Kenya National School Based Deworming Programme

Year 4 (2016) Impact Analysis

Technical Report Based on Data Collected Between 6th January and 21st July 2016

19th April, 2017

Executive Summary

The impact of the Kenya's national school-based deworming programme is monitored in a five year (2012-2017) monitoring and evaluation (M&E) programme consisting of pre-post intervention and repeated cross-sectional surveys. The specific objectives of the evaluation are to understand what the long-term impact is on Soil Transmitted Helminths (STH) and schistosomiasis prevalence and intensity, as well as annual programme effectiveness in terms of reductions in prevalence and intensity.

Here we present the report for the year 4 results of the M&E programme showing the impact of the school-based deworming programme at the national level. The survey consisted of 60 schools surveyed for pre-MDA assessment and 48 schools surveyed after the fourth mass drug administration (MDA) delivery. However, 12 schools from Homabay, Kisumu and Migori counties were not surveyed during the post-MDA assessment due to last-minute changes in the treatment schedule. This was accounted for and is made clear in the analysis.

In the 48 schools, the STH combined pre-MDA prevalence was 18.8% with *A. lumbricoides* 14.6%, *T. trichiura* 4.2% and hookworm 2.6%. After treatment, the post-MDA prevalence reduced to; 5.8%, 1.8%, 3.7%, and 1.0% for STH combined, *A. lumbricoides, T. trichiura*, and hookworm respectively. These translated to an immediate statistically significant reduction in prevalence of 69.1%, 87.6%, 11.9% and 60.8% for STH combined, *A. lumbricoides*, *T. trichiura* and hookworm respectively.

Similarly, based on 48 schools, the year 4 pre-MDA prevalence of schistosome infections were; 1.8% and 3.0% for *S. mansoni* and *S. haematobium* respectively and after treatment the prevalence were; 1.2% and 5.3% respectively for *S. mansoni* and *S. haematobium*. It is of note that at such low levels of prevalence, the current diagnostic techniques are not sufficient. Newly available more accurate diagnostics will be used in Year 5 for *S. mansoni*.

Key performance indicators (KPI) for overall and immediate infection prevalence reduction, and prevalence of moderate to heavy infection were used to assess the progress of the programme. For any STH infection, a target of 60% immediate reduction in prevalence was set; in year 1 the actual immediate reduction was 73.5%, in year 2 the actual reduction in prevalence was 68.5%, year 3 it was 60.8% and year 4 it was 62.8%. Immediate reductions in prevalence of moderate to

heavy intensity of any STH infections were: year 1 (89.9%), year 2 (91.3%), year 3 (86.7%), and year 4 (90.4%), showing improvements compared to the target of 60%. For any schistosome infection, the target for immediate reduction in prevalence was also 60%, whereas the actual immediate reduction in prevalence being poorly achieved as follows: Year 1 (not done), year 2 (56.0%), year 3 (42.9%), and year 4 (increased). However, the programme has nearly achieved its target of 60% for the yearly reduction in prevalence of moderate to heavy intensity of schistosome infections as follows: Year 1 (20.4%), year 2 (73.3%), year 3 (85.9%), and year 4 (50.4%).

The findings of the M&E programme after four rounds of MDA indicate that STH infections have continued to decline from baseline infection level of 33.6% to mid-term infection level of 18.6%, and eventually to 15.9% at Y4 pre-MDA with overall significant baseline to Y4 pre-MDA relative reduction of 52.1% for any STH. Despite the staggered treatment for schistosome infections, there has been a significant decline in prevalence for any schistosome infection from 37.9% in baseline to 9.4% in year 4 pre-MDA which translates to an overall significant baseline to Y4 pre-MDA relative reduction of 64.9%.

Implications: The immediate relative reductions reported here are within the expectations in a national deworming programme and provide an indication that the programme is working. While the evaluation was not powered to detect county-level changes, looking at county level results shows heterogeneity in programmatic impact, which is consistent with other research that is finding hot spots that may merit much more intensive programmatic interventions to get to the goal of morbidity control and transmission break. It is also obvious that, of the STHs, children are getting re-infected with *A. lumbricoides* very rapidly, eroding the gains made by immediate reductions due to drug administration. This has implication of adding additional, more intense interventions. Additionally, as shown below, not covering other age groups and non-enrolled children is likely to be leaving reservoirs of infection in those groups. The evaluation was not designed to look at levels of infection in those groups, but there are indications in the data that younger children tend to have higher moderate-to-heavy infections. The programmatic implication is to increase coverage, the implication for evaluation is to start looking at infection levels in groups beyond school-attending children – these recommendations will be discussed as the programme plans for new stage of implementation.

Finally, we note that drug therapy alone to school age children is only a short term measure of reducing worm infection and reinfection. In fact, several mathematical models suggest that long-term control measures lie in concomitantly improving the quality of the water supply, sanitation and hygiene (WASH) and hygiene education in schools, alongside treatment of the neglected groups of the population i.e. the pre-school aged children and the adult populations. Post year five, the program should be scaled to more explicitly target and cover the non-enrolled children, the adult population, and the under-fives since they seem to act as reservoir for infection, if the infection transmission interruption is to be realized. We additionally recommend studies to be conducted after year five of the programme to accurately measure drug efficacy and detect potential emergence of drug resistance to albendazole and praziquantel.

Sampling considerations and changes since inception report: We note that this study was designed based on the old administrative units (provinces/regions), the sample size was not therefore statistically powered to carry out estimation at the county level (new administration units). However, this study rides on the advantage that these new administrative units were formed by combining several districts together. Nonetheless, we have still summarized our results by these defunct regions.

Introduction

From the year 2012, the ministries of health and of education of Kenya started to deworm all school – age children who live in 66 districts (now sub counties) identified as having a high prevalence of soil-transmitted helminths (STH) and schistosome infections to warrant mass drug administration as per the WHO guidelines in four regions (Western, Nyanza, Rift Valley and Coast). The impact of the Kenya's school-based deworming is monitored in a five year (2012-2017) monitoring and evaluation (M&E) programme including pre-post intervention and repeated cross-sectional surveys as outlined in figure 1.

The repeat cross-sectional surveys are conducted in a representative, stratified, two-stage sample of schools across Kenya. Sub counties stratification was based on both geography and anticipated infection prevalence. The programme contains three tiers of monitoring: i) a national baseline survey including 200 schools in 20 sub counties which aims to establish an accurate

national measurement of infection levels; ii) surveys conducted pre and post intervention (pre-post surveys), which monitor 60 of the 200 schools before and immediately after the deworming activity to evaluate reductions in infections that can be directly attributed to programme implementation.

Both the year four pre- and post-MDA surveys were done in two sets, all approximately one month before the year 4 treatment dates. At the 1st treatment date (25th February, 2016), 27 schools were surveyed between 6th – 28th January, 2016 for pre-MDA and between 2nd – 20th March, 2016 for post-MDA. While during the 2nd treatment date (26th May, 2016), 33 schools were surveyed between 9th – 25th May, 2016 for pre-MDA and between 4th – 21st July, 2016 for post-MDA.

This report therefore presents the survey results of 60 schools surveyed from 16 counties for year 4 pre-MDA assessment in Western, Nyanza, Rift Valley, and Coast regions and 48 schools surveyed from 13 counties after fourth MDA delivery in the same regions, with comparison to previous surveys since baseline. However, 12 schools from Homabay, Kisumu and Migori counties were not surveyed during the post-MDA assessment due to mixed up in the treatment schedule.

Results

Overall 11,310 children with mean age of 9.6 years (2 – 24 years) were surveyed in both pre- and post-MDA surveys as shown in table 1. All the pre-MDA surveys were conducted approximately one year after year 3 MDA delivery and post-MDA surveys were conducted 4-34 days after the year 4 MDA delivery.

Soil Transmitted Helminths (STH)

STH year-on-year reduction in prevalence and mean intensity based on 172 schools and 59 schools

During baseline survey in 172[1] schools, the combined STH prevalence was 33.6% (95%CI: 31.2-36.2), with *A. lumbricoides* most prevalent 20.7% (95%CI: 18.3-23.5) followed by hookworm 15.2% (95%CI: 13.2-17.4) and *T. trichiura* 6.3% (95%CI: 5.0-8.0). In the year 3 mid-term survey after two rounds of MDA, the overall STH prevalence dropped to 18.6% (95%CI: 16.4-21.0); with 13.8% (95%CI: 12.0-15.9), 2.4% (95%CI: 1.8-3.2), and 5.0% (95%CI: 3.7-6.8) for *A. lumbricoides*, hookworms and *T. trichiura* respectively. Similarly, the baseline and mid-term mean intensities are as shown in table 2. This table, further gives the overall reduction in prevalence and mean intensity for any STH from baseline to mid-term as 44.7% ($p<0.001$) and 43.3% ($p<0.001$) respectively.

Additionally, based on 59 schools, table 5 gives the prevalence and relative reductions in prevalence of STH infections from Y1 pre-MDA to Y4 post-MDA with the overall reduction in prevalence and mean intensity of any STH from Y1 pre- to Y4 pre-MDA being 52.1% ($p<0.001$) and 32.6% ($p=0.004$) respectively.

STH immediate reductions in prevalence and mean intensity based on 59 schools

a) Year 4 prevalence, mean intensity and relative reductions based on 48 schools

Table 3 and 4 respectively outlines the overall and county prevalence and mean intensities of STH combined and species specific infections based on the 48 schools for year 4 data. In the remaining 48 schools, the combined STH pre-MDA prevalence was 18.8% (95%CI: 15.1-23.4), with *A. lumbricoides* most prevalent at 14.6% (95%CI: 11.2-19.0) followed by *T. trichiura* 4.2% (95%CI: 2.6-7.0) and hookworm 2.6% (95%CI: 1.8-4.0). Similarly, the pre-MDA mean intensity

[1] In the Coast region, year two treatment was delivered only 1 month before the Y3 surveys, therefore 27 schools were excluded from the analysis to prevent an overestimation of treatment impact as the time for potential reinfection was much shorter than for the other schools, also 1 school was replaced since the baseline survey in Bungoma County and was therefore excluded together with the replacement school to allow for comparability with subsequent surveys.

for specific species was highest for *A. lumbricoides* 1397 epg (95%CI: 1010-1931) followed by hookworm 40 epg (95%CI: 14-119) and *T. trichiura* 24 epg (95%CI: 7-76).

For post-MDA, the combined STH prevalence reduced to 5.8% (95%CI: 4.2-8.0). *T. trichiura* was the most prevalent specific species 3.7% (95%CI: 2.5-5.7) with mean intensity of 12 epg (95%CI: 7-23) followed by *A. lumbricoides* 1.8% (95%CI: 1.1-3.0) with mean intensity of 114 epg (95%CI: 51-256) and hookworm 1.0% (95%CI: 0.6-1.8) with mean intensity of 2 epg (95%CI: 1-5).

The prevalence of STH combined significantly reduced by 69.1% ($p<0.001$) immediately after year 4 MDA delivery, with *A. lumbricoides* showing the highest reduction of 87.6% ($p<0.001$) followed by hookworm 60.8% ($p<0.001$) and *T. trichiura* 11.9% ($p=0.377$) which was however insignificant.

Though, the study was not statistically powered at county level, it is worth mentioning that after the fourth round of MDA; Kilifi, Bungoma and Taita Taveta counties had their prevalence for any STH reduced to ≤ 1%, with 9 counties reducing their hookworm prevalence to below 1%, and similarly 7 and 5 counties reduced their *T. trichiura* and *A. lumbricoides* prevalence to below 1% respectively.

b) Prevalence and immediate relative reduction trend: Year 1 to 4 based on <u>59 schools</u>

Table 5 summarizes the prevalence and immediate relative reduction of STH combined and specific species since year 1 based on 59 schools. The overall prevalence of each specific species has declined over the four years to below 4%, and below 6% for STH combined. The immediate reductions in prevalence since baseline is as follows: For year 1 (STH combined: 73.5%, hookworm: 80.4%, *A. lumbricoides*: 88.2%, and *T. trichiura*: 20.3%), year 2 (STH combined: 68.5%, hookworm: 50.3%, *A. lumbricoides*: 85.5%, and *T. trichiura*: 48.5%), year 3 (STH combined: 60.8%, hookworm: 26.1%, *A. lumbricoides*: 77.7%, and *T. trichiura*: 24.1%) and year 4 (STH combined: 68.5%, hookworm: 60.9%, *A. lumbricoides*: 87.3%, and *T. trichiura*: 11.6%). The trend in prevalence of the STH infections since year 1 to 4 is shown in figure 2.

c) Prevalence of light, moderate and heavy intensity of infections: Year 1 to 4 based on 59 schools

Table 6 outlines the prevalence of light, moderate and heavy intensity of infections from year 1 to 4 based on data for 59 schools. The prevalence of both light, moderate and heavy infections have tremendously reduced since baseline with an overall reduction as follows: For STH combined (light: 78.7%, moderate: 92.4%, heavy: 74.1%), for hookworm (light: 93.6%, moderate: 92.8%, heavy: 100%), for *A. lumbricoides* (light: 88.5%, moderate: 93.7%) and *T. trichiura* (light: 32.8%). However, there were no reductions in moderate and heavy infections for *T. trichiura*.

Table 7 shows a general declining trend in the prevalence of moderate to heavy intensity of infections from year 1 to year 4. At baseline the prevalence of moderate to heavy intensity of infections for any STH was 8.4% but after four rounds of MDA delivery, this reduced to 0.7%. Similarly, substantive reductions were seen for hookworm (baseline: 0.4% and Y4 post-MDA: 0%) and *A. lumbricoides* (baseline: 8.0% and Y4 post-MDA: 0.5%) but not for *T. trichiura* which instead had increased by half over the four years. The trend in prevalence of moderate to heavy intensity of STH infections since year 1 to 4 is shown in figure 2.

d) Re-infections since year 1 to 4 based on 59 schools

Table 8 outlines the re-infections in prevalence and mean intensity from year 1 to 4 based on the data for 59 schools. After one year of MDA delivery, the re-infection in prevalence for STH combined was 14.0% with *A. lumbricoides* showing the highest re-infection levels of 7.5%, followed by *T. trichiura* at 4.8% and hookworm at 3.9%. However, after four years of MDA delivery, the re-infection levels didn't reduce significantly with the STH combined re-infection in prevalence being 11.2% (*A. lumbricoides* was 7.4%, *T. trichiura* 3.1% and hookworm 2.2%).

Changes in STH prevalence and mean intensity of infections by regions

Changes in prevalence and mean intensity of STH infections were also assessed by the former regions (Coast, Nyanza, Rift Valley and Western) of Kenya, and the results summarized in tables 9 and 10.

During baseline, the STH combined prevalence was 24.2% (95%CI: 19.9-29.4) for Coast, 30.6% (95%CI: 27.0-34.6) for Nyanza, 36.3% (95%CI: 30.4-43.4) for Rift Valley and 38.6% (95%CI: 34.9-42.7) for Western region. At year four pre-treatment the prevalence dropped to 5.8%, 13.3%, 25.5% and 22.4% for Coast, Nyanza, Rift Valley and Western regions respectively.

Generally, hookworm infections were found to be common in Western region, (OR = 1.12, p=0.002) than the rest of the regions, with *T. trichiura* significantly common in R. Valley (OR = 2.63, p<0.001) and Western (OR = 1.33, p<0.001) regions. However, *A. lumbricoides* was found to be significantly common in all the regions.

Schistosomiasis

Stool samples were examined for *S. mansoni* infections in all the 16 counties in Western, Nyanza, Rift valley and Coast regions, while urine samples were examined for *S. haematobium* infections in 4 counties in the Coast region with the overall and county infection levels shown in tables 11 and 12.

Schistosomiasis year-on-year reduction in prevalence and mean intensity based on 172 schools

Table 13 provides the overall prevalence, average intensity of infection and relative reductions from baseline to Y4 post-MDA. Baseline prevalence based on 172 schools were in overall low with a prevalence of 2.4% (95%CI 1.5-4.1) with average intensity of 14 epg (95%CI 5-41) for *S. mansoni* and a prevalence of 18.0% (95%CI: 13.0-24.9) with average intensity of 20 epg (95%CI: 11-39) for *S. haematobium*. This dropped, after two years of programme implementation, to a prevalence of 1.7% (95%CI: 0.8-3.6) with average intensity of 6 epg

(95%CI: 2-16) for *S. mansoni* and 7.9% (95%CI: 3.8-16.2) with average intensity 7 epg (95%CI: 3-16) for *S. haematobium* in the year 3 mid-term survey. This translated to a non-significant prevalence reduction of 28.6% (p=0.105) for *S. mansoni* and a significant reduction of 56.2% (p=0.039) for *S. haematobium*, table 13.

Additionally, based on 59 schools, table 12 gives the prevalence and relative reductions in prevalence of schistosome infections from Y1 pre-MDA to Y4 post-MDA with the overall reduction in prevalence of any schistosome infections from Y1 pre- to Y4 pre-MDA being 64.9% (p=0.005).

Schistosomiasis immediate reductions in prevalence and mean intensity based on 59 schools

Comparison for both year 4 pre- and post-MDA surveys analysis were similarly based on 48 schools. The overall pre-MDA prevalence for *S. mansoni* and *S. haematobium* were 1.8% (95%CI: 0.4-7.8) and 3.0% (95%CI: 0.7-12.8) respectively with respective mean intensity of infections of 7 epg (95%CI: 2-33) and 3 epg (95%CI: 1-18), while for the post-MDA, the overall prevalence for *S. mansoni* and *S. haematobium* were 1.2% (95%CI: 0.4-3.4) and 5.3% (95%CI: 1.9-14.7) respectively and with respective mean intensity of infections of 4 epg (95%CI: 1-13) and 2 epg (95%CI: 1-7). *S. mansoni* showed an immediate insignificant reduction in both prevalence and mean intensity of 33.0% and 40.1% respectively whereas *S. haematobium* showed an insignificant reduction in mean intensity of 25.0% but an increase in prevalence.

Despite the staggered treatment for schistosomiasis, after four years of programme implementation, the overall prevalence of *S. mansoni* has been reduced to zero levels in the following counties; Bomet, Kericho, Mombasa, Nyamira and Taita taveta. The overall prevalence of *S. haematobium* has also been reduced to zero in Mombasa and Taita Taveta counties, see table 11.

Comparisons from year one of the pre- and post-MDA prevalence for any schistosome infections and for specific species show that prevalence has in overall reduced, see figure 3. Specifically, after four years the overall prevalence of any schistosome infection has significantly reduced by 66.8% (p=0.005) and the specific species has also reduced by 70.7% (p=0.042) and 32.5%

(p=0.337) for *S. haematobium* and *S. mansoni* respectively since year 1 pre-MDA to year 4 post-MDA. The immediate pre- and post-MDA significant reductions in prevalence for any schistosome infections was seen in year 2 (RR = 56.0%, p=0.001) and year 3 (RR = 42.9%, p=0.044) but not in year 1 and year 4, see table 12.

The prevalence of light, moderate and heavy intensity of schistosome infections based on 59 schools from year 1 to 4 is detailed in table 14. In overall, the relative reduction in prevalence of light, moderate and heavy intensity of infections for *S. mansoni* from Y1 pre-MDA to Y4 post-MDA has been insignificant; 23.4% (p=0.507), 30.5% (p=0.643) and 53.4% (p=0.184) respectively for light, moderate and heavy intensity. Similarly, for *S. haematobium*, the overall prevalence of light and heavy intensity reduced by 19.5% (p=0.002) and 72.2% (p=0.080) respectively. Figure 3 shows the trend in prevalence of moderate to heavy intensity of schistosome infections since year 1 to 4.

Table 15 outlines the re-infection levels in prevalence and mean intensity of any schistosome infections and specifically for *S. mansoni* and *S. haematobium* from year 1 to 4 based on data for 59 schools. Re-infections in prevalence has significantly remained high for any schistosome infections since baseline, the re-infection rates for any schistosome infections were; 21.9%, 10.8% and 8.9% after year 1, 2 and 3 MDA deliveries respectively. The re-infection rates for *S. haematobium* has for the last three MDAs been high compared to those for *S. mansoni*.

Changes in Schistosomiasis prevalence and mean intensity of infections by regions

Table 16 shows the changes in prevalence and mean intensity of *S. mansoni* infection by the former regions (Coast, Nyanza, Rift Valley and Western) of Kenya, with *S. haematobium* being examined only at the Coast region.

During baseline, the *S. mansoni* prevalence was 0% for Coast, 2.8% (95%CI: 1.5-5.0) for Nyanza, 0.4% (95%CI: 0.1-2.5) for Rift Valley and 4.2% (95%CI: 1.9-9.2) for Western region. At year four pre-treatment the prevalence insignificantly dropped to 0%, 1.1%, and 0.3% for Coast, Nyanza, and Rift Valley regions respectively, with Western region showing insignificant increase in prevalence to 4.8%.

The prevalence of *S. haematobium* was 14.8% (95%CI: 11.3-19.5) at baseline in the Coast region which significantly dropped to 3.0% (95%CI: 0.1-12.8) at year 4 pre-treatment assessment.

Generally, Western (OR = 8.81, p<0.001) and Nyanza (OR = 3.39, p<0.001) regions are still significantly likely to be prone to *S. mansoni* infection compared to the Coast region.

Discussion

This report has largely focussed on the analysis of the 60 schools category from baseline to year four post-MDA delivery, with the overall prevalence and mean intensity also given for the 200 schools category done during baseline and year three midterm surveys. Notably, the prevalence and mean intensity of combined and species specific infections have decreased significantly from baseline to year four post-MDA despite reinfections still occurring between treatments.

At the initial level (baseline results), the STH prevalence were 33.6%, 15.2%, 20.7% and 6.3% for STH combined, hookworm, *A. lumbricoides* and *T. trichiura* respectively, these however, dropped to 5.9%, 1.1%, 1.9% and 3.8% respectively after four rounds of MDA, showing an impressive significant relative reduction for any STH infection specific species. The results are a pointer to the efficacy of the single-dose oral albendazole given to the school children once every year. During the year four surveys, the immediate relative reductions in prevalence of STH from pre- to post-MDA were; 69.1%, 60.8%, 87.6% and 11.9% for any STH and specific species of hookworm, *A. lumbricoides* and *T. trichiura* infections respectively. Other studies which have assessed the efficacy of single-dose oral albendazole against hookworm, *A. lumbricoides* and *T. trichiura* infections from various parts of the world have come up with broadly comparable findings for the immediate reduction rates of 72%, 88% and 28% respectively [1], but potentially warranting some exploration into resistance for *A. lumbricoides* – it is recommended that it is added to the evaluation in subsequent years. The predominance of other species over *T. trichiura* may indicate that the single-dose albendazole schedule currently used for deworming is less effective for reducing trichuriasis since this parasite is less susceptible to this drug [1], [2].

The prevalence of moderate to heavy intensity of infection has also significantly dropped after the four rounds of MDA from an initial level of 8.4% to 6.8%. However, *T. trichiura* did not

record a drop in the prevalence of moderate to heavy intensity. Remarkably, the within-year reduction of the prevalence of moderate to heavy intensity of infection for any STH was all time greater than 86.7%. This decline shows that the program has managed to reduce the morbidity associated with both hookworm and *A. lumbricoides* infections among the school children for some months during the year. Unfortunately, that gain has been almost erased for *A. lumbricoides* due to rapid reinfection.

During the four years, the program has recorded reinfections for any STH and for specific species after each treatment round. These reinfections have been high in *A. lumbricoides*. A systematic review and meta-analysis on STH reinfection after mass treatment by Jia T. *et al*. [3], reported similar findings on reinfections among 42 studies on STH around the world. They concluded that reinfections occur rapidly after treatment, particularly for *A. lumbricoides* and *T. trichiura.* Hence, there is a need for frequent anthelmintic drug administration to maximize the benefit of preventive chemotherapy. Additionally, integrated control approaches emphasizing health education, and WASH are needed to interrupt transmission of STH infections. Further, a cross-sectional study on STH reinfection and associated risk factors among school-age children in Southern Ethiopia [4], reported similar findings on STH reinfections, *A. lumbricoides (*reinfection of 23.8%*), T. trichiura (*reinfection of 16.2%*)* and hookworm (reinfection of 1.0%).

Even though this study was not statistically designed to show the treatment impact at county level, after four rounds of MDA, counties have variedly reduced STH infections with some counties instead showing increase in infections. Three counties; Bungoma, Kisii and Nyamira, had significantly reduced any STH infection by over 90%, four counties (Kakamega, Kericho, Kisii and Nyamira) had significantly reduced hookworm infection by over 90%. While six counties; Bungoma, Kakamega, Kisii, Mombasa, Narok and Nyamira, reduced *A. lumbricoides* infection by over 90%. However, *T. trichiura* infection was reduced by over 90% in only Bungoma County. The variations in counties are likely due to specific epidemiological situation, geographical heterogeneity, initial prevalence levels/worm burden, different transmission intensities, as well as differing drug uptake and compliance in each county, these further affects the reinfection rates. Additionally, county-specific reduction may not be authoritatively arrived at, since the currently used diagnostic method (Kato Katz) would not probably be sensitive to detect a significant reduction in infection prevalence when the prevalence is less than 1%.

Treatment for both schistosome infections has not been consistent since baseline, though, during year four of the programme this treatment was offered. This complicates comparison of the observed prevalence and intensity of schistosome infections over the four years of the programme implementation. This challenge notwithstanding, the programme has reduced the prevalence of schistosome infections from baseline level. Though, reinfection of both schistosome infections is still an issue, this could not be conclusively determined due to the haphazard treatment schedule. The programme noted high reinfection rates for any schistosome infections, with the reinfection rates being higher for *S. haematobium* than *S. mansoni*.

The reduction in prevalence for both schistosome infections has been similarly varying by county. The overall prevalence of *S. mansoni* has been reduced to zero levels in the following counties; Bomet, Kericho, Mombasa, Nyamira and Taita Taveta, while the overall prevalence of *S. haematobium* has only been reduced to zero in Mombasa and Taita Taveta counties. However, after the fourth MDA delivery, prevalence of any of the schistosome infections increased in Kakamega, Kilifi, Kwale and Vihiga counties. This increase in infection in four counties should be a cause for concern in the wake of inconsistence treatment schedule witnessed throughout the program period. This is also consistent with data seen in other countries, where 'hot spots' or areas of persistent reinfection despite intensive treatment have been found.

Even though it might not be feasible to implement a different preventive chemotherapy regimen before end of year five of the program, it is vital to be vigilant of the different patterns of transmission of individual STH and schistosome species [5]. Post year five, it would be useful to conduct studies to accurately measure drug efficacy and detect potential emergence of drug resistance to albendazole and praziquantel [6]–[8].

We established that parasite infections for any STH and any schistosome were more prevalent in younger (ECD) children than older children (table 17), underscoring the inadequate deworming delivered to this group of school children, this might also point to the higher levels of infection among the non-enrolled children. Post year five, the program should be scaled to cover the non-enrolled children, the adult population and pre-school children since they seem to act as reservoir for infection, if the infection interruption is to be realized.

Further, we also note that hookworm infection is still common in Western region, *T. trichiura* still common in Rift Valley and Western regions, and *S. mansoni* in Western and Nyanza regions. However, *A. lumbricoides* is common in all the regions.

Methods of Analysis

Infection prevalence and average intensity of infections were calculated for STH combined and separately for each specific species using STATA 14. Intensity of infections was defined according to WHO guidelines [9]. Confidence intervals for prevalence and average intensity of infections were obtained using binomial and negative binomial regression models, respectively, adjusting for school clustering.

Relative reductions in prevalence and average intensity of infections were estimated by binomial regression and negative binomial regression, respectively, taking into account school clusters and the likelihood ratio test (LRT) p-values obtained using multivariable mixed effects models with random intercepts for schools and counties implemented in R software. Graphs were developed using the ggplot package implemented in R software.

Conclusion

We note that drug therapy alone is only a short term measure of reducing worm infection and reinfection. In fact, several studies suggest that in all but low transmission settings, the treatment of school-aged children alone is unlikely to drive transmission to a level where the parasites cannot persist [10]. Long-term control measures lie in concomitantly improving the quality of the water supply, sanitation and hygiene (WASH) and hygiene education in schools.

References

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Appendix

Table 1: Number of schools and children examined by County in year 4

	Pre-MDA		Post-MDA	
County	Number of schools	Number of children	Number of schools	Number of children
BOMET	3	316	3	323
BUNGOMA	3	313	3	306
BUSIA	6	643	6	626
HOMA BAY	6	635	-	-
KAKAMEGA	6	623	6	618
KERICHO	3	315	3	321
KILIFI	3	322	3	312
KISII	3	320	3	323
KISUMU	3	323	-	-
KWALE	6	643	6	621
MIGORI	3	317	-	-
MOMBASA	3	278	3	289
NAROK	3	323	3	324
NYAMIRA	3	301	3	322
TAITA TAVETA	3	319	3	318
VIHIGA	3	304	3	312
Total	60	6,295	48	5,015

Table 2: Overall prevalence, average intensity of infection and relative reductions

Survey	STH combined	Hookworm	*A. lumbricoides*	*T. trichiura*
Y1 baseline* Prevalence (%):	33.6 (31.2-36.2)	15.2 (13.2-17.4)	20.7 (18.3-23.5)	6.3 (5.0-8.0)
Av. Intensity (epg):	2012 (1698-2385)	62 (50-78)	1914 (1601-2288)	36 (11-122)
Y1 post-MDA Prevalence (%):	8.8 (6.6-11.7)	3.2 (2.2-4.8)	2.3 (1.6-3.2)	4.4 (2.8-7.0)
Av. Intensity (epg):	127 (85-190)	7 (4-12)	108 (68-171)	12 (4-34)
Y2 pre-MDA Prevalence (%):	19.1 (15.7-23.3)	4.5 (2.9-6.9)	12.6 (9.7-16.4)	5.2 (3.3-8.1)
Av. Intensity (epg):	1109 (828-1487)	18 (9-34)	1078 (797-1459)	14 (6-32)
Y2 post-MDA Prevalence (%):	6.0 (4.5-8.0)	2.2 (1.4-3.6)	1.8 (1.1-3.0)	2.7 (1.8-4.1)
Av. Intensity (epg):	90 (55-147)	4 (2-8)	82 (48-138)	5 (2-9)
Y3 mid-term* Prevalence (%):	18.6 (16.4-21.0)	2.4 (1.8-3.2)	13.8 (12.0-15.9)	5.0 (3.7-6.8)
Av. Intensity (epg):	1141 (962-1352)	9 (5-16)	1113 (936-1324)	19 (12-30)
Y3 post-MDA Prevalence (%):	6.4 (4.8-8.6)	1.8 (1.1-3.0)	2.9 (1.7-4.8)	2.3 (1.5-3.8)
Av. Intensity (epg):	130 (87-196)	6 (3-12)	119 (77-185)	6 (3-12)

Y4 pre-MDA Prevalence (%):	15.9 (12.6-20.1)	2.6 (1.8-3.7)	11.9 (8.9-15.8)	3.8 (2.4-6.1)
Av. Intensity (epg):	1180 (842-1655)	34 (12-96)	1126 (796-1594)	20 (7-62)
Y4 post-MDA$ Prevalence (%):	5.9 (4.3-8.2)	1.1 (0.6-1.8)	1.9 (1.1-3.0)	3.8 (2.5-5.8)
Av. Intensity (epg):	131 (62-279)	3 (1-5)	116 (52-261)	12 (7-23)
Relative Reduction (baseline to mid-term)	PR: 44.7 (p<0.001) IR: 43.3 (p<0.001)	84.2 (p<0.001) 86.2 (p<0.001)	33.3 (p<0.001) 41.8 (p<0.001)	20.0 (p=0.012) 47.5 (p=0.324)

*Y1 baseline and Y3 mid-term were based on 172 schools while pre-post surveys were based on 59 schools, except $Y4 post-MDA survey which was based on 48 schools

Table 3: Year 4 pre- and post-MDA prevalence % (95%CI) by county, based on data from 48 schools

County	STH combined			Hookworm			*A. lumbricoides*			*T. trichiura*		
	Y4 Pre-MDA	Y4 Post-MDA	RR (%)	Y4 Pre-MDA	Y4 Post-MDA	RR (%)	Y4 Pre-MDA	Y4 Post-MDA	RR (%)	Y4 Pre-MDA	Y4 Post-MDA	RR (%)
Overall	18.8 (15.1-23.4)	5.8 (4.2-8.0)	69.1*	2.6 (1.8-4.0)	1.0 (0.6-1.8)	60.8*	14.6 (11.2-19.0)	1.8 (1.1-3.0)	87.6*	4.2 (2.6-7.0)	3.7 (2.5-5.7)	11.9
BOMET	18.4 (6.1-55.6)	7.7 (2.2-27.3)	57.8*	0	1.9 (0.3-13.3)	-	12.0 (4.8-30.0)	4.0 (0.7-23.0)	66.5	8.5 (1.4-53.7)	5.0 (2.1-11.7)	42.0
BUNGOMA	15.3 (11.6-20.3)	0.7 (0.2-1.7)	95.7*	0.3 (0-2.2)	0.3 (0-2.3)	-	14.4 (10.7-19.3)	0.3 (0-2.3)	97.7*	1.3 (0.3-4.8)	0	100*
BUSIA	18.0 (11.0-29.4)	11.3 (7.1-18.2)	37.0*	4.7 (2.5-9.1)	3.0 (1.4-6.4)	36.0*	12.3 (7.1-21.5)	1.9 (0.8-4.4)	84.4*	6.6 (2.8-15.8)	8.0 (3.8-16.8)	-
HOMA BAY	-	-	-	-	-	-	-	-	-	-	-	-
KAKAMEGA	20.5 (13.1-32.1)	2.4 (1.3-4.6)	88.2*	4.3 (1.8-10.5)	0.2 (0-1.1)	96.3*	17.8 (11.4-27.9)	1.3 (0.5-3.2)	92.7*	0.3 (0.1-1.1)	1.0 (0.3-3.3)	-
KERICHO	17.8 (15.5-20.4)	4.0 (1.1-14.5)	77.2*	0.3 (0-2.3)	0	100*	17.1 (15.2-19.3)	3.7 (0.8-16.5)	78.2*	2.2 (1.1-4.6)	0.3 (0-2.3)	86.0*
KILIFI	5.3 (1.9-15.3)	1.0 (0.3-3.0)	82.0*	1.9 (0.6-6.0)	0.6 (0.1-4.6)	66.0	0.6 (0.1-4.4)	0.3 (0-2.3)	49.0*	3.1 (1.1-9.1)	0.6 (0.2-1.7)	79.6*
KISII	30.9 (21.1-45.4)	2.8 (1.3-5.9)	91.0*	2.8 (0.7-11.1)	0	100*	28.8 (18.8-44.1)	2.2 (0.6-7.3)	92.5*	0.6 (0.1-4.4)	0.6 (0.2-1.7)	0.9
KISUMU	-	-	-	-	-	-	-	-	-	-	-	-
KWALE	7.9 (3.6-17.4)	6.9 (3.7-13.0)	12.2	4.7 (1.6-14.0)	2.7 (1.2-6.1)	42.1	0.9 (0.3-3.3)	0.5 (0.1-1.8)	49.0	3.3 (1.3-8.2)	4.2 (1.6-10.7)	-
MIGORI	-	-	-	-	-	-	-	-	-	-	-	-
MOMBASA	6.5 (2.8-15.5)	5.5 (2.2-14.0)	15.4	1.5 (0.5-3.9)	0.3 (0.1-2.2)	76.2	0.7 (0.1-6.0)	0	100*	4.4 (1.5-13.0)	5.2 (2.2-12.3)	-
NAROK	39.9 (28.8-55.4)	13.0 (5.1-32.9)	67.5*	2.5 (0.5-12.3)	0.3 (0-2.2)	87.5	28.8 (27.6-30.0)	2.2 (0.6-7.3)	92.5*	17.0 (4.5-63.9)	12.0 (4.6-31.4)	29.3
NYAMIRA	30.9 (17.5-54.7)	1.9 (0.4-8.4)	94.0*	1.0 (0.3-3.2)	0	100*	30.2 (17.1-53.5)	1.6 (0.2-11.1)	94.9*	0.3 (0-2.2)	0.3 (0-2.2)	0.7
TAITA TAVETA	1.3 (0.5-3.4)	0.3 (0-2.2)	75.4	0	0	0	0	0	0	1.3 (0.5-3.4)	0.3 (0-2.2)	75.5
VIHIGA	40.1 (26.0-61.9)	14.4 (7.0-29.6)	64.0*	4.3 (1.8-10.2)	1.3 (0.5-3.4)	70.0	38.5 (24.4-60.8)	7.1 (2.2-22.7)	81.7*	7.9 (2.4-25.7)	9.0 (4.4-18.5)	-

RR; relative reduction in %,

* indicates a significant relative reduction (i.e $p<0.05$)

- indicates an increase in prevalence rather than relative reduction

Table 4: Year 4 pre- and post-MDA mean intensity epg (95%CI) by county, based on data from 48 schools

County	Hookworm			*A. lumbricoides*			T. *trichiura*		
	Y4 Pre-MDA	Y4 Post-MDA	RR (%)	Y4 Pre-MDA	Y4 Post-MDA	RR (%)	Y4 Pre-MDA	Y4 Post-MDA	RR (%)
Overall	40 (14-119)	2 (1-5)	93.9*	1397 (1010-1931)	114 (51-256)	91.8*	24 (7-76)	12 (7-23)	48.2
BOMET	0	4 (1-26)	-	1124 (407-3102)	225 (32-1610)	79.9*	32 (5-212)	8 (3-23)	74.7*
BUNGOMA	0	0	-	1498 (931-2409)	39 (6-276)	97.4*	1 (0-6)	0	100
BUSIA	29 (6-130)	2 (1-5)	91.9*	1147 (545-2414)	335 (63-1777)	70.8	26 (9-79)	35 (10-118)	-
HOMA BAY	-	-	-	-	-	-	-	-	-
KAKAMEGA	33 (8-130)	0 (0-3)	98.7*	1195 (845-1690)	31 (7-135)	97.4*	1 (0-3)	1 (0-5)	-
KERICHO	1 (0-5)	0	100*	1192 (677-2098)	422 (62-2890)	64.6	1 (0-2)	0	93.9*
KILIFI	4 (1-30)	0 (0-2)	94.0	42 (6-293)	2 (0-16)	94.5*	5 (1-17)	1 (0-2)	86.8*
KISII	2 (1-6)	0	100*	1845 (958-3556)	23 (7-73)	98.8*	1 (0-5)	0 (0-1)	67.0
KISUMU	-	-	-	-	-	-	-	-	-
KWALE	174 (26-1158)	11 (4-31)	93.6*	258 (75-890)	2 (0-10)	99.4*	6 (2-17)	15 (5-45)	-
MIGORI	-	-	-	-	-	-	-	-	-
MOMBASA	5 (1-23)	0 (0-2)	93.8	275 (33-2264)	0	100*	9 (2-38)	13 (4-38)	-
NAROK	104 (22-501)	0 (0-1)	99.9*	2785 (2299-3375)	51 (8-341)	98.2*	218 (32-1495)	35 (6-205)	84.0*
NYAMIRA	1 (0-3)	0	100	3517 (1680-7364)	64 (9-456)	98.2*	5 (1-35)	0 (0-1)	98.6*
TAITA TAVETA	0	0	0	0	0	0	2 (1-7)	0 (0-1)	92.5*
VIHIGA	50 (22-116)	8 (2-37)	84.8*	4916 (2376-10171)	247 (91-669)	95.0*	30 (7-134)	36 (15-88)	-

RR; relative reduction in %,

* indicates a significant relative reduction (i.e $p<0.05$)

- indicates an increase in intensity rather than relative reduction

Table 5: Prevalence % (95%CI) and relative reduction % (p-value) trend: Year 1 to 4 based on 59 schools

Survey		STH combined	Hookworm	*A. lumbricoides*	*T. trichiura*
Year 1					
	Pre-MDA	33.2 (29.4-37.4)	16.5 (13.3-20.4)	19.5 (15.3-24.8)	5.5 (3.8-7.9)
	Post-MDA	8.8 (6.6-11.7)	3.2 (2.2-4.8)	2.3 (1.6-3.2)	4.4 (2.8-7.0)
	Relative reduction	73.5 (p<.001)	80.4 (p<0.001)	88.2 (p<0.001)	20.3 (p=0.077)
Year 2					
	Pre-MDA	19.1 (15.7-23.3)	4.5 (2.9-6.9)	12.6 (9.7-16.4)	5.2 (3.3-8.1)
	Post-MDA	6.0 (4.5-8.0)	2.2 (1.4-3.6)	1.8 (1.1-3.0)	2.7 (1.8-4.1)
	Relative reduction	68.5 (p<.001)	50.3 (p=0.001)	85.5 (p<0.001)	48.5 (p<0.001)
Year 3					
	Pre-MDA	16.4 (13.2-20.3)	2.4 (1.5-3.9)	12.8 (9.8-16.7)	3.1 (2.0-4.8)
	Post-MDA	6.4 (4.8-8.6)	1.8 (1.1-3.0)	2.9 (1.7-4.8)	2.3 (1.5-3.8)
	Relative reduction	60.8 (p<.001)	26.1 (p=0.032)	77.7 (p<0.001)	24.1 (p=0.021)
Year 4					
	Pre-MDA	15.9 (12.6-20.1)	2.6 (1.8-3.7)	11.9 (8.9-15.8)	3.8 (2.4-6.1)
	Pre-MDA*	18.8 (15.0-23.6)	2.7 (1.8-4.0)	14.6 (11.1-19.1)	4.3 (2.6-7.1)
	Post-MDA*	5.9 (4.3-8.2)	1.1 (0.6-1.8)	1.9 (1.1-3.0)	3.8 (2.5-5.8)
	Relative reduction*	68.5 (p<.001)	60.9 (p<0.001)	87.3 (p<0.001)	11.6 (p=0.393)
Overall reduction:					
Y1 pre- to Y4 pre- MDA		52.1 (p<0.001)	84.5 (p<0.001)	39.2 (p<0.001)	30.3 (p=0.026)

*The Y4 post-MDA was based on 47 schools, hence additional row for Y4 pre-MDA with 47 schools was created to compare with the Y4 post-MDA

Table 6: Prevalence of light, moderate and heavy intensity of infection % (95%CI) in year 1, 2, 3 and 4 based on data from 59 schools

	Light	Moderate	Heavy
STH combined			
Y1 pre-MDA (baseline)	24.8 (22.1-27.8)	8.3 (6.3-11.1)	0.1 (0.0-0.2)
Y1 post-MDA	7.9 (5.9-10.6)	0.8 (0.5-1.3)	0.0 (0.0-0.1)
Y2 pre-MDA	12.3 (9.9-15.4)	6.7 (5.0-9.0)	0.1 (0.0-0.2)
Y2 post-MDA	5.4 (4.1-7.2)	0.6 (0.4-1.0)	0
Y3 pre-MDA (midterm)	10.8 (8.9-13.2)	5.5 (4.1-7.5)	0.0 (0.0-0.2)
Y3 post-MDA	5.7 (4.2-7.7)	0.7 (0.5-1.1)	0.0 (0.0-0.1)
Y4 pre-MDA	9.8 (7.9-12.1)	5.7 (4.0-8.1)	1.1 (0.7-1.6)
Y4 post-MDA[$]	5.3 (3.8-7.2)	0.6 (0.3-1.2)	0.0 (0.0-0.1)
Y4 RR (pre-post MDA)	*46.1% (p<0.001)*	*89.0% (p<0.001)*	*98.1% (p<0.001)*
Overall RR (Y1baseline-Y4post MDA)	*78.7% (p<0.001)*	*92.4% (p<0.001)*	*74.1% (p<0.001)*
Hookworm			
Y1 pre-MDA (baseline)	16.1 (13.0-20.0)	0.3 (0.1-0.6)	0.1 (0.0-0.2)
Y1 post-MDA	3.2 (2.1-4.8)	0.0 (0.0-0.1)	0.0 (0.0-0.1)
Y2 pre-MDA	4.3 (2.8-6.6)	0.1 (0.0-0.3)	0.1 (0.0-0.2)
Y2 post-MDA	2.2 (1.4-3.5)	0.0 (0.0-0.1)	0

Y3 pre-MDA (midterm)	2.4 (1.5-3.9)	0	0.0 (0.0-0.2)
Y3 post-MDA	1.8 (1.1-2.9)	0.0 (0.0-0.1)	0.0 (0.0-0.1)
Y4 pre-MDA	3.1 (2.3-4.2)	0.1 (0.0-0.3)	0.1 (0.0-0.2)
Y4 post-MDA[$]	1.0 (0.6-1.8)	0.0 (0.0-0.1)	0
Y4 RR (pre-post MDA)	*66.9% (p<0.001)*	*75.0% (p=0.178)*	*100% (p<0.001)*
Overall RR (Y1baseline-Y4post MDA)	*93.6% (p<0.001)*	*92.8% (p=0.016)*	*100% (p<0.001)*
A. lumbricoides			
Y1 pre-MDA (baseline)	11.5 (9.0-14.6)	8.0 (6.0-10.8)	NA*
Y1 post-MDA	1.7 (1.2-2.4)	0.6 (0.4-1.0)	NA*
Y2 pre-MDA	6.2 (4.6-8.2)	6.5 (4.8-8.8)	NA*
Y2 post-MDA	1.3 (0.8-2.3)	0.5 (0.3-0.9)	NA*
Y3 pre-MDA (midterm)	7.5 (5.7-9.7)	5.3 (3.9-7.3)	NA*
Y3 post-MDA	2.2 (1.3-4.0)	0.6 (3.7-1.0)	NA*
Y4 pre-MDA	6.1 (4.5-8.2)	5.6 (3.9-8.1)	NA*
Y4 post-MDA[$]	1.3 (0.8-2.2)	0.5 (0.2-1.1)	NA*
Y4 RR (pre-post MDA)	*78.2% (p<0.001)*	*91.0% (p<0.001)*	NA*
Overall RR (Y1baseline-Y4post MDA)	*88.5% (p<0.001)*	*93.7% (p<0.001)*	NA*
T. trichiura			
Y1 pre-MDA (baseline)	5.4 (3.8-7.7)	0.1 (0.0-0.3)	0
Y1 post-MDA	4.2 (2.7-6.6)	0.2 (0.0-0.6)	0 (0.0-.0-0.1)
Y2 pre-MDA	5.0 (3.3-7.6)	0.2 (0.1-0.7)	0
Y2 post-MDA	2.6 (1.7-3.9)	0.1 (0.0-0.3)	0
Y3 pre-MDA (midterm)	2.9 (1.9-4.5)	0.2 (0.1-0.4)	0
Y3 post-MDA	2.2 (1.4-3.6)	0.1 (0.0-0.2)	0.0 (0.0-0.1)
Y4 pre-MDA	4.4 (3.0-6.3)	0.2 (0.1-0.6)	0.0 (0.0-0.2)
Y4 post-MDA[$]	3.6 (2.4-5.5)	0.2 (0.1-0.5)	0
Y4 RR (pre-post MDA)	*17.0% (p=0.140)*	*6.3% (p<=0.912)*	*100% (p<0.001)*
Overall RR (Y1baseline-Y4post MDA)	*32.8% (p=0.004)*	*increased*	*0% (p<0.001)*

***A. lumbricoides* egg counts were truncated at 24,000 epg;

[$] Year 4 post-MDA was based on 47 schools

RR:- Relative reduction

Table 7: Prevalence of moderate to heavy intensity of infection % (95%CI) in year 1, 2, 3 and 4 based on data from 59 schools

Infection		STH combined	Hookworm	*A. lumbricoides*	*T. trichiura*
Year 1	Pre-MDA	8.4 (6.3-11.2)	0.4 (0.2-0.7)	8.0 (6.0-10.8)	0.1 (0-0.3)
	Post-MDA	0.9 (0.6-1.3)	0 (0-0.1)	0.6 (0.4-1.0)	0.2 (0-0.7)
	Relative reduction	89.9 (p<0.001)	86.7 (p<0.001)	92.0 (p<0.001)	+
Year 2	Pre-MDA	6.8 (5.1-9.1)	0.2 (0.1-0.4)	6.5 (4.8-8.8)	0.2 (0.1-0.7)
	Post-MDA	0.6 (0.4-1.0)	0 (0-0.1)	0.5 (0.3-0.9)	0.1 (0-0.3)
	Relative reduction	91.3 (p<0.001)	69.7 (p=0.017)	92.3 (p<0.001)	71.1 (p=0.166)
Year 3	Pre-MDA	5.6 (4.1-7.5)	0 (0-0.2)	5.3 (3.9-7.3)	0.2 (0.1-0.4)
	Post-MDA	0.7 (0.5-1.1)	0 (0-0.2)	0.6 (0.4-1.0)	0.1 (0-0.2)
	Relative reduction	86.7 (p<0.001)	+	88.6 (p<0.001)	49.3 (p=0.099)
Year 4	Pre-MDA	6.8 (5.1-9.1)	0.2 (0.1-0.4)	6.5 (4.9-8.8)	0.2 (0.1-0.7)
	Post-MDA[$]	0.7 (0.3-1.3)	0 (0-0.1)	0.5 (0.3-1.1)	0.2 (0.1-0.5)
	Relative reduction	90.4 (p<0.001)	88.6 (p=0.007)	91.9 (p<0.001)	19.7 (p=0.730)
Overall reduction	Y1Pre-MDA to Y4Post-MDA	92.3 (p<0.001)	94.4 (p=0.005)	93.4 (p<0.001)	+

[$] Year 4 post-MDA was based on 47 schools

[+] Indicates an increase in prevalence rather than reduction

Table 8: Re-infection in prevalence % (p-value) and mean intensity epg (p-value) in year 1, 2, 3 and 4 based on data from 59 schools

Re-infections	Y1 – Y2	Y2 – Y3	Y3 – Y4
Prevalence:			
STH combined	14.0 (p<0.001)	11.2 (p<0.001)	11.2 (p<0.001)
Hookworm	3.9 (p<0.001)	2.3 (p<0.001)	2.2 (p<0.001)
A. lumbricoides	7.5 (p<0.001)	7.3 (p<0.001)	7.4 (p<0.001)
T. trichiura	4.8 (p<0.001)	2.9 (p<0.001)	3.1 (p<0.001)
Mean intensity:			
STH combined	620 (p<0.001)	512 (p<0.001)	657 (p<0.001)
Hookworm	12 (p<0.001)	5 (p<0.001)	20 (p<0.001)
A. lumbricoides	595 (p<0.001)	500 (p<0.001)	625 (p<0.001)
T. trichiura	13 (p<0.001)	6 (p<0.001)	13 (p<0.001)

Table 9: Prevalence % (95%CI) of STH infections by regions

Region	Number of schools	STH combined	Hookworm	*A. lumbricoides*	*T. trichiura*
Coast Region					
Y1 baseline	46	24.2 (19.9-29.4)	18.2 (14.0-23.5)	1.0 (0.7-1.6)	7.9 (5.7-10.9)
Y1 post-MDA	15	6.8 (3.7-12.5)	3.3 (1.5-7.0)	0.1 (0-0.5)	4.1 (1.9-9.1)
Y2 pre-MDA	15	11.3 (6.0-21.3)	7.9 (3.7-17.0)	0.3 (0.1-0.9)	3.9 (1.9-8.1)
Y2 post-MDA	15	4.7 (2.6-8.5)	2.5 (1.0-6.1)	0.2 (0.1-0.5)	2.5 (1.2-5.1)
Y3 midterm	46	5.4 (3.5-8.4)	4.2 (2.5-7.0)	0.2 (0.1-0.5)	1.6 (1.0-2.7)
Y3 post-MDA	15	4.5 (2.4-8.5)	3.2 (1.4-7.0)	0.1 (0-0.5)	1.5 (0.7-2.8)
Y4 pre-MDA	15	5.8 (3.4-9.8)	2.6 (1.1-6.2)	0.6 (0.3-1.6)	3.1 (1.8-5.2)
Y4 post-MDA	15	4.1 (2.3-7.4)	1.3 (0.6-3.0)	0.3 (0.1-0.8)	2.9 (1.4-5.7)
Nyanza Region					
Y1 baseline	64	30.6 (27.0-34.6)	11.8 (9.8-14.1)	19.9 (16.0-24.7)	3.6 (2.5-5.1)
Y1 post-MDA	18	6.5 (3.6-11.8)	3.8 (1.8-8.2)	1.9 (0.9-4.0)	2.0 (1.0-3.7)
Y2 pre-MDA	18	15.5 (10.6-22.5)	3.5 (1.6-7.5)	12.0 (7.3-19.6)	1.8 (0.9-3.4)
Y2 post-MDA	18	7.3 (4.6-11.7)	3.6 (1.9-6.9)	3.5 (1.6-7.5)	1.4 (0.5-3.5)
Y3 midterm	64	15.0 (12.1-18.7)	2.4 (1.6-3.6)	12.6 (9.7-16.2)	1.7 (1.2-2.4)
Y3 post-MDA	18	5.2 (3.3-8.2)	2.5 (1.1-5.5)	1.8 (1.0-3.3)	1.6 (0.9-2.8)
Y4 pre-MDA	18	13.3 (8.0-22.0)	2.0 (1.0-3.9)	10.5 (5.4-20.3)	1.5 (0.9-2.7)
Y4 post-MDA*	6	2.3 (1.2-4.7)	0	1.9 (0.7-5.0)	0.5 (0.2-1.1)
R. Valley Region					
Y1 baseline	34	36.3 (30.4-43.4)	3.5 (2.1-6.1)	27.1 (21.9-33.6)	11.9 (7.7-18.4)
Y1 post-MDA	9	12.3 (5.6-27.3)	0.8 (0.1-5.8)	4.1 (2.3-7.4)	8.5 (2.7-26.7)
Y2 pre-MDA	9	28.9 (20.3-41.3)	0.7 (0.1-5.2)	22.8 (15.7-33.1)	9.8 (3.8-25.1)
Y2 post-MDA	9	7.7 (3.8-15.4)	0.2 (0.1-0.9)	2.1 (0.9-4.6)	6.0 (2.6-13.8)
Y3 midterm	34	25.7 (20.8-31.8)	0.3 (0.1-0.6)	18.5 (14.6-23.4)	11.2 (7.3-17.0)
Y3 post-MDA	9	6.5 (3.1-13.8)	0	3.3 (1.4-7.5)	3.5 (1.1-10.9)
Y4 pre-MDA	9	25.5 (17.2-37.8)	0.9 (0.2-4.2)	19.4 (14.3-26.2)	9.3 (3.5-24.6)
Y4 post-MDA	9	8.3 (4.3-15.8)	0.7 (0.1-3.8)	3.3 (1.4-7.6)	5.8 (2.5-13.5)
Western Region					
Y1 baseline	55	38.6 (34.9-42.7)	24.8 (21.1-29.2)	24.6 (20.8-29.1)	5.9 (3.9-9.0)
Y1 post-MDA	17	10.8 (7.2-16.3)	3.9 (2.2-6.9)	3.6 (2.4-5.4)	4.9 (2.4-10.0)
Y2 pre-MDA	17	24.8 (19.7-31.4)	4.5 (2.7-7.5)	18.9 (14.5-24.7)	7.5 (3.7-15.3)
Y2 post-MDA	17	5.0 (2.8-8.9)	1.6 (0.6-3.9)	1.5 (0.8-2.6)	2.6 (1.2-5.7)
Y3 midterm	55	21.2 (17.5-25.8)	1.9 (1.3-2.7)	16.9 (13.8-20.6)	6.0 (3.5-10.2)
Y3 post-MDA	17	9.3 (5.6-15.6)	0.8 (0.5-1.5)	6.1 (3.0-12.6)	3.3 (1.4-8.1)
Y4 pre-MDA	17	22.4 (16.8-29.7)	4.0 (2.5-6.4)	19.0 (13.6-26.3)	4.0 (2.0-8.2)
Y4 post-MDA	17	7.6 (4.7-12.1)	1.4 (0.7-2.9)	2.4 (1.2-5.0)	4.8 (2.6-8.8)

*12 schools were not surveyed in some counties of Nyanza region due to mix up in the treatment schedule

Table 10: Mean intensity (epg) (95%CI) of STH infections by regions

Region	Number of schools	Hookworm	*A. lumbricoides*	*T. trichiura*
Coast Region				
Y1 baseline	46	64 (34-122)	29 (15-54)	10 (5-21)
Y1 post-MDA	15	9 (4-18)	15 (2-107)	6 (2-14)
Y2 pre-MDA	15	48 (21-110)	10 (3-38)	7 (3-15)
Y2 post-MDA	15	7 (2-22)	15 (2-101)	3 (1-7)
Y3 midterm	46	12 (6-23)	15 (4-51)	3 (1-7)
Y3 post-MDA	15	15 (6-39)	0 (0-3)	3 (1-8)
Y4 pre-MDA	15	73 (12-465)	164 (60-445)	6 (3-11)
Y4 post-MDA	15	5 (1-14)	1 (0-4)	9 (4-21)
Nyanza Region				
Y1 baseline	64	19 (14-26)	1897 (1353-2659)	64 (10-403)
Y1 post-MDA	18	7 (2-26)	88 (33-233)	6 (1-36)
Y2 pre-MDA	18	8 (2-33)	810 (465-1413)	2 (1-6)
Y2 post-MDA	18	5 (2-13)	81 (25-262)	1 (0-3)
Y3 midterm	64	13 (5-36)	992 (734-1340)	5 (3-8)
Y3 post-MDA	18	4 (1-15)	118 (50-278)	2 (1-6)
Y4 pre-MDA	18	5 (2-11)	944 (441-2021)	4 (2-8)
Y4 post-MDA*	6	0	43 (11-173)	0
R. Valley Region				
Y1 baseline	34	18 (6-57)	3445 (2699-4398)	31 (17-57)
Y1 post-MDA	9	1 (0-10)	148 (68-324)	46 (9-240)
Y2 pre-MDA	9	2 (0-13)	2398 (1601-3591)	42 (8-212)
Y2 post-MDA	9	0	127 (61-264)	14 (4-52)
Y3 midterm	34	1 (0-2)	1412 (1028-1939)	49 (27-86)
Y3 post-MDA	9	0	105 (45-243)	8 (2-37)
Y4 pre-MDA	9	35 (7-187)	1709 (1151-2537)	85 (16-448)
Y4 post-MDA	9	1 (0-8)	232 (67-802)	14 (3-61)
Western Region				
Y1 baseline	55	143 (115-177)	1639 (1311-2049)	17 (11-28)
Y1 post-MDA	17	9 (4-20)	185 (95-359)	5 (2-15)
Y2 pre-MDA	17	10 (6-18)	1619 (1144-2291)	19 (7-49)
Y2 post-MDA	17	2 (1-10)	119 (55-257)	5 (2-13)
Y3 midterm	55	4 (6-7)	1434 (1117-1842)	22 (9-54)
Y3 post-MDA	17	2 (1-4)	229 (136-387)	11 (3-36)
Y4 pre-MDA	17	30 (14-64)	1845 (1126-3023)	15 (6-37)
Y4 post-MDA	17	2 (1-6)	180 (58-557)	19 (8-47)

*12 schools were not surveyed in some counties of Nyanza region due to mix up in the treatment schedule

Table 11: Schistosomiasis: Year 4 pre- and post-MDA prevalence % (95%CI) by county, based on data from 48 schools

County	*S. mansoni*			*S. haematobium*		
	Y4 Pre-MDA	**Y4 Post-MDA**	**RR (%)**	**Y4 Pre-MDA**	**Y4 Post-MDA**	**RR (%)**
Overall	1.8 (0.4-7.8)	1.2 (0.4-3.4)	33.0	3.0 (0.7-12.8)	5.3 (1.9-14.7)	+
BOMET	0.3 (0-2.2)	0	100*	-	-	-
BUNGOMA	0.3 (0-2.3)	0.3 (0-2.3)	0	-	-	-
BUSIA	12.0 (2.2-64.2)	4.3 (0.7-28.5)	64.1*	-	-	-
HOMA BAY	-	-	-	-	-	-
KAKAMEGA	1.3 (0.4-4.5)	4.0 (0.9-17.9)	+	-	-	-
KERICHO	0	0	0	-	-	-
KILIFI	0	0.3 (0-2.2)	+	0	3.8 (1.8-8.0)	+
KISII	0.3 (0-2.2)	0.3 (0-2.2)	0.9	-	-	-
KISUMU	-	-	-	-	-	-
KWALE	0	0.3 (0.1-1.1)	+	7.3 (1.8-28.9)	11.1 (3.7-33.4)	+
MIGORI	-	-	-	-	-	-
MOMBASA	0	0	0	0	0	0
NAROK	0.6 (0.2-1.6)	0.3 (0-2.2)	50.2	-	-	-
NYAMIRA	0	0	0	-	-	-
TAITA TAVETA	0	0	0	0	0	0
VIHIGA	0	0.6 (0.1-4.6)	+	-	-	-

[+] indicates an increase in prevalence between Y4 pre- and post-MDA

Table 12: Schistosomiasis: Prevalence % (95%CI) and relative reduction % (p-value) trend: Year 1 to 4 based on 59 schools

Survey		Any schistosomiasis	*S. mansoni*	*S. haematobium*
Year 1				
	Pre-MDA	26.6 (16.8-42.3)	1.8 (0.5-6.1)	18.0 (12.6-25.6)
	Post-MDA	**	2.4 (1.3-4.4)	**
	RR	**	+	**
Year 2				
	Pre-MDA	15.4 (7.6-30.9)	2.7 (0.9-8.1)	6.3 (3.2-12.5)
	Post-MDA	6.8 (3.2-14.1)	0.6 (0.1-2.6)	4.6 (2.0-10.4)
	RR	56.0 (p=0.001)	77.7 (p<0.001)	27.7 (p=0.374)
Year 3				
	Pre-MDA	14.9 (7.2-30.7)	1.7 (0.4-7.1)	9.0 (4.0-19.9)
	Post-MDA	8.5 (4.8-15.1)	0.8 (0.4-1.5)	5.8 (2.6-12.8)
	RR	42.9 (p=0.044)	55.9 (p=0.193)	35.7 (p=0.059)
Year 4				
	Pre-MDA	9.4 (3.6-24.4)	1.8 (0.5-5.9)	3.0 (0.7-12.8)
	Pre-MDA*	8.3 (2.8-24.5)	1.8 (0.4-8.0)	3.0 (0.7-12.8)
	Post-MDA*	8.8 (4.2-18.7)	1.2 (0.4-3.5)	5.3 (1.9-14.7)
	RR*	+	33.0 (p=0.364)	+
Overall RR:Y1 pre- to Y4 pre-MDA		64.9 (p=0.005)	2.7(p=0.816)	83.4 (p=0.029)

* The Y4 post-MDA was based on 47 schools, hence additional row for Y4 pre-MDA with 47 schools was created to compare with the Y4 post-MDA;
RR:- Relative Reduction
[+] Indicates an increase in prevalence rather than relative reduction

Table 13: Schistosomiasis: Overall prevalence, average intensity of infection and relative reductions

Survey	Any Schistosome	*S. mansoni*	*S. haematobium*
Y1 baseline* Prevalence (%):	37.9 (27.4-52.5)	2.4 (1.5-4.1)	18.0 (13.0-24.9)
Av. Intensity (epg):	20 (11-39)	14 (5-41)	20 (11-39)
Y1 post-MDA Prevalence (%):	**	2.4 (1.3-4.4)	**
Av. Intensity (epg):	**	28 (10-79)	**
Y2 pre-MDA Prevalence (%):	15.4 (7.6-30.9)	2.7 (0.9-8.1)	6.3 (3.2-12.5)
Av. Intensity (epg):	5 (2-11)	16 (3-72)	5 (2-11)
Y2 post-MDA Prevalence (%):	6.8 (3.2-14.1)	0.6 (0.1-2.6)	4.6 (2.0-10.4)
Av. Intensity (epg):	4 (2-8)	2 (0-9)	4 (2-8)
Y3 mid-term* Prevalence (%):	20.6 (12.3-34.6)	1.7 (0.8-3.6)	7.9 (3.8-16.2)
Av. Intensity (epg):	7 (3-16)	6 (2-16)	7 (3-16)

Y3 post-MDA Prevalence (%):	8.5 (4.8-15.1)	0.8 (0.4-1.5)	5.6 (2.6-12.8)
Av. Intensity (epg):	2 (1-3)	1 (1-2)	1 (0-3)
Y4 pre-MDA Prevalence (%):	9.4 (3.6-24.4)	1.8 (0.5-5.9)	3.0 (0.7-12.8)
Av. Intensity (epg):	3 (1-18)	6 (1-26)	3 (1-18)
Y4 post-MDA[$] Prevalence (%):	8.8 (4.2-18.7)	1.2 (0.4-3.5)	5.3 (1.9-14.7)
Av. Intensity (epg):	6 (1-25)	4 (1-13)	2 (1-7)
Relative Reduction	45.6 (p=0.004)	PR: 28.6% (p=0.105)	56.2% (p=0.039)
(baseline to mid-term)	63.7 (p=0.062)	IR: 55.9% (p=0.003)	63.7% (p=0.062)

*Y1 baseline and Y3 mid-term were based on 172 schools while pre-post surveys were based on 59 schools, except [$]Y4 post-MDA survey which was based on 48 schools

Table 14: Schistosomiasis: Prevalence of light, moderate and heavy intensity of infection % (95%CI) in year 1, 2, 3 and 4 based on data from 59 schools

	Light	Moderate	Heavy
S. mansoni			
Y1 pre-MDA (baseline)	0.8 (0.4-1.5)	0.6 (0.1-3.2)	0.4 (0.1-2.8)
Y1 post-MDA	1.0 (0.6-1.7)	0.7 (0.2-2.2)	0.7 (0.3-1.4)
Y2 pre-MDA	0.9 (0.5-1.7)	0.8 (0.2-2.7)	1.0 (0.2-4.8)
Y2 post-MDA	0.3 (0.1-1.2)	0.2 (0-1.0)	0.1 (0-0.5)
Y3 pre-MDA (midterm)	0.7 (0.2-2.4)	0.7 (0.2-3.2)	0.3 (0.1-1.6)
Y3 post-MDA	0.6 (0.3-1.1)	0.1 (0.1-0.3)	0.1 (0-0.2)
Y4 pre-MDA	0.7 (0.2-1.8)	0.7 (0.2-2.8)	1.1 (0.6-2.0)
Y4 post-MDA[$]	0.6 (0.2-1.6)	0.4 (0.1-1.6)	0.2 (0.1-0.7)
Y4 RR (pre-post MDA)	*11.6 (p=0.592)*	*40.2 (p=0.413)*	*83.6 (p=0.001)*
Overall RR (Y1baseline-Y4post MDA)	*23.4 (p=0.507)*	*30.5 (p=0.643)*	*53.4 (p=0.184)*
S. haematobium			
Y1 pre-MDA (baseline)	86.8 (79.2-95.2)	-	4.4 (2.3-8.7)
Y1 post-MDA	**	-	**
Y2 pre-MDA	75.3 (65.1-87.0)	-	2.6 (1.3-5.2)
Y2 post-MDA	74.8 (64.5-86.7)	-	1.4 (0.6-3.1)
Y3 pre-MDA (midterm)	76.4 (66.6-87.7)	-	3.8 (1.6-9.0)
Y3 post-MDA	76.6 (66.8-87.8)	-	0.3 (0.1-1.0)
Y4 pre-MDA	75.7 (65.6-87.3)	-	0.8 (0.2-3.9)
Y4 post-MDA[$]	69.9 (58.2-84.0)	-	1.2 (0.4-3.7)
Y4 RR (pre-post MDA)	*7.6 (p=0.018)*	-	*+*
Overall RR (Y1baseline-Y4post MDA)	*19.5 (p=0.002)*	-	*72.2 (p=0.080)*

[$] Year 4 post-MDA was based on 47 schools

[+] denotes an increase rather than reduction

Table 15: Schistosomiasis: Re-infection in prevalence % (p-value) and mean intensity epg (p-value) in year 1, 2, 3 and 4 based on data from 59 schools

Re-infections	Y1 – Y2	Y2 – Y3	Y3 – Y4
Prevalence:			
Any schistosomiasis	21.9 (p<0.001)	10.8 (p<0.001)	8.9 (p<0.001)
S. mansoni	2.6 (p<0.001)	1.2 (p<0.001)	1.3 (p<0.001)
S. haematobium	6.3 (p<0.001)	6.7 (p<0.001)	4.4 (p<0.001)
Mean intensity:			
Any schistosomiasis	5 (p<0.001)	6 (p<0.001)	2 (p=0.173)
S. mansoni	22 (p<0.001)	5 (p=0.033)	4 (p=0.044)
S. haematobium	5 (p<0.001)	6 (p<0.001)	2 (p=0.381)

Table 16: Prevalence % (95%CI) and mean intensity (epg) (95%CI) of STH infections by regions

Region	Number of schools	Prevalence (%)		Mean intensity (epg)	
		S. mansoni	*S. haematobium*	*S. mansoni*	*S. haematobium*
Coast Region					
Y1 baseline	46	0 (0-0.1)	14.8 (11.3-19.5)	0	16 (10-26)
Y1 post-MDA	15	4.4 (2.4-8.2)	0	100 (34-294)	0
Y2 pre-MDA	15	0.1 (0-0.4)	6.3 (3.2-12.5)	0	5 (2-11)
Y2 post-MDA	15	0.1 (0-0.4)	4.6 (2.0-10.4)	0 (0-1)	4 (2-8)
Y3 midterm	46	0 (0-0.2)	6.8 (4.3-10.7)	0	7 (4-12)
Y3 post-MDA	15	0.4 (0.2-1.0)	5.8 (2.6-12.8)	1 (0-3)	1 (0-3)
Y4 pre-MDA	15	0	3.0 (0.1-12.8)	0	3 (1-18)
Y4 post-MDA	15	0.2 (0.1-0.6)	5.3 (1.9-14.7)	3 (1-22)	2 (1-7)
Nyanza Region					
Y1 baseline	64	2.8 (1.5-5.0)	-	3 (1-7)	-
Y1 post-MDA	18	0.8 (0.3-1.7)	-	1 (0-3)	-
Y2 pre-MDA	18	1.7 (0.7-4.0)	-	6 (2-19)	-
Y2 post-MDA	18	0.4 (0.1-1.3)	-	0 (0-2)	-
Y3 midterm	64	0.8 (0.5-1.2)	-	1 (0-1)	-
Y3 post-MDA	18	1.5 (0.6-3.6)	-	2 (1-5)	-
Y4 pre-MDA	18	1.1 (0.5-2.2)	-	2 (0-6)	-
Y4 post-MDA*	6	0.2 (0-1.1)	-	0	-
R. Valley Region					
Y1 baseline	34	0.4 (0.1-2.5)	-	1 (0-9)	-
Y1 post-MDA	9	0	-	0	-
Y2 pre-MDA	9	1.0 (0.1-6.7)	-	3 (0-18)	-
Y2 post-MDA	9	0	-	0	-
Y3 midterm	34	0.4 (0.1-1.3)	-	3 (1-15)	-
Y3 post-MDA	9	0.1 (0-0.8)	-	0	-
Y4 pre-MDA	9	0.3 (0.1-0.8)	-	4 (1-11)	-
Y4 post-MDA	9	0.1 (0-0.7)	-	0	-
Western Region					

Y1 baseline	55	4.2 (1.9-9.2)	-	40 (12-129)	-
Y1 post-MDA	17	3.5 (1.1-11.5)	-	7 (2-21)	-
Y2 pre-MDA	17	7.2 (1.8-28.8)	-	46 (8-274)	-
Y2 post-MDA	17	1.6 (0.3-10.2)	-	6 (1-32)	-
Y3 midterm	55	4.2 (1.7-10.5)	-	17 (5-50)	-
Y3 post-MDA	17	0.6 (0.2-2.6)	-	1 (0-5)	-
Y4 pre-MDA	17	4.8 (1.0-22.1)	-	18 (3-99)	-
Y4 post-MDA	17	3.1 (1.0-9.5)	-	9 (2-34)	-

*12 schools were not surveyed in some counties of Nyanza region due to mixed up in the treatment schedule

Table 17: Comparison of infection prevalence among ECD and older children

Year/survey	Number sampled (percent)	STH combined prevalence	Any schistosomiasis prevalence	Prevalence of STH combined moderate to heavy intensity	Prevalence of any schisto somiasis moderate to heavy intensity
Year 1: Pre-MDA					
ECD children	0	0	0	0	0
Older children	3193(100%)	32.1	25.8	6.5	1.9
Year 1: Post-MDA					
ECD children	903 (15.7%)	9.0	*	1.1	1.1
Older children	4865 (84.3%)	9.2	*	0.9	1.6
Year 2: Pre-MDA					
ECD children	267 (16.5%)	10.9	3.7	1.1	1.5
Older children	1347 (83.5%)	11.4	6.9	0.4	2.8
Year 2: Post-MDA					
ECD children	-	-	-	-	-
Older children	-	-	-	-	-
Year 3: Pre-MDA					
ECD children	3439 (16.3%)	18.0	15.2	7.0	1.8
Older children	17624 (83.7%)	16.0	14.8	5.2	2.0
Year 3: Post-MDA					
ECD children	1026 (16.7%)	7.8	7.5	1.6	0.2
Older children	5136 (83.3%)	6.2	8.8	0.6	0.3
Year 4: Pre-MDA					
ECD children	1011 (16.3%)	20.7	7.8	10.3	2.2
Older children	5183 (83.7%)	15.1	9.9	6.2	2.1
Year 4: Post-MDA					
ECD children	824 (16.6%)	6.9	6.8	0.6	0.4
Older children	4143 (83.4%)	5.7	9.0	0.7	1.1

Table A1: Key indicators by year based on 59 schools

Indicator	Year 1	Year 2	Year 3	Year 4	Year 5
Combined STH (infection with any STH)					
Prevalence moderate-heavy (%) [pre - post]	8.4 – 0.9	6.8 – 0.6	5.6 – 0.7	6.8 – 0.7	-
Relative moderate-heavy prevalence reduction since last pre-MDA survey (%)	*NA*	*19.0 (p=0.006)*	*18.3 (p=0.093)*	increase	-
Relative moderate-heavy prevalence reduction since baseline (%)	*NA*	*19.0 (p=0.006)*	*33.8 (p<0.001)*	19.3 (p=0.046)	-
Pre-MDA Prevalence (%)	33.2	19.1	16.4	15.9	-
Relative prevalence reduction since last pre-MDA survey (%)	*NA*	*42.3 (p<0.001)*	*14.3 (p=0.035)*	3.0 (p=0.712)	-
Relative prevalence reduction since baseline (%)	*NA*	*42.3 (p<0.001)*	*50.6 (p<0.001)*	52.1 (p<0.001)	-
Post-MDA prevalence (%)	8.8	6.0	6.4	5.9	-
Relative prevalence reduction since pre-MDA survey (%)	*73.5 (p<0.001)*	*68.5 (p<0.001)*	60.8 (p<0.001)	62.8 (p<0.001)	-
Schistosomiasis (infection with any type)					
Prevalence moderate-heavy (%) [pre - post]	1.7 – 1.4	2.5 – 0.7	2.0 – 0.3	2.1 – 1.0	-
Relative moderate-heavy prevalence reduction since last pre-MDA survey (%)	*NA*	*+ (p=0.001)*	*20.0 (p=0.374)*	+ (p=0.875)	-
Relative moderate-heavy prevalence reduction since baseline (%)	*NA*	*+ (p=0.001)*	*+ (p=0.605)*	+ (p=0.475)	-
Pre-MDA prevalence (%)	26.6	15.4	14.9	9.4	-
Relative prevalence reduction since last pre-MDA survey (%)	*NA*	*42.3 (p=0.012)*	*3.0 (p=0.885)*	37.2 (p=0.137)	-
Relative prevalence reduction since baseline (%)	*NA*	*42.3 (p=0.012)*	*44.1 (p=0.052)*	64.9 (p=0.005)	-
Post MDA prevalence (%)	**	6.8	8.5	8.8	-
Relative prevalence reduction since pre-MDA survey (%)	*+ (p<0.001)*	*56.0 (p=0.001)*	*42.9 (p=0.044)*	5.6 (p=0.868)	-

+ indicates an increase in prevalence instead of relative reduction

Figure 1: Outline of the 5-year M&E programme

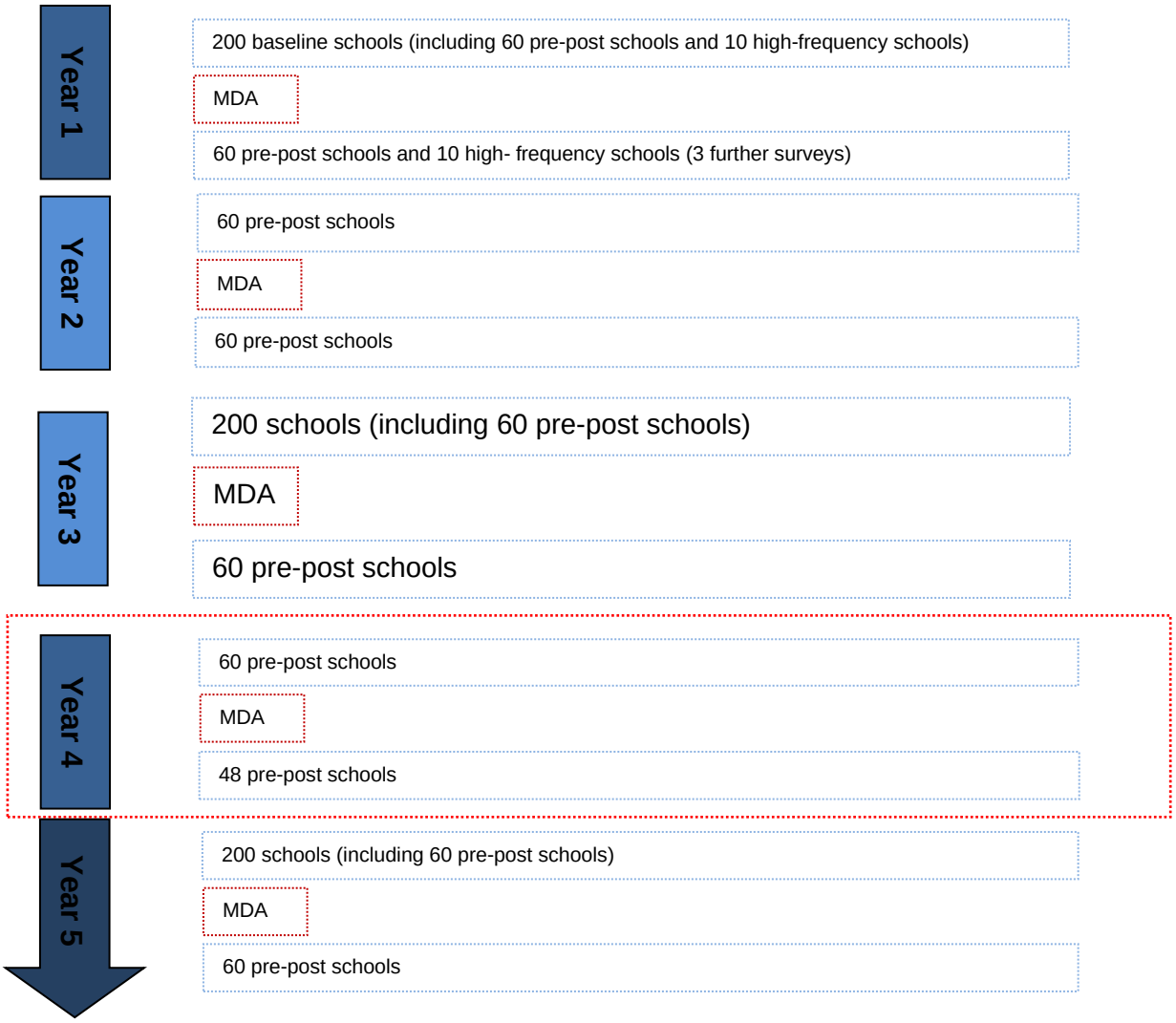

Figure 2: Infection prevalence (%) and prevalence of moderate to heavy intensity of STH infections from Y1 pre-MDA to Y4 post-MDA based on 59 schools

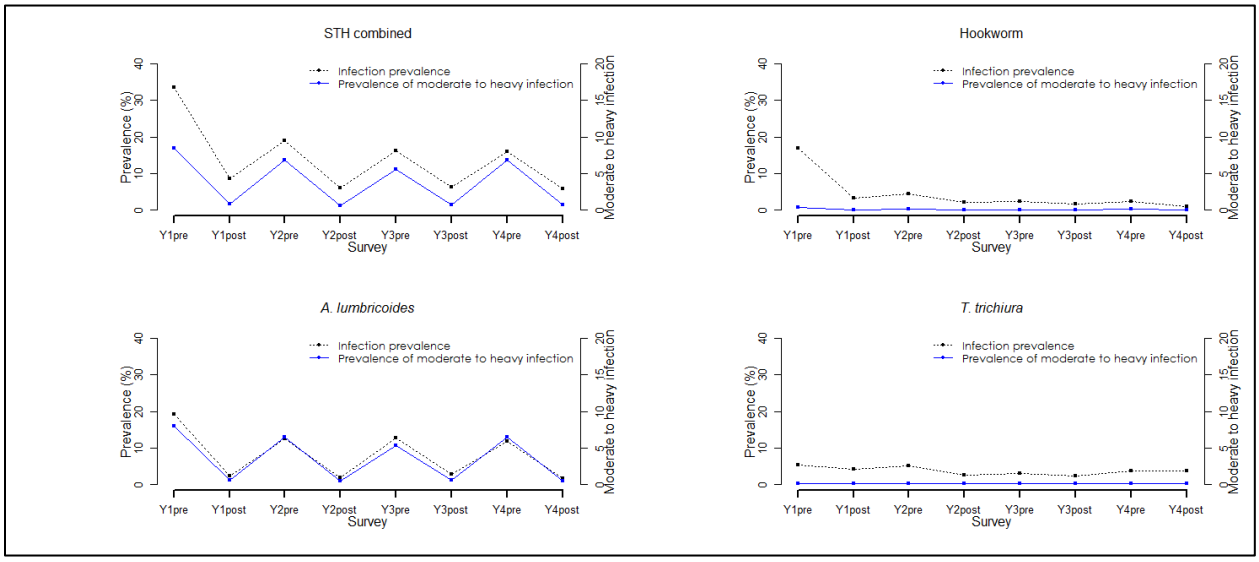

Figure 3: Infection prevalence (%) and prevalence of moderate to heavy intensity of schistosome infections from Y1 pre-MDA to Y4 post-MDA based on 59 schools