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Feasibility of mainstreaming schistosomiasis and soil transmitted helminthiasis mass drug administration into primary healthcare: a baseline survey for a community case study in Western Kenya

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1 Abstract

Background: Mass drug administration campaigns have enabled great progress in the prevention and control of schistosomiasis and soil transmitted helminthiasis. However, the persistence of these infections continues to challenge public health systems despite decades of control efforts. This study was commissioned to evaluate the feasibility of a transition from periodic mass drug administration campaigns to a sustainable, facility- and community-based delivery model in Western Kenya.

Methods: The study is part of a non-randomized, controlled before-and-after study using a mixed-methods approach. Data were collected from 1,229 households, 24 health facilities (12 control, 12 intervention), focus group discussions, and key informant interviews. The analysis focused on six domains of mainstreaming feasibility: perception of mainstreaming among key stakeholders, processes, infrastructure and system readiness,

acceptability and trust for primary healthcare-led treatment, facilitators, and barriers. Finally, we calculated a composite readiness index to grade facility readiness.

Results: Generally, community perceptions to schistosomiasis and soil-transmitted helminthiasis treatment benefits were found to be high in both the control and intervention groups. . Qualitative data showed enhanced trust in the integrated model by virtue of the credibility and professional nature of health facility staff. An overwhelming majority of community members received treatment through household visits (95.5%) implying reliance on periodic MDA at baseline. Community Health Promoters remain a critical source of information on treatment opportunities for low-literacy populations, while media and health facilities are increasingly important among more educated groups. We also found high infrastructural and systemic readiness for treatment mainstreaming with respect to stock availability and data reporting systems. However, stock outs were reported among the facilities. High variability in health worker training coverage suggests a critical challenge in workforce preparedness.

Conclusion: The findings point to a strong foundation for mainstreaming but underscore the need for a structured implementation package. Priority actions should include standardized operating procedures, supply chain and digital system strengthening, and expanded Community Health Promoter-

led outreach activities to improve consistency, access, and sustainability of deworming services within primary healthcare platforms

Trial Registration: Registration number NCT07507461, prospectively registered on 28th January, 2026

2 Introduction

Schistosomiasis (SCH) and soil transmitted (STH) helminthiasis pose a significant public health burden as some of the more prevalent neglected tropical diseases (NTDs) (1). These diseases disproportionally affect the children and marginalized communities in low- and middle-income countries globally, and specifically those in sub-Saharan Africa (2). They contribute to significant morbidity, including anemia, impaired cognitive development, and reduced productivity. Preventive chemotherapy through mass drug administration (MDA) has been a key strategy for SCH/STH control in the region (3). However, the persistence of these infections continues to challenge public health systems despite decades of control efforts (1).

Conventional MDA programs are donor-driven and operate as vertical initiatives, separate from national health systems. This reliance on external funding often results in difficulties in sustaining interventions once donor support is withdrawn (4). The disconnect between MDA interventions and routine healthcare services has resulted in fragmented service delivery, inefficient resource utilization, and weak health system ownership at both

the national and subnational levels (5). Inadequate health infrastructure and gaps in community engagement also undermine the effectiveness of these programs (6). These challenges call for sustainable and effective intervention strategies such as treatment mainstreaming into primary healthcare (PHC), especially for improved sustainability (7). PHC systems provide an essential framework for integrating disease control programs into routine health services, ensuring sustainability and long-term impact (8).

The western region of Kenya is an infection hotspot, with environmental and socioeconomic factors contributing to persistent infections (9). The country's recent transition to the Social Health Authority and the establishment of the Primary Health Care Fund (PHCF) present a unique opportunity to integrate NTD control into routine PHC services, ensuring sustainable and equitable access to deworming interventions (10). Mainstreaming will improve efficiency by utilizing existing community health structures while enhancing equity by reaching vulnerable populations through routine healthcare services. Additionally, increasing MDA coverage through community-based distribution and school-based deworming programs will help sustain the progress made in controlling STH and SCH.

At present, there is a knowledge gap on the implementation of this approach in the Kenyan context. Existing literature on NTDs in Kenya

largely focuses on epidemiological trends but overlooks operational research on mainstreaming mechanisms (11). This study aims to evaluate the feasibility of integrating SCH/STH MDA programs into PHC in Western Kenya as a community case study. The study will generate evidence on barriers, facilitators, and best practices for MDA mainstreaming into PHC systems in the country.

3 Methods

3.1 Study Design

This study is part of a larger study investigating the mainstreaming of SCH/STH treatment into PHC systems in Western Kenya, using the Sub-national Interruption of Transmission project by the Deworming Innovation Fund as a case study. The larger study follows a controlled before-and-after structure, where SCH/STH treatment implementation is observed at two-time points—before (baseline) and after (endline) mainstreaming. The control group consists of health facilities and communities where the conventional MDA approach was employed, while the intervention group includes sites where SCH/STH treatment was integrated into PHC services over the course of the study. Data at baseline was collected from both groups to facilitate a comparative analysis of MDA coverage rates, disease prevalence, and health system efficiency before and after mainstreaming.

For this objective, a cross-sectional mixed methods approach was carried out among the community members, healthcare workers in health facilities

and key informants in Western Kenya. The study was conducted in Vihiga, Kakamega, Bungoma and Trans Nzoia counties where MDA campaigns under the Sub-national Interruption of Transmission Project have been implemented (Figure 1).

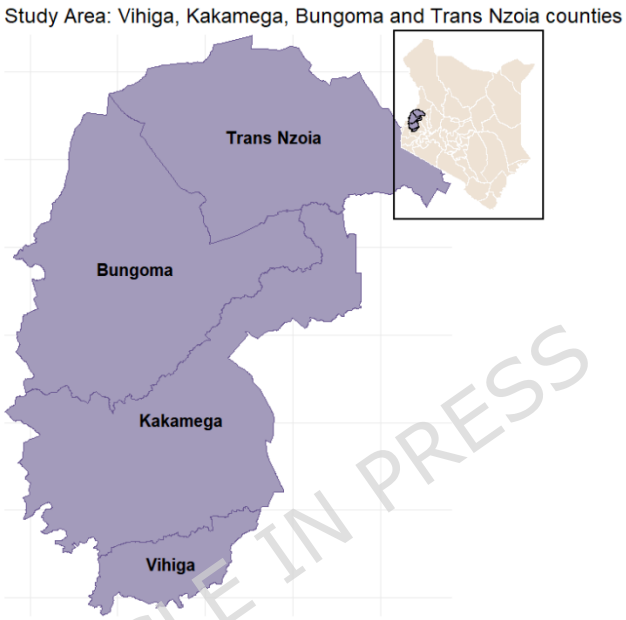

Figure 1: The four counties where the Subnational Interruption of Transmission of STH and SCH Project was implemented in Western Kenya

3.2 Sampling strategy

The study was conducted in selected counties comprising a total of 122 Non-Interruption of Transmission (Non-IoT) designated wards that only had the conventional MDA interventions to treat SCH/STH. A comprehensive list of all non-IoT wards was compiled for each county, from which eligible wards were randomly assigned to either the intervention or control group using a computer-generated randomization process. Randomization was

stratified by county to account for contextual variations in health system capacity, disease burden, and population dynamics.

The inclusion criteria was:

- All eligible community members, including school-age children (SAC; 5–14 years) and adults (15 years and above) receiving targeted treatment for SCH.
- Preschool-age children (PRESAC; 1–4 years), school-age children (SAC; 5–14 years), and adults (15 years and above) receiving targeted treatment for STH.
- Must be residents of the target counties (Vihiga, Kakamega, Bungoma, and Trans-Nzoia).

The exclusion criteria:

- Residents in wards outside the 122 non-Interruption of Transmission (non-IoT) wards.

The sample size was calculated using a standard formula for comparing two proportions in a clustered study design, adjusted for intra-cluster correlation (ICC) and average cluster size. Although the study is non-randomized, the formula commonly used in cluster randomized trials was applied to account for clustering effects and to ensure sufficient statistical power for between-group comparisons:

$$N = \frac{(Z_{\alpha/2} + Z_{\beta})^2.[p_1(1 - p_1) + p_2(1 - p_2)]}{(p_1 - p_2)^2}. \frac{1 + (m - 1).\ ICC}{m}$$

Where:

- **N** = Number of wards per group
- **Zα/2** = Z-score for the desired significance level (1.96 for 95% confidence)
- **Zβ** = Z-score for desired power (0.84 for 80% power)
- **p1=** Proportions in control group (0.50 (assumed))
- **p2** = Proportions in intervention group (0.65 (assumed effect size of 15%))
- **(p1 - p2)** = The expected difference in proportions between the two groups (0.15)
- **m** = 50 (assumed)
- **ICC** = 0.05 (assumed)

A total of 11.47 wards was estimated per study arm, which was rounded up to 12 wards each for the intervention and control groups, distributed to the four counties.

The qualitative aspect of the feasibility assessment involved key informant interviews (KIIs), focus group discussions (FGDs), and facility assessments. To ensure representation across different implementation settings:

Key Informant Interviews were conducted with the Ministry of Health County Coordinators for PHC, NTDs and School Health Programs, for all four counties. An additional KII was conducted with the Facility In-Charge of randomly selected health facilities in both the intervention and control wards of each county. This gave a total of 20 KIIs, as the two facility in-charge KIIs were in addition to the three county officials. These were purposively sampled according to their role and familiarity with the NTD policy and implementation at county level.

We conducted two focus group discussions in each county, one with the community members and the other with community health promoters (CHPs) in each. To ensure representativeness, the participants were obtained interchangeably from the intervention and control wards in each county. Therefore, we had a total of 2 FGDs with the community members in each arm, and 2 FGDs with the CHPs in each arm. We conducted structured facility assessments for 24 health facilities (12 in intervention wards and 12 in control wards).

For the quantitative aspect, we administered a Knowledge, Attitude and Practices Survey to households. The survey questionnaire was deployed to collect data on MDA coverage at baseline, therefore the sample size was calculated using the formula for comparing two proportions to detect a statistically significant difference in MDA coverage between groups:

$$n = \frac{\left(Z^2_{\alpha/2} \times p \times (1 - p)\right)}{d^2}$$

Where:

- n represents the required sample size per group.
- $Z_{\alpha/2}$= 1.96 for a 95% confidence level.
- p = expected MDA coverage assumed at 75% (0.75) based on previous studies.
- d = margin of error, set at 5% (0.05).

A design effect (DEFF) of 1.5 was applied for cluster sampling thus giving the $n_{adjusted}$ of 432. The sample was adjusted for a 15% non-response rate to give 508. Thus, each group required approximately 508 participants, resulting in a total study sample of 1,016 individuals. Since this study uses a cluster sampling approach, with 24 clusters (wards), the sample was evenly distributed across clusters, leading to approximately 17 individuals per cluster using probability proportional to size (PPS) sampling for the household survey.

3.3 Data collection and handling

The household survey questionnaires were programmed into a digital format using KoBoCollect. The digital tools were downloaded on smartphones that enumerators used to collect data. The digital questionnaire had quality control features, including in-built skip logic, mandatory inputs, consistency checks, and a Global Positioning System (GPS) to enable geospatial mapping of the surveyed households. The questionnaire, focus group discussion (FGD) and key informant interview

(KII) guides are included in the Supplementary File. The audios were recorded and notes developed separately for thematic analysis. All data was encrypted and securely stored in Amref's data management systems. De-identified datasets were also used to protect participant confidentiality..

3.4 Data analysis

3.4.1 Qualitative data analysis

The transcripts were coded manually, by highlighting relevant sections of text and assigning descriptive labels, without the use of qualitative analysis software. A hybrid coding approach was used. Codes were developed in advance based on the study questions and the quasi-experimental design, particularly around implementation experiences, perceived changes, and contextual influences. New codes were also allowed to emerge naturally from the data to capture participants' own priorities, explanations, and meanings that were not anticipated at the outset. Themes were developed gradually through an iterative process.

As coding progressed, similar codes were grouped together and compared across interviews, focus groups, and study arms. These groupings were refined into broader themes that reflected recurring patterns in how participants described their experiences, challenges, and perceived effects of the intervention. Themes were continuously revisited and adjusted as additional transcripts were reviewed, ensuring they accurately reflected the data rather than preconceived assumptions.

The primary coding and analysis were conducted by one researcher, with periodic review by a second team member. Any differences in interpretation were discussed openly and resolved through consensus, using the original transcripts to ground decisions.Formal inter-rater reliability testing was not undertaken. Instead, analytic rigor was supported through careful familiarization with the data, ongoing reflexive discussion within the research team, consistent application of codes, and clear documentation of how codes and themes evolved over the course of the analysis.

3.4.2 Quantitative data analysis

Household survey and health facility assessment data were cleaned and analyzed using Stata (StataCorp, College Station, TX). Sociodemographic variables included continuous age, categorical education (no formal, primary, secondary, university), household size (categorized as 1-3, 4-6, ≥7 members), and intervention arm status. Composite indicators were constructed by the summation of binary indicators relevant at household and facility level. Specifically, the readiness index sums seven binary indicators for service provision, integrated treatment services, CHW training and refresher trainings, stock-outs, outreach treatments, and data reporting. Shapiro-Wilk and Kolmogorov-Smirnov tests were used to test facility and household data distributions respectively for normality. Svyset procedures were implemented to ensure that the inferential statistics account for clustering effects at ward level within the counties.

Descriptive analysis used tabstat for continuous variables and tab for categorical variables to obtain percentages and chi-squared tests. Independent t-tests were used to assess mean differences between the control and intervention arms. Binary logistic regressions were employed for MDA awareness and uptake as functions of county, sub-county, ward (with base category), age, gender, education, and income.

3.5 Ethical considerations

Ethical approval was obtained from the ethics committee of the University of Eastern Africa, Baraton on January 20, 2025 (Approval Reference Number: B1422192025). Participants were included only if they give informed consent by a parent or legal guardian in case of participating children and adolescents or by the participant in case of participating adults. Respondents were informed of their rights to refuse participation or withdraw from the assessment at any point and that this would not affect the services provided. The information provided during the interviews was not linked to any specific respondent in the final report. For the FGDs and KIIs, participant consent to be tape recorded was obtained at the beginning of the interview. All information provided was kept confidential and used solely for the limited purposes of the survey. Only general identifying information (geographical unit, gender, and age if reported voluntarily) was utilized. Any information that could be directly linked to an individual was not used.

4 Results

4.1 Sociodemographic characteristics of survey respondents

Overall, there were no statistically significant differences between the control and intervention arms , with the exception of the type of sanitation facilities at baseline (Table 1). Notable results include the gender distribution showed that 68% of respondents were female and 32% male. The largest proportion of respondents fell between 25 and 54 years of age, and over 80% of respondents lived in households with more than four members. The level of education was also broadly comparable, although a slightly higher proportion of university-educated respondents were observed in the intervention arm. In terms of income sources, farming (48%) was the most common livelihood, followed by daily wage labor (24%) and small businesses (18%).

A total of 24 health facilities were assessed, evenly split between control and intervention arms. The sample included a representative mix of dispensaries, health centers, and sub-county hospitals. Dispensaries made up 42% of the facilities, with 60% of them located in intervention areas. Health centers constituted 46%, nearly evenly distributed across study arms. Sub-county hospitals were least represented, comprising 12% of total responses, with two located in control areas and one in the intervention arm.

4.2 Feasibility of SCH/STH treatment mainstreaming into PHC

Our definition of feasibility is key stakeholder's perceptions, along with processes, infrastructure, barriers, facilitators, acceptability, adoption, appropriateness, and fidelity of integrating schistosomiasis (SCH) and soil-transmitted helminths (STH) treatment into PHC systems rather than using a campaign-based approach. The key stakeholders include the community, health workers and key informants at County level of administration within the study area.

Mainstreaming as per our study is the incorporation of deworming services for SCH and STH into routine PHC delivery. This includes administering Praziquantel (PZQ), Albendazole (ALB) and Mebendazole (MBZ) through PHC facilities, training frontline health workers for treatment, ensuring drug availability through existing supply chains, and integrating surveillance into the national health information system. This is in addition to creating awareness among the community members about behavior change and uptake of treatment. Table 2 contains details on feasibility construct definitions and measurement

4.2.1 Processes for SCH/STH treatment through PHC services

4.2.1.1 Sources of information on SCH/STH treatment, and community awareness levels of MDA treatment opportunities

CHPs were the most frequently cited source of information across all education levels, especially among those with no formal education or with primary education. Media and health facilities were the next most common

sources. Reliance on community meetings (12%), schools (3%), and public criers (5%) was low across the board. Media (19%) and health facilities (16%) gained more prominence as sources of information, especially among respondents with higher education in the intervention group. The association between education level and source of information was statistically significant in both arms, indicating that information channels used varied meaningfully by education level (Table 2). These findings point to the need for segmented communication strategies that align with the audience's educational background. Strengthening the capacity of CHPs while also leveraging formal media platforms and health facility communication will be essential to ensure equitable access to information across the full spectrum of education levels

We observed a high awareness of MDA for SCH/STH treatment across the study population, with 90% of respondents reporting familiarity with deworming campaigns conducted in the previous three years. However, awareness levels varied by education status (Table 3). The overall analysis revealed a statistically significant association between education level and MDA awareness ($p = 0.027$). Respondents with no formal education were disproportionately represented among those unaware of MDA-making up 35% of the unaware group, despite accounting for only 27% of the total sample. In contrast, respondents with secondary or university education were more likely to report being aware of MDA activities.

Table 3: Educational Gaps in MDA Awareness

MDA Awareness	No formal	Primary	Secondary	University	Total	P-values
No	41(12%)	47(9%)	14(5%)	15(13%)	117(10%)	
Yes	296(88%)	473(91%)	241(95%)	102(87%)	1112(90%)	0.027
Total	337(27%)	520(42%)	255(21%)	117(10%)	1229(100%)	

p-values obtained from Chi-square tests for categorical values at α = 0.05

4.2.1.2 Status of SCH/STH treatment in routine health services

All the assessed PHC facilities reported offering treatment for STH and SCH, indicating 100% nominal availability. However, community survey data show that only 3.9% of respondents reported receiving treatment from a PHC facility. In contrast, 95.5% (95% CI, 94.2 – 96.6) received treatment through household visits. This finding was supported by qualitative data from KIIs. In Kamukuywa Ward (Bungoma), a facility in-charge observed that most children are not brought to the PHC facility for treatment and suggested involving CHPs for household-level follow-up. In Tuwani Ward (Trans Nzoia), another facility head noted, *"We wait for the county to bring drugs during school visits or MDA periods,"* indicating a reliance on externally coordinated supply and outreach, often driven by the county in collaboration with the Ministry of Education and the Ministry of Health.

While the baseline assessment shows that SCH/STH treatment has begun to be incorporated into PHC services in some settings, the completeness, consistency, and system-wide linkage of mainstreaming remains limited

(Table 4). Dispensaries often rely solely on antenatal and postnatal care visits for treatment delivery, with minimal evidence of surveillance, outreach, or supply chain mainstreaming. Health centers and subcounty hospitals show broader service platforms but limited community engagement. Only 15% of facilities had comprehensive mainstreaming across all potential treatment outlets. A chi-square test ($p = 0.434$) showed no statistically significant association between facility type and mainstreaming modality, indicating that these patterns may be driven more by facility-level operational choices and resource constraints than by structured policy guidance.

Table 4: Status of Mainstreaming of STH and SCH Treatment into Routine Health Services

Facility Level	**All**	**MCH/ANC**	**Community outreach**	**School outreach**	**Other**	**Total**	**p-value**
Dispensary	0(0%)	6(75%)	1(13%)	1(13%)	0(0%)	8(40%)	0.434
Health Center	2(22%)	4(44%)	1(11%)	0(0%)	2(22%)	9(45%)	
Subcounty	1(33%)	1(33%)	0(0%)	0(0%)	1(33%)	3(15%)	
Total	**3(15%)**	**11(55%)**	**2(10%)**	**1(5%)**	**3(15%)**	**20(100%)**	

p-values obtained from Chi-square tests for categorical values at $\alpha = 0.05$

Qualitative data highlighted wide variation in the operationalization of mainstreaming across both intervention and control arms. While several

facilities reported delivering deworming services, their practices did not always meet the full definition of mainstreaming. For example, in Kakamega's Kisa North Ward, CHPs described conducting household-level follow-up and referrals: *"We walk household to household... aside from those we don't get, we take them to the facility."* This reflects a partial mainstreaming model that includes community-linked delivery, but without confirmation of consistent drug supply, data reporting via HIS, or structured facility-based treatment across multiple service points.

4.2.1.3 Health worker training on SCH and STH treatment

The mean number of health workers trained in community-based SCH/STH treatment across all facilities was 3.0. Some facilities had as many as 6 trained workers while others had none, as confirmed by a standard deviation of 4.0. This shows a lack of standardization in training coverage across PHC facilities. Targeted and equitable capacity building will be essential to strengthen the delivery of SCH/STH services. Equally important is enhancing health workers' understanding of mainstreaming as a system-wide approach, so they can actively identify and seize opportunities to embed treatment into routine service contacts across platforms.

Most facilities (71%) had not conducted any refresher training at the time of the survey. This limited training coverage was observed across both study arms. While initial training may have occurred, ongoing reinforcement and updates on deworming protocols appear to be sporadic and uneven. This

reliance on ad-hoc or partner-supported training efforts limits the sustainability and quality assurance of deworming services integrated into PHC.

4.2.2 Infrastructure and Systems Readiness for SCH/STH Treatment Delivery in PHC Facilities

4.2.2.1 Stock availability of SCH/STH medication within PHC facilities

An audit of stock availability for SCH/STH treatment drugs was conducted as part of the health facility assessments. Among the facilities, 20 of 24 health facilities reported that SCH/STH medication was available, while 17% reported stockouts. Ensuring continuous and reliable drug supply will be essential to support effective mainstreaming of SCH/STH treatment into routine PHC services. Periodic shortages, even if infrequent, may undermine trust in the health system and interrupt continuity of care.

4.2.2.2 Data reporting systems for SCH/STH treatment monitoring

Most surveyed facilities (88%, 95% CI, 65.5 – 96.3) tracked deworming service delivery using standard MoH paper-based tools. These records are typically consolidated and updated into the Kenya Health Information System (KHIS) by the designated Health Records and Information Officer (HRIO), in line with national reporting procedures. Use of the electronic community health information system (eCHIS) is exclusive to the

community level, where CHPs use the platform to document household visits and service delivery. Both arms showed low but equal engagement with eCHIS (17%), reflecting its emerging role in supporting community-level deworming data.

4.2.3 Key stakeholder perceptions of integrating SCH/STH treatment into PHC

4.2.3.1 Community perception on the benefits of deworming

At baseline, respondents across all education levels and study arms demonstrated high levels of confidence in the effectiveness of SCH/STH treatment (Table 5). In the control arm, 97% of respondents affirmed the treatment as effective, while in the intervention arm, 96% expressed the same belief. Only a small proportion in each arm reported uncertainty or doubt-3% in the control and 4% in the intervention arm. Education level does not appear to significantly influence baseline perceptions of treatment effectiveness in either the control or intervention arm. These findings highlight a high degree of public confidence in deworming interventions across diverse populations.

Table 5: Perception of the benefits of SCH/STH Treatment

Education Level	Control Yes, % (95% CI)	Control p-value	Intervention Yes, % (95% CI)	Intervention p-value
No formal	96% (88-96)	0.402	96% (92-98)	0.110
Primary	98% (95-99)		96% (93-98)	
Secondary	95% (90-98)		97% (93-99)	
University	98% (90-100)		98% (91-100)	
Total	**97%**		**96%**	

p-values obtained from Chi-square tests for categorical values at α = 0.05

Respondents from the control arm overwhelmingly associated SCH/STH treatment with improved health outcomes. Among the 580 respondents, 75% indicated that the main benefit of deworming was positive health effects, while 24% cited prevention of worm infections. Findings from the intervention arm mirrored those in the control arm. Among the 604 respondents, 74% reported improved health as the main perceived benefit of SCH/STH treatment, while 26% cited other benefits, including but not limited to infection prevention.

Statistical analysis found no significant association between level of education and perceived benefit in both arms, indicating that perceptions of deworming benefits were relatively uniform across educational

backgrounds (Table 6) This consistency may reflect standardized messaging in past campaigns or community outreach, ensuring shared knowledge regardless of literacy levels.

Table 6: Perceived benefits of deworming

Level of education	**Improved health**	**Increased school attendance**	**Prevention worms infections**	**Other**	**Total**	**p-values**
Control group						
No formal education	134(81%)	0(0%)	31(19%)	165(28%)	134(81%)	0.406
Primary school	172(74%)	1(0%)	59(25%)	232(40%)	172(74%)	
Secondary school	93(71%)	0(0%)	38(29%)	131(23%)	93(71%)	
University	38(73%)	0(0%)	14(27%)	52(9%)	38(73%)	
Total	**437(75%)**	**1(0%)**	**142(24%)**	**580(100%)**	**437(75%)**	
Intervention group						
No formal education	124(81%)	0(0%)	1(1%)	29(19%)	154(25%)	0.209
Primary school	197(72%)	1(0%)	0(0%)	75(27%)	273(45%)	
Secondary school	85(75%)	0(0%)	0(0%)	29(25%)	114(19%)	
University	40(63%)	0(0%)	0(0%)	23(37%)	63(10%)	
Total	**446(74%)**	**1(0%)**	**1(0%)**	**156(26%)**	**604(100%)**	

p-values obtained from Chi-square tests for categorical values at $\alpha = 0.05$

4.2.3.2 Community concerns about SCH/STH treatment

Respondents were asked whether they had any concerns regarding SCH/STH deworming. The results indicated a relatively low level of concern overall, with some variation between study arms and across gender groups. In the control arm, 16% of all respondents expressed concerns about deworming. When analyzed by gender, a higher proportion of female respondents (18%) reported concerns compared to males (11%). This difference was statistically significant ($p = 0.029$), suggesting that women in the control arm were more likely to report apprehension or hesitation about deworming treatment.

In contrast, the intervention arm reported a lower overall level of concern, with only 8% of respondents expressing reservations. Among male respondents, 7% reported concerns, while 8% of females did the same. The difference between the genders was not statistically significant ($p = 0.598$), suggesting that at the time of the baseline survey, concerns about deworming in intervention areas were relatively consistent across gender lines.

4.2.3.3 Experience of side effects from SCH/STH treatment

Across both study arms, the proportion of respondents reporting side effects was generally low but varied by gender and study group.

In the control arm, 12% of respondents reported having experienced side effects. A closer look at the gender distribution revealed that 13% of females (54 out of 405) reported side effects compared to 8% of males (14 out of 183). This difference was statistically significant ($p = 0.046$), suggesting that women in control areas were more likely to report side effects following treatment. The higher reporting rate among women may be linked to greater engagement with health services, heightened health awareness, or greater willingness to report discomfort. It could also reflect variations in drug tolerability or perceived reactions. In the intervention arm, the overall proportion of respondents reporting side effects was slightly higher at 17%. Here, 18% of females (73 out of 416) and 15% of males (29 out of 198) reported side effects. However, unlike in the control arm, the gender-based difference was not statistically significant ($p = 0.367$).

Although the data do not indicate high levels of concern, the experiences of side effects –real or perceived– could influence attitudes toward future treatment rounds, especially in communities where such reactions are not clearly explained or expected.

4.2.4 Qualitative insights on acceptability and trust in PHC-led SCH/STH treatment

Analysis of the transcripts from community and CHP respondents across the four counties reveals generally high acceptability and trust in PHC-led

deworming as echoed in the high confidence from the survey (96% - 97%). In Bungoma's Kabula ward, a community member interviewed at Talitia Dispensary expressed strong support for facility-based deworming, stating, *"When you go to the hospital, you are advised and given drugs. There's follow-up... it's better than just taking pills from school without explanation."* Similarly, in Trans Nzoia's Kwanza ward, a community member from Kaisagat Health Center observed, *"When I go for my child's check-up, they also give me the worm tablets. It saves time and feels normal."* These statements illustrate that mainstreaming enhances both convenience and confidence in treatment.

Regarding trust, PHC staff were widely viewed as credible and professional. A CHP in Vihiga's Busali ward stated, *"They prefer getting the drugs at the health center because they believe nurses know better. When we accompany them, they are even more confident."* Another a CHP in the intervention ward of Kisa North, Kakamega emphasized the value of referral linkages: *"When I say I got the information from the nurse, they listen. People trust the hospital more than the campaigns."*

In Kakamega's Kisa East ward, a community respondent from Eshinutsa Model Health Center shared, *"These drugs are good for children. Adults are okay unless someone is really sick."* This view reflects the narrower perception of who deworming is intended for, a gap likely exacerbated by episodic campaigns rather than routine messaging through PHC. In Trans

Nzoia's Tuwani ward, a CHP noted, *"They believe us, but when we tell them to go to the hospital, they postpone or forget. If we had the drugs with us, more would take them."* This indicates that proximity and convenience influence whether treatment is accepted, even when trust exists.

Similarly, stock-outs and poor treatment availability threatened confidence and trust. In Kabula ward, Bungoma, a community respondent at Talitia Dispensary lamented, *"Sometimes you go, and they say the drugs are not there. You come back another day. It discourages people."* This concern was echoed across counties, underscoring the importance of supply consistency in sustaining trust. Across both arms, community and CHP respondents consistently highlighted that the credibility of facility staff, ease of access, and dependable supply are critical to the success of integrated deworming programs.

4.2.5 Barriers and facilitators to SCH/STH treatment services

A key facilitator in intervention sites was the mainstreaming of deworming into routine healthcare services. For example, in Kabula ward (intervention) in Bungoma County, one community member explained, "*Going to the facility feels safer, and we get advice as well-not just the drugs*," highlighting the combined value of medical treatment and professional guidance. Similarly, in Kwanza ward (intervention) in Trans Nzoia County, residents appreciated accessing deworming services during child health visits, describing the experience as both "*convenient and normal*."

Trust in PHC personnel was another strong enabler of service uptake. CHPs in Kakamega county noted, "*People listen when I tell them it's from the nurse-they trust that more than drugs given in barazas*," emphasizing the authority and credibility associated with facility-based health workers. This sentiment was echoed in Busali ward in Vihiga County, where CHPs reported that community members preferred receiving treatment from trained facility staff due to perceived safety and legitimacy. Survey data echoed this findings with over 96% of the treatment uptake coming through household visits from CHPs.

Despite these facilitators, several barriers were reported, particularly related to health system capacity and delivery models. Rising community expectations often outpaced facility readiness. CHPs from Matulo ward in Bungoma County expressed frustration, stating, "*We are told to refer for deworming, but the facility sometimes lacks drugs-this disappoints us and the community*." Another CHP from Tuwani ward in Trans Nzoia observed, "*When we refer them to facilities, most do not follow through*," indicating that while referral systems are in place, challenges such as limited follow-up, poor linkage between CHPs and facilities, and lack of treatment availability at the point of referral hinder effective service uptake.

In Kisa East ward in Kakamega County, misconceptions persisted, as one respondent remarked, "*These drugs are meant for school-going children;*

adults don't really need them," pointing to the need for improved health education and inclusive messaging.

4.2.6 Qualitative synthesis of health system bottlenecks affecting SCH/STH mainstreaming

Stakeholders across all four counties consistently highlighted several bottlenecks that threaten the feasibility, effectiveness, and sustainability of treatment mainstreaming. These barriers cut across supply chains, delivery models, human resource capacity, and community engagement systems.

A dominant challenge reported across counties was the inconsistent availability of deworming drugs, particularly praziquantel for SCH. Health facility in-charges, CHPs, and county officials described frequent delays, insufficient quantities, and lack of control over forecasting and distribution. As one facility in-charge in Trans Nzoia observed, *"We often run out of stock. Sometimes the drugs come late or in small quantities and we have to wait for months before resupply."* Similarly, a CHP in Bungoma expressed frustration: *"We are told to refer for deworming, but the facility sometimes lacks drugs-this disappoints us and the community."* CHPs in Vihiga echoed this concern, noting that *"Stockouts are common. Even if we sensitize people, if they come and find no drugs, they won't return."*

Stakeholders acknowledged that while MDAs have achieved wide coverage, they are not sustainable and tend to bypass adults and out-of-school children. "*People still wait for the MDA - it's the only time most of them*

access treatment," explained the County NTD Coordinator in Kakamega. In Trans Nzoia, the school health coordinator remarked, "*If it were not for MDA, the grown-ups, adults would not go for that drug… It calls for wide sensitization, which we are yet to reach all the population.*"

Facility staff reported that, although deworming could be provided during outpatient or maternal-child health visits, this was not systematically done. *"Mainstreaming happens if someone remembers to ask. It's not in the routine workflow,"* admitted a facility head in Bungoma. A nurse in Kakamega added, *"We don't have a protocol that tells us how to incorporate it into OPD or ANC."* In Trans Nzoia, one provider noted, *"Some children are missed because unless the parent asks, no one remembers to give deworming."* This highlights the limited functional mainstreaming of deworming into PHC workflows.

Community Health Promoters were widely viewed as essential to service delivery, especially in hard-to-reach areas. However, their effectiveness was hindered by inadequate training on SCH protocols, limited logistical support, and lack of incentives. "*We don't even have red kits, yet we're expected to give drugs and monitor side effects*," said a CHP in Trans Nzoia. Another in Bungoma observed, "*We lack materials, transportation, and sometimes we don't even have the drugs to give.*" The PHC coordinator in Vihiga emphasized, "*CHPs know the community and can do more, but they're overstretched and unsupported*."

Data fragmentation emerged as a significant barrier to the effective mainstreaming of deworming into PHC services. While routine treatment data for under-fives and pregnant women is captured using MoH reporting tools and entered into DHIS2, respondents raised concerns about inconsistent documentation practices and the limited visibility of data outside of MDA periods. A County NTD Officer in Trans Nzoia noted, "*We use tally sheets during MDA, but routine treatment is rarely recorded in DHIS2*," reflecting confusion over where different datasets are housed and who is responsible for reporting. Similarly, a health records officer in Kakamega explained, "*CHPs record in books; it doesn't get into the official system*," suggesting gaps in the flow of community-level data, especially from eCHIS, into national systems. These issues highlight a broader data reporting challenge that undermines planning, monitoring, and accountability.

4.3 Readiness Index for the mainstreaming of treatment into PHC services

The facility-level Readiness Index was used to assess structural and operational preparedness for integrating SCH/STH treatment into routine PHC services. Facilities were categorized as not ready, moderately ready, or ready based on a composite index measuring seven variables reflecting the essential components of mainstreaming: (i) provision of deworming services, (ii) mainstreaming into routine PHC activities, (iii) availability of laboratory testing, (iv) frequency of service provision, (v) staff training, (vi)

drug stock continuity, and (vii) number of people treated during the June-August 2025 treatment period (Table 7). Responses were scored from 0-10, where higher values represented stronger readiness, or rather structural and operational readiness. Facilities were then categorized as Not Ready (1-4 points), Moderately Ready (5-8 points), or Ready (9-10 points)

Across all sites, 54% of facilities were classified as moderately ready, 33% as not ready, and only 13% met the criteria for being fully ready. This distribution suggests that while many facilities have made progress toward mainstreaming, a significant proportion still lack the foundational capacity for full implementation, and only a few are optimally positioned to deliver integrated deworming services. Disaggregating the facilities by county showed that this distribution is consistent in all four counties (Table 8)

5 Discussion

This cross-sectional mixed-method study shows that integrating SCH/STH treatment into PHC services in Western Kenya is feasible. Generally, community perceptions to SCH/STH treatment benefits were found to be high across all groups. Qualitative data showed enhanced trust in the integrated model by virtue of the credibility and professional nature of PHC staff. A relatively low of the respondents reported concerns about SCH/STH treatment, and experiences with side effects especially from ingesting PZQ. These concerns and experiences could influence attitudes toward future treatment, especially in communities where such reactions are not clearly

explained or expected. This calls for strong health education and awareness through appropriate channels as part of the intervention package.

We found a shift away from traditional community campaign strategies as source of information on SCH/STH treatment, possibly reflecting reduced reliance on school-based mass drug administration or public mobilization through loudspeakers. CHPs remain a critical source of information for low-literacy populations, while media and health facilities are increasingly important among more educated groups. These findings are similar to those from a paper assessing barriers to participation in lymphatic filariasis MDAs in coastal Kenya (12). Strengthening the capacity of CHPs while also leveraging formal media platforms and health facility communication provides opportunities to ensure equitable access to information across the full spectrum of education levels. Indeed, the importance of awareness creation for the success of treatment campaigns has also been noted elsewhere (13).

We also found gaps in routine treatment, even with 100% nominal availability of treatment in the health facilities assessed. Qualitative interviews exposed the disruption of service delivery due to stockouts. This could be an artefact of the health facility assessments only capturing stock availability during the time of the assessment, whereas qualitative data reflects shortages that the community has experienced over a period of time. This pattern has also been documented in Tanzanian health facilities

where in over 30% of the cases, stockouts have exceeded 14days in spite of over 70% nominal availability (14).

An overwhelming majority of community members received treatment via household visits, showing a reliance on periodic campaigns for therapy. This gap appears to stem from multiple interrelated factors, including limited staff capacity, lack of consistent prioritization of SCH/STH treatment during routine care, and low public awareness that deworming services are available outside scheduled campaigns. This further reinforces the need to incorporate CHPs for health education and awareness creation in the integrated model. Lessons from Haiti's exemplary epidemiological coverage in nation-wide control efforts emphasize the importance of strong communication (14).

This study found that health worker training coverage across sites was highly variable and unstandardized, suggesting a critical challenge in workforce preparedness. In addition, a majority of facilities had no refresher trainings for their staff. This reinforces the appropriateness of health worker trainings as part of the intervention package. Evidence of the impact of in-job training to the capacity of facilities to prevent and control infectious diseases is abundant (15,16)

We also found moderate infrastructural and systemic readiness for treatment mainstreaming with respect to stock availability and data reporting systems. More work ought to be done to increase the efficiency of

service provision through PHC and increase the uptake of PHC based treatment. In particular, stock outs were reported among the facilities. This is common in literature especially for PZQ drugs, such as in Ghana (17) and Senegal (18). The findings highlight the need for efforts to strengthen commodity forecasting, distribution, and resupply systems-especially in facilities where deworming is being integrated into maternal, child health, and community outreach services. Addressing gaps in reporting will require standardized reporting processes, strengthened digital capacity among health workers, and promoting consistent use of available tools to ensure accurate and timely data for integrated deworming service delivery. Other major bottlenecks include training gaps among the health workers and workflow inconsistencies due to a lack of standard guidelines even in monitoring and reporting systems.,

Limited follow-up, poor linkage between CHPs and facilities, and lack of treatment availability at the point of referral were found to be potential barriers to mainstreaming. This explains why household surveys showed a high trust PHC systems while also having a low uptake of PHC-based deworming services. This shows that efficient systems are necessary in addition to perceived reliability for improved uptake. Strengthening of service delivery in PHC facilities would enable more effectiveness for mainstreaming.

5.1 Study Limitations

We acknowledge some limitations to our study given our study design and methodology. We collected data at the baseline with no follow-up, and therefore we are unable to establish causal relationships between any exposures and outcomes. Data collection through household surveys introduces self- report bias such as recall bias, especially since the participants are expected to reflect on mass drug administration campaigns happening years apart. In addition, the study was also prone to social desirability bias, given that we sought information on hygiene and health habits from the participants. There was also potential for reporting bias during health facility assessments that relied on interviews with facility in-charges. The findings of this study may not be generalizable over the entire study area given that the selected households and facilities might not be fully representative of the variations in mainstreaming feasibility. At the same, time the findings may not be generalizable beyond the four study counties especially as we employed a non-randomized controlled trial design. In addition, the qualitative insights, though valuable did not capture the insights of all stakeholders such as health workers within the facilities, local leaders and policymakers. This limits the comprehensiveness of insights into aspects such as the barriers and enablers for mainstreaming. Future investigations should seek to obtain insights from county health management teams on sustainable financing strategies to implement the intervention.

6 Conclusions

Overall, the findings underscore the need for a structured implementation package in future mainstreaming studies. Priority actions should include standardized operating procedures, supply chain and digital system strengthening, and expanded CHP-led outreach activities to improve consistency, access, and sustainability of deworming services within PHC platforms.

7 List of abbreviations

ANC – Antenatal Care

ALB – Albendazole

CHPs – Community Health Promoters

DEFF – Design Effect

DHIS2 – District Health Information System

eCHIS – electronic community health information system

FGDs – Focus Group Discussion

GPS – Global Positioning System

HRIO – Health Records and Information Officer

ICC – Intra-Cluster Correlation

IoT – Interruption of Transmission

KHIS – Kenya Health Information System

KIIs – Key Informant Interview

MBZ – Mebendazole

MDA – Mass Drug Administration

NTD – Neglected Tropical Diseases

PZQ – Praziquantel

PHC – Primary Healthcare

PHCF – Primary Healthcare Fund

PPS – Probability Proportional to Size

SCH – Schistosomiasis

STH – Soil Transmitted Helminthiases

8 Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the ethics committee of the University of Eastern Africa, Baraton (UEAB) Institutional Scientific and Ethics Review Committee (ISERC) on January 20, 2025 (Approval Reference Number: B1422192025). All procedures were carried out in accordance with the

Declaration of Helsinki and relevant local regulations. Informed consent was obtained from all participants or their legal guardians. Respondents were informed of their rights to refuse participation or withdraw at any point, and all information was kept confidential.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due to ethical restrictions on participant confidentiality but are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interest.

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Author Contributions

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YO: Conceptualization, Funding acquisition, Methodology, Project administration, Resources, Validation, Writing – review & editing.

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Tables

Table 1: Sociodemographic characteristics of respondents

County of residence	**Total(N=1229)**	**Control (N=600)**	**Intervention (N=629)**	**P-values**
Bungoma	385(31%)	192(50%)	193(50%)	0.758
Kakamega	410(33%)	205(50%)	205(50%)	
Transnzoia	210(17%)	97(46%)	113(54%)	
Vihiga	224(18%)	106(47%)	118(53%)	

Gender of the respondent				
Male	390(32%)	185(47%)	205(53%)	0.508
Female	839(68%)	415(49%)	424(51%)	
Age categories (Yrs)				
18-24	34(3%)	17(50%)	17(50%)	0.395
25-34	239(19%)	111(46%)	128(54%)	
35-44	283(23%)	133(47%)	150(53%)	
45-54	262(21%)	140(53%)	122(47%)	
55-64	184(15%)	82(45%)	102(55%)	
Above 64	227(18%)	117(52%)	110(48%)	
Household size				
1 - 3 people	222(18%)	100(45%)	122(55%)	0.424
4 -6 people	628(51%)	315(50%)	313(50%)	
Above 6 people	379(31%)	185(49%)	194(51%)	
Level of education				
No formal education	337(27%)	172(51%)	165(49%)	0.098
Primary school	520(42%)	237(46%)	283(54%)	
Secondary school	255(21%)	138(54%)	117(46%)	
University	117(10%)	53(45%)	64(55%)	
Main source of income				
Business	216(18%)	109(50%)	107(50%)	0.145
Daily wage labor	295(24%)	126(43%)	169(57%)	
Farming	594(48%)	300(51%)	294(49%)	
Salaried job	87(7%)	48(55%)	39(45%)	
Others	37(3%)	17(46%)	20(54%)	

Presence of drinking water				
No	81(7%)	35(43%)	46(57%)	0.296
Yes	1148(93%)	565(49%)	583(51%)	
Type of sanitation facility				
Flush toilet	34(3%)	26(76%)	8(24%)	0.010
Open defecation	7(1%)	3(43%)	4(57%)	
Other (specify)	6(0%)	2(33%)	4(67%)	
Pit latrine	1182(96%)	569(48%)	613(52%)	

p-values obtained from Chi-square tests for categorical values at α = 0.05

Table 2: Definitions of feasibility constructs, measurement and variables.

Feasibility Domain	Definition	Measurement	Variables	Data Source
Processes	Standard workflows and procedures for SCH/STH treatment delivery.	Availability of SCH/STH treatment at facility; health worker trainings and refresher trainings on SCH/STH treatment	Community awareness; mean number of HWs trained per facility; proportion of facilities conducting refresher trainings	Community survey, health facility assessment
Infrastructure	Health system resources in stock availability for SCH/STH treatment	Stock availability audit within PHC facilities. Proportion of facilities and CHPs using data reporting	Facility offers deworming services; Household has safe drinking water; Improved sanitation; Number of trained staff;	Health facility assessments, household survey

		systems for treatment monitoring	Recent drug stock-outs	
Perceptions	Beliefs and attitudes about SCH/STH treatment	Proportions of study population: (1) reporting awareness, (2) affirming perception of deworming benefits, (3) reporting concerns about treatment, and (4) reporting an experience of side effects from SCH/STH treatment	Believes deworming improves health; Recognized benefits (nutrition, growth, school); Treatment concerns (safety, side effects)	Household survey and community FGDs
Acceptability	Perception that mainstreaming is agreeable and satisfactory	Preferred treatment locations; tolerance of side effects	Preferred place for treatment (PHC/community/school); Experienced side effects; Safety concerns	
Trust	Confidence in providers/systems within an integrated system to deliver the	Primary information sources, household decision-makers	Main source of deworming information (health workers/community leaders); Who decides household	Household survey, KIIs

	intervention effectively		treatment participation	
Barriers	Obstacles hindering the mainstreaming of SCH/STH treatment into PHC	Reasons for missing treatment; community concerns; facility supply issues	Reasons household missed treatment (absence, refusal, distance); Community treatment concerns; Facility drug stock-outs	Household survey, facility assessment
Facilitators	Factors enabling mainstreaming	Training coverage; routine service mainstreaming; recognized benefits	Households previously treated; Facility offers routine services alongside deworming; Community recognizes treatment benefits	Facility assessment, household survey
Readiness	Health facilities capacity for routine delivery of SCH/STH treatment.	Composite readiness score (7 indicators)	Facility readiness index: Offers deworming + Integrated services + Trained staff + Refresher training + No stock-outs + Outreach conducted + Daily treatment capacity	Facility assessment

Table 3: Sources of Information on SCH/STH Treatment

Level of education	**Control**								
	CHP	**Community meetings**	**Health facility**	**Media**	**Public criers**	**School**	**Other**	**Total**	**P-values**
No formal education	84(54%)	28(18%)	13(8%)	19(12%)	7(4%)	2(1%)	3(2%)	156(28%)	<0.001

Primary school	107(49%)	17(8%)	38(17%)	33(15%)	11(5%)	5(2%)	7(3%)	218(40%)	
Secondary school	48(38%)	17(13%)	28(22%)	25(20%)	5(4%)	4(3%)	1(1%)	128(23%)	
University	22(47%)	3(6%)	4(9%)	9(19%)	3(6%)	6(13%)	0(0%)	47(9%)	
Total	**261 (48%)**	**65(12%)**	**83(15%)**	**86(16%)**	**26(5%)**	**17(3%)**	**11(2%)**	**549(100%)**	
Level of education	**Intervention**								
	CHP	**Community meetings**	**Health facility**	**Media**	**Public criers**	**School**	**Other**	**Total**	**P-values**
No formal education	64(46%)	32(23%)	19(14%)	19(14%)	2(1%)	1(1%)	3(2%)	140(25%)	0.010
Primary school	111(44%)	49(19%)	32(13%)	49(19%)	9(4%)	2(1%)	1(0%)	253(45%)	
Secondary school	37(33%)	17(15%)	23(21%)	23(21%)	5(5%)	4(4%)	2(2%)	111(20%)	
University	11(20%)	9(16%)	16(29%)	13(24%)	3(5%)	2(4%)	1(2%)	55(10%)	
Total	**223 (40%)**	**107(19%)**	**90(16%)**	**104(19%)**	**19(3%)**	**9(2%)**	**7(1%)**	**559(100%)**	

p-values obtained from Chi-square tests for categorical values at α = 0.05

Table 7: Comparison of Mean Facility Readiness Scores Between Control and Intervention Arms (Two-Sample t-Test)

Group	**Observations**	**Mean**	**Std.Err**	**Std. Dev.**	**95% Conf. Interval**	**P-values**

Control	12	4.17	0.41	1.40	3.27	5.06	0.648
Intervention	12	4.42	0.36	1.24	3.63	5.20	
Combined	24	4.29	0.27	1.30	3.74	4.84	
Diff	-0.25	0.54	-1.37	0.87			

p-values obtained from Chi-square tests for categorical values at α = 0.05

Table 8: : Comparison of Mean Facility Readiness Scores Across Counties

County	**Arm**	**Baseline n(%)**			
		Not Ready	**Moderately Ready**	**Ready**	**Total**
Bungoma	Control	1 (25%)	3 (75%)	0 (0%)	4 (100%)
	Intervention	2 (50%)	1 (25%)	1 (25%)	4 (100%)
Subtotal		**3 (38%)**	**4 (50%)**	**1 (13%)**	**8 (100%)**
Kakamega	Control	2 (50%)	1 (25%)	1 (25%)	4 (100%)
	Intervention	1 (25%)	3 (75%)	0 (0%)	4 (100%)
Subtotal		**3 (38%)**	**4 (50%)**	**1 (13%)**	**8 (100%)**
Trans Nzoia	Control	1 (50%)	0 (0%)	1 (50%)	2 (100%)
	Intervention	0 (0%)	0 (0%)	2 (100%)	2 (100%)
Subtotal		**1 (25%)**	**3 (75%)**	**0 (0%)**	**4 (100%)**
Vihiga	Control	1 (50%)	1 (50%)	0 (0%)	2 (100%)
	Intervention	0 (0%)	1 (50%)	1 (50%)	2 (100%)
Subtotal		**1 (25%)**	**2 (50%)**	**1 (25%)**	**4 (100%)**
Overall	Control	5 (42%)	6 (50%)	1 (8%)	12 (100%)
	Intervention	3 (25%)	7 (58%)	2 (17%)	12 (100%)

Total	**8 (33%)**	**13 (54%)**	**3 (13%)**	**24 (100%)**