene and Sanitation Knowledge and Practices Among Pupils in Baringo County, Kenya - Difference in Differences Analysis

Table 5 provides the results of the DID analysis regarding the impact of the SLTS intervention on hygiene and sanitation knowledge and practices among students, comparing baseline and end-line surveys in the intervention and control groups. At baseline, 13.1% of children in the intervention group and 17.4% in the control group were highly knowledgeable about hand washing steps. Post-intervention, the intervention group showed a substantial improvement in highly knowledgeable children compared to the control group (63.2% and 15.2%, respectively, $\chi^2 = 104.67$, df = 1, $P < 0.0001$). There was a 52.3% increase in knowledge among children attributed to the intervention.

In terms of sanitation, a 17.6% increase was found in knowledge about safe feces disposal after the intervention. During the baseline survey, knowledge level scores exceeding 50 regarding the harmful effects of feces were 0.9% and 0.5% in the intervention and control groups, respectively. However, by the end-line, substantial improvements were evident in both the intervention (62.7%) and control (20.6%) groups. The perception that children's feces are not harmful to their health decreased by 26.2%. Additionally, the practice of open defecation at school and home decreased by 11.7% and 17.8%, respectively.

Finally, there was an increase in the proportion of pupils demonstrating all hand washing steps and practicing hand washing with soap after the intervention at the end-line survey (34.1% and 19.6%, respectively).

Discussion

Pupils' Hygiene and Sanitation Knowledge

The findings of this study reported significant improvements in hygiene and sanitation knowledge within the intervention group in comparison to the control group. This underscores the importance of SLTS interventions in improving children's grasp of key concepts such as hand washing, proper feces disposal, and the health implications

Table 3. Knowledge of Pupils Regarding Sanitation and Hygiene in the Control and Intervention Group Both at Baseline and End-line Survey

Themes on knowledge	Baseline Survey					End-line Survey				
	Intervention n (%)	Control n (%)	χ^2	*df*	*P* Value	Intervention n (%)	Control n (%)	χ^2	*df*	*P* Value
Hand washing										
Highly knowledgeable	29 (13.1)	38 (17.4)	1.58	1	0.21	132 (63.2)	34 (15.2)	104.67	**1**	**<**0.0001
Less knowledgeable	192 (86.9)	180 (82.6)				77 (36.8)	189 (84.8)			
Reason for washing hands										
None	14 (6.3)	13 (6.0)	0.34	3	0.99	5 (2.4)	19 (8.5)	14.60	3	0.002
One	99 (44.8)	98 (45.0)				48 (23.0)	46 (20.4)			
Two	68 (30.8)	68 (31.2)				61 (29.2)	83 (38.1)			
Three	40 (18.1)	39 (17.9)				95 (45.5)	73 (32.1)			
Safest feces disposal method										
Defecation in latrine	169 (76.5)	176 (80.7)	1.20	1	0.27	201 (96.0)	184 (82.6)	20.66	1	<0.0001
Open defecation	52 (23.5)	42 (19.3)				8 (4.0)	39 (17.4)			
Effect of feces categorical score										
Less or equal to 50%	219 (99.1)	217 (99.5)	0.32	1	0.57	78 (37.3)	177 (79.4)	78.89.	1	<0.0001
More than 50%	2 (0.9)	1 (0.5)				131 (62.7)	46 (20.6)			
Perception if<5 children's feces is harmful to health										
Harmful	140 (63.3)	129 (64.4)	0.55	1	0.46	190 (89.0)	148 (65.9)	32.52	**1**	**<**0.0001
Not harmful	81(36.7)	89 (33.6)				19 (11.0)	75 (34.1)			

Table 4. Sanitation and Hygiene Practices by Pupils in the Intervention and Control Sites at Baseline and End-Line Surveys

Characteristic	Baseline					End-line				
	Intervention n (%)	Control n (%)	χ^2	*df*	*P* Value	Intervention n (%)	Control n (%)	χ^2	*df*	*P* Value
Demonstrate all hand washing steps										
Yes	53 (23.7)	60 (27.5)	0.87	1	0.352	127 (60.8)	68 (30.5)	39.92	1	<0.0001
No	171 (76.3)	158 (72.5)				82 (39.2)	155 (69.5)			
Hand washing with soap										
Yes	145 (65.6)	142 (65.1)	0.01	1	0.917	179 (85.6)	146 (65.5)	23.57	1	<0.0001
No	79 (34.4)	76 (34.9)				30 (14.4)	77 (34.5)			
Place of defecation at school										
Toilet	191 (86.3)	197 (88.7)	0.56	1	0.453	200 (95.8)	193 (86.5)	11.06	1	0.0008
Open defecation	30 (13.7)	25 (11.3)				9 (4.2)	30 (13.5)			
Place of defecation at home										
Latrine	151 (68.3)	146 (67)	0.92	1	0.761	175 (83.7)	144 (64.6)	20.5	1	<0.0001
Open defecation	70 (31.7)	72 (33)				34 (16.3)	79 (35.4)			

of poor hygiene practices. These findings are in line with the objectives of SLTS programs, which strive to equip children with the knowledge necessary for adopting good hygiene and sanitation practices (1).

Hand washing plays a vital role in preventing diarrheal diseases. Health education is crucial in raising awareness, encouraging the practice, and highlighting the importance of hand washing among primary school children. Hand washing training in schools emerges as a potent tool in the fight against fecal-oral diseases (24).

This study evaluated the knowledge of hygiene and sanitation among school-going children in both the intervention and control groups three months after the intervention. Children in intervention schools demonstrated significantly higher levels of knowledge about hygiene and sanitation compared to their counterparts in control schools. A significantly higher percentage of students in the intervention group (63.2%) was rated as highly knowledgeable, in contrast to the control group (15.2%). Additionally, knowledge among the children in intervention schools increased by 52.3%. This study underscores the positive impact of the SLTS intervention on hygiene and sanitation knowledge among children in Kenya. The intervention could effectively improve the understanding of key concepts related to hand washing and sanitation. This improvement in knowledge can be attributed to the educational components of the intervention, including information dissemination and

Table 5. DID Analyses of the Effect of the SLTS Intervention on Hygiene and Sanitation Knowledge and Practices Among Pupils Between Intervention and Control Groups at Baseline and End-line Surveys

Knowledge and Practices on Hygiene and Sanitation	Baseline Survey			End-line Survey			Contribution
	C (%)	I (%)	Diff (I-C)	C (%)	I (%)	Diff (I-C)	DID in %
Pupils' knowledge of hygiene and sanitation							
Highly knowledgeable about hand washing	17.4	13.1	-4.3	15.2	63.2	48**	52.3**
Knowledge level of safe feces disposal method	80.7	76.5	-4.2	82.6	96.0	13.4**	17.6**
Knowledge level of effects of the feces score of > 50%	0.5	0.9	0.4	20.6	62.7	42.1**	41.7**
The perception that the feces of < 5 children are not harmful to health	33.6	36.7	3.1	34.1	11.0	-23.1**	-26.2**
Pupils' sanitation and hygiene practices							
Demonstrate hand washing steps	27.5	23.7	-3.8	30.5	60.8	30.3**	34.1**
Hand washing with soap	65.1	65.6	0.5	65.5	85.6	20.1**	19.6**
Open defecation at school	11.3	13.7	2.4	13.5	4.2	-9.3**	-11.7**
Open defecation at home	33	31.7	-1.3	35.4	16.3	19.1**	-17.8**

Note. **$P < 0.001$; C: Control group; I: Intervention group; DID: The difference in differences; -DID: Net reduction impact; + DID: Net increase impact.

hands-on demonstrations (25).

While limited studies have specifically addressed the effectiveness of SLTS interventions among school-going children, other hygiene and sanitation interventions utilizing various approaches to target behavior change and enhance knowledge among school-going children have demonstrated positive outcomes. The results of a study conducted in India revealed an improvement in hygiene- and sanitation-related knowledge and practices among school-going children following a school-based intervention (26). Likewise, the findings of a study performed in Pakistan confirmed that a hand washing educational program enhanced primary school children's knowledge of hand washing practices. The mean knowledge of hand washing significantly increased after the intervention, measuring 18.64 ($t = -14.13$, $P = 0.001$) compared to the mean before the intervention, which was 13.38 (27). In Malawi, a cluster randomized controlled trial examining the impact of a school-based hand hygiene program revealed that knowledge scores in the intervention group were significantly higher than those in the control group (28).

In contrast, the findings of this study differ from those of another study conducted in Malawi, which reported no substantial improvement in hand washing knowledge among students after implementing the intervention compared to control schools (29). This disparity may be explained by the fact that the Malawian study focused on the hardware component of health promotion, while the present study addressed behavioral changes.

The promotion of positive behavioral changes requires a combination of education and behavioral reinforcement. This was a key strategy for SLTS implementation in the current study. Learners were exposed to information and knowledge regarding the importance of hand washing for personal hygiene and disease prevention. They were guided on the potential health risks linked to inadequate sanitation and hygiene practices, as well as the advantages of adopting healthy practices. This approach likely contributed to an enhanced understanding of the taught concepts and, consequently, the adoption of healthier hygiene and sanitation practices.

Pupils' Hygiene and Sanitation Practices

This study also examined school-going children's hygiene and sanitation practices in the intervention and control groups. The results revealed a significant improvement in practices among the intervention group compared to the control group. At the end-line, a higher proportion of pupils in the intervention group (85.6%), compared to the control group (65.1%), reported washing their hands with soap ($\chi^2 = 23.57$, $df = 1$, $P < 0.0001$). These findings are consistent with those of educational interventions conducted in South India on personal hygiene, where hand washing practice significantly increased in the intervention group than in the control group (30). Similarly, the *Mikono Safi* intervention in Tanzania reported significant improvements in hand washing after implementing the intervention (31). However, these results contradict those of a study conducted among Filipino school children that assessed the impact of a school-based water, sanitation, and hygiene program on hand washing. The results of this study revealed no significant differences in the mean hand washing practices scores or hand washing with soap between the intervention and control schools (32). In the Filipino study, the intervention primarily involved providing hand washing facilities, while the approach in this study focused on behavioral changes. This difference, combined with socio-economic variations between the two study areas, may partly explain the discrepancies in the results.

Open defecation poses considerable health risks, including the transmission of waterborne diseases, malnutrition, and stunting (33), parasitic infections (34), and issues such as school absenteeism and poor academic performance (35). Addressing the risks associated with open defecation and promoting improved sanitation and hygiene practices can protect children's health, well-

being, and educational opportunities. Ultimately, this contributes to their holistic development and fosters a healthier society (36). The study examined the prevalence of open defecation at both school and home within the intervention and control groups. In the end-line survey, the intervention group exhibited a significantly lower prevalence of open defecation at school compared to the control group (6.2% vs. 13.5%; $\chi^2 = 5.34$, $P = 0.012$). Similarly, at home, the intervention group demonstrated a significantly lower prevalence of open defecation in comparison to the control group (16.3% vs. 35.4%; $\chi^2 = 20.66$, $P < 0.001$). These findings demonstrate the intervention's effectiveness in reducing the practice of open defecation within the intervention group.

DID analysis confirmed that the intervention significantly reduced open defecation at school and home by 11.7% and 17.8%, respectively. Based on the observed improvement in hygiene and sanitation practices, including increased hand washing with soap and reduced open defecation, the behavior change achieved through the intervention, which conforms to the findings of previous studies. A systematic review and meta-analysis of randomized controlled interventions on the effectiveness of community and school-based sanitation interventions reported increased latrine usage and safe feces disposal among children from eighteen schools (19). In Nepal, the recognition that children can serve as change agents, coupled with the success of the School Sanitation and Hygiene Education initiative led by UNICEF Nepal, resulted in the establishment of SLTS, wherein open defecation-free areas were attained with school children actively playing a leading promotional role (14).

This study's findings corroborate those of previous research, reinforcing the observation that targeted interventions can effectively reduce open defecation practices and promote improved sanitation behaviors at school and home. The findings further emphasize the significance of school-led interventions in creating a conducive environment for promoting healthy habits and improving hygiene and sanitation practices among school-going children. There is evidence that the majority of sanitation interventions lead to improved latrine coverage and usage, irrespective of their implementation location (28).

Strength of the Study

This study employed a quasi-experimental design, which allowed for a comparison between the intervention and control groups. This design helped establish a causal relationship between the SLTS intervention and the observed outcomes, providing valuable evidence for the transformative effects of the intervention.

It also assessed hygiene and sanitation knowledge and practices through questionnaires and direct observations. This multi-method approach improved data reliability by triangulating different sources of information. Direct observations provided objective behavioral measures, whereas questionnaires collected self-reported knowledge and practice.

Finally, the study was conducted in Baringo County, Kenya, a relevant setting for examining the impact of SLTS interventions. In addition to addressing the community's challenges, the study's findings hold significant practical implications for local policymakers, educators, and public health practitioners.

Study Limitations

While this study provides useful insights, it is important to recognize its limitations. The study focused on a specific age group and geographic location, limiting the generalizability of the findings. The findings may be limited in their applicability to other populations and age groups. Future research should consider a broader age range and a more diverse sample to increase the findings' external validity.

Secondly, this study evaluated the combined effect of all SLTS elements, namely, the formation of health clubs, triggering, and distribution of information, education, and communication materials. Consequently, the effectiveness of each element remains unknown. Future studies can address this gap by evaluating the effects attributable to each SLTS element.

Thirdly, a quasi-experimental design with a control group was used in the study. While this design allows for comparisons, it is susceptible to observer and measurement bias. This, however, was minimized by using standardized questionnaires.

Fourth, the study was conducted just after the coronavirus disease 19 pandemic had subsided in Kenya. During the coronavirus disease 19 period, all schools were closed, and health messages, particularly on hand washing, were promoted across the country. This could have worked to reinforce SLTS messages and the subsequent adoption of healthy practices promoted by the intervention.

Finally, the study relied on self-reported data and direct observations, susceptible to social desirability and observer biases. Future studies may incorporate objective measures or complementary qualitative approaches to better understand the experiences and perspectives of all individuals involved.

Conclusion

In general, the SLTS intervention positively improved hygiene and sanitation knowledge and practices among school-going children in Baringo County, Kenya. The significant improvements in knowledge scores and the adoption of positive hygiene practices highlight the importance of implementing comprehensive and context-specific interventions.

These findings contribute to the existing literature on school-based sanitation interventions and can inform future efforts to promote healthy habits and improve overall health outcomes among school-going children. In particular, the Kenyan Government's Departments

of Health and Education could consider adopting the SLTS strategy in addition to the ongoing interventions addressing the problem of hygiene and sanitation. Most importantly, the inclusion of school-going children and the school community in interventions is key to achieving a greater impact.

Acknowledgments

The authors would like to acknowledge all the participants who made this research possible.

Authors' Contribution

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Competing Interests

The authors declared no conflict of interests associated with the material presented in this paper.

Ethical Approval

The study was approved by the Board of Postgraduate Studies at Jomo Kenyatta University of Agriculture and Technology. Ethical review was performed by the Institutional Ethical Review Committee of the University of Eastern Africa, Baraton, and a research license was issued by the National Commission for Science, Technology, and Innovation (NACOSTI). The approval for performing this study was obtained from the County Director of Preventive and Promotive Services, the County Commissioner, the County Director of Basic Education, and the office of the Governor of Baringo County. The respective sub-county heads, chiefs, and ward public health officers of both the control and intervention sites were notified of the study. Permission was sought from school head teachers and chiefs among schools and villages participating in the study. Before data collection, caregivers provided informed consent for their children to participate in the study, ensuring confidentiality, anonymity, and the right to withdraw.

Funding

This research was funded by an African Doctoral Dissertation Research Fellowship (ADDRF) award offered by the African Population and Health Research Center (APHRC) and funded by the Bill and Melinda Gates Foundation through a project grant to APHRC.

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