Kenya National School Based Deworming Programme

Year 3 (2014-2015) Impact Analysis

Technical Report Based on Data Collected Between 3rd March 2014 and 4th August 2015

16th August, 2016

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Executive Summary

The Kenyan national school based deworming programme was first launched in 2009 targeting more than 8 million school age children out of whom 3.6 million school children were treated for STH in 45 endemic sub-counties. However, this programme faced logistical changes and was re-launched in the year 2012 with Ministries of Health and Education planning to deworm all school age children who live in 66 sub-counties identified as having high prevalence of STH and schistosome infections in Western, Nyanza, Rift-Valley and Coast regions.

The impact of the 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 STH and schistosomiasis prevalence and intensity as well as annual programme effectiveness in terms of reductions in prevalence and intensity and monitor re-infection across years.

Here we present the report for the year 3 result of the M&E programme. The survey consisted of 200 schools surveyed for mid-term assessment and 60 schools surveyed after the third MDA delivery. However, in the Coast region, year 2 treatment was delivered only 1 month before the year 3 surveys, therefore 27 schools were excluded from the analysis to prevent an overestimation of treatment impact. Moreover, 1 school was replaced since the baseline survey in Bungoma County and was therefore excluded together with the replacement school to allow for comparability between baseline and year 3 mid-term surveys.

High treatment coverage has been achieved in all the 16 counties the M&E programme is working on with a total of 5,056,530 (coverage of 78.6%); 5,066,396 (coverage of 76.0%) and 5,270,916 (coverage of 82.2%) children; both enrolled and non-enrolled, being dewormed for STH in years 1, 2 & 3 respectively. For schistosomiasis, a total of 132,767 (coverage of 96.7%); 447,403 (coverage of 83.4%) and 39,446 (coverage of 84.9%) children; both enrolled and non-enrolled, have been dewormed in years 1, 2 & 3 respectively.

STH combined pre-MDA prevalence was 33.2%, 19.1% and 16.4%, with post-MDA prevalence of 8.8%, 6.0% and 6.3% for years 1, 2 & 3 respectively. The immediate reductions were; 73.5%, 68.5% and 60.8% for STH combined for the three years respectively. The prevalence of moderate-heavy intensity of infections were; 8.4%, 6.8% and 5.6% for pre-MDA and 0.9%, 0.6% and 0.7% for post-MDA in years 1, 2 & 3 respectively. Infection with any type of schistosomiasis showed pre-MDA prevalence of 26.6%, 15.4% and 14.9% in years 1, 2 & 3; and post-MDA prevalence of 6.8% and 8.5% in years 2 & 3 respectively. The immediate reductions in prevalence were; 56.0%

and 42.9% in years 2 & 3 respectively. The prevalence of moderate-heavy infections were; (1.7% - 1.4%), (2.5% - 0.7%) and (2.0% - 0.3%) simultaneously for each pre- and post-MDA in years 1, 2 & 3 respectively.

The findings of the M&E programme after three rounds of MDA indicate that STH infections have continued to steadily decline over the three years from initial infection level of 33.6% to 16% for any STH. The overall and immediate relative reductions reported here are within the expectation in a national deworming programme. Results for schistosome infections were haphazard and largely not statistically significant, hence not extensively discussed. For elimination of the parasites to be achieved, other intervention measures alongside preventive chemotherapy need to be considered.

Introduction

From the year 2012, the ministries of health and of education of Kenya have started to deworm all school –age children who live in 66 districts (now sub counties) identified as having a high enough prevalence of soil-transmitted helminth (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 Kenyan 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 (see Appendix 3).

This report presents the survey results of 200 schools surveyed for mid-term assessment in Western, Nyanza, Rift Valley, and Coast regions and 60 schools surveyed after third MDA delivery in the same regions.

However, 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. Moreover, 1 school was replaced since the baseline survey in Bungoma County and was therefore excluded together with the replacement school to allow for comparability between baseline and year 3 mid-term surveys. The full list of these 27 excluded schools is provided in the appendix as table A2. Notably, the 27 schools will be considered for analysis during year 5 (endline) of the study and compared with year 1 (baseline).

Results

Year 3 mid-term surveys were conducted in 16 counties in Western, Nyanza, Rift Valley, and Coast regions between 3rd March 2014 and 19th February 2015. A total number of 21,111 children were surveyed in the 200 schools as shown in table 1. The year 3 preMDA surveys were conducted approximately 1 year after year 2 MDA delivery (209- 383 days), with exception of 27 schools from Coast and some parts of Western Kenya where MDA was delivered 18-45 days prior to the surveys.

Year 3 postMDA surveys were conducted 4-28 days after year 3 MDA delivery in 9 counties between 29th September and 14th October 2014 in Western, Nyanza and Rift Valley regions, with the remaining schools done between 13th June and 4th August 2015 in 7 counties including those from Coast. During these surveys, 6,201 children were examined in 60 schools as shown in table 1.

Soil Transmitted Helminths (STH)

STH – Y3 Mid-Term survey: Changes since Y1 baseline survey

In the remaining 172 schools, the combined baseline STH prevalence was 33.6% (95%CI: 31.2-36.2), with *A. lumbricoides* most prevalent with 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. Combined STH and species specific prevalences by county based on 172 schools are provided in Table 2. There is strong statistical evidence ($p<0.001$) for a reduction in combined STH and species specific prevalence since baseline with highest reductions for hookworm (84.2 %), followed by *A. lumbricoides* (33.3%) and *T. trichiura* (20.0%). The overall relative reductions for combined and species specific STH infections and by county are summarised in table 2 (see Appendix) and figure 2 (below).

Based on the 172 schools, baseline average intensity of infection was 1,914 epg (95%CI: 1601-2288) for *A. lumbricoides*, 62 epg (95%CI: 50-78) for hookworm, and 36 epg (95%CI: 11-122) for *T. trichiura* compared to the year 3 mid-term survey with 1,113 epg (95%CI: 936-1324) for *A. lumbricoides*, 9 epg (95%CI: 5-16) for hookworm, and 19 epg (95%CI: 12-30) for *T. trichiura*. The relative reductions in average intensity since baseline were significant for all three worm types

except *T. trichiura* and were also highest for hookworms, see table 3 (Appendix) and figure 2 (above).

The prevalence of infection by intensity group for baseline and year three mid-term surveys together with their relative reductions are provided in table 4 whereas the year three midterm intensity group by county is given as table A5. Overall, both heavy and moderate intensity of infection for STH combined has reduced by 70.3% ($p=0.095$) and 32.1% ($p<0.001$) respectively.

Assessing the pattern of annual treatment impact and reinfections since baseline to year 3 post MDA based on 59 schools, showed that each species specific infection prevalence and intensity has been reducing steadily, (see figures 3 and 4, below).

Assessment is determined by immediate reductions in infections after year one, two and three treatment delivery followed by reinfections between the treatments. Table 14 summarises the immediate reductions in year 1, 2 & 3.

Maps showing the geographical distribution of infection prevalence and intensity as well as the relative reductions for each STH species in year 1 pre-MDA (baseline) and year 3 pre-MDA are provided in figures 5, 6 and 7. During the baseline, the observed prevalence and intensity of all STH species were highest in Western Kenya while in Coast; pockets of high prevalence of hookworm were observed, and during year three pre-MDA (mid-term), there was observed substantial reduction of hookworm and *T. trichiura* across all the counties.

STH – Y3 pre-MDA survey: Changes since Y2 pre-MDA survey

The analysis of 60 schools monitored yearly pre and post MDA delivery showed a significant reduction in *A. lumbricoides* prevalence and intensity (35.2% and 35.8% respectively) after the first MDA (baseline to year 2 preMDA survey), however, there was no evidence of reduction after the second round of MDA (year 2 preMDA to year 3 preMDA survey), see box 1. On the contrary, significant reductions in *T. trichiura* infections were only observed after the second year of MDA. Hookworm infections decreased after each treatment round. The immediate treatment impact (3-5 weeks after MDA delivery) was significant for each worm type and treatment round, with exception of *T. trichuris* prevalence after year 1 MDA delivery and *A. lumbricoides* prevalence after year 2 MDA. Reinfections after the second year of MDA delivery were highest for *A. lumbricoides* (7.2%); followed by *T. trichiura* (2.8%) and hookworm (2.3%), see box 2.

STH – Y3 Post-MDA survey in 60 schools

Combined and species specific STH prevalences in the 60 schools surveyed pre and post Y3 MDA delivery are summarised in table 5. After year 3 MDA delivery, STH combined prevalence decreased significantly overall (60.9%, p<0.001) and for *A. lumbricoides* (77.9%, p<0.001), hookworm (26.2%, p=0.032) and *T. trichiura* (23.6%, p=0.023). Average intensity of infection decreased significantly overall and for *A. lumbricoides* (87.1%, p<0.001) but not for hookworm and *T. trichiura* (p=0.879 and p=0.294 respectively), see box 3. Prevalences of infection by intensity group in the 60 pre-post MDA schools from baseline to year 3 postMDA and relative reductions for year 1 pre-MDA compared to year 3 pre-MDA are summarised in table 6.

STH – Treatment coverage

The Mass Drug Administration in the Kenyan School – based deworming programme is conducted by Ministry of Health and Ministry of Education in collaboration with Evidence Action. Deworming exercise for Soil transmitted helminths has been consistent and all the 16 counties where the M&E programme is working were covered for treatment in year 1, 2 or 3.

Since 2012, a total of 5,056,530; 5,066,396 and 5,270,916 children (both enrolled and non-enrolled) have been dewormed for STH in years 1, 2 and 3 respectively in the 16 counties being monitored by M&E programme. The overall programme treatment coverage was, 78.6%, 76.0% and 82.2% for years 1, 2 and 3 respectively.

The deworming exercise has treated a total of 11,416; 12,521 and 13,585 primary schools for STH during years 1, 2 and 3 respectively in the 16 counties being monitored by M&E programme. The overall school treatment coverage for years 1, 2 and 3 are 94.7%, 97.5% and 98.9% respectively. The median school coverage per county is shown in the table 7 and figure 8.

Schistosomiasis

It is important to note that during year 3 of the programme implementation no treatment for urinary or intestinal schistosomiasis was delivered due to unavailability of the treatment drug, praziquantel. Nonetheless, the M&E programme evaluated all the counties regardless of whether they were

treated or not to discover any pattern in schistosome infection levels. There was no extra cost for this examination as the teams were already testing children for STH in these schools.

Comparison for both year 1 baseline and year 3 mid-term surveys analysis were similarly based on 172 schools; in the year 3 mid-term survey, schistosomiasis infections were overall low with 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 a prevalence of 7.9% (95%CI 3.8-16.2) with average intensity of 7 epg (95%CI 3-16) for *S. haematobium*. This compares to 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 18.0% (95%CI: 13.0-24.9) with average intensity 20 epg (95%CI: 11-39) for *S. haematobium* in the year 1 baseline 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*, see table 8.

The year 3 post-MDA survey, resulted in a slight drop of both prevalence and intensity to 0.8% (95%CI: 0.4-1.5) with 1 epg (95%CI: 1-2) for *S. mansoni* and 5.6% (95%CI: 2.6-12.8) with 1 epg (95%CI: 0-3) for *S. haematobium*, even though no treatment for schistosomiasis was delivered in all the programme areas during year 3 of the implementation, this indicates non-significant relative reductions in prevalence of 56.6% (p=0.184) for *S. mansoni* and 35.7% (p=0.059) for *S. haematobium*. Surprisingly, the average intensity for both schistosomes parasites showed high relative reductions which were as well statistically significant, see box 4.

Overall, the reductions in prevalence and intensity for both schistosomes parasites during year 1 baseline to year 3 pre-MDA and those for immediate reductions (i.e year 3 pre and post - MDA) are haphazard and largely not statistically significant probably due to lack of schistosomiasis treatment during year 3, see box 4.

The prevalence of light, moderate and heavy intensity of *schistosomiasis* infection, based on 172 schools, comparing year 1 baseline and year 3 mid-term together with their relative reductions is provided in table 9. Only reduction in prevalence of heavy infection for *S. mansoni* was significant (53.7%, p<0.001) while only reduction in light infections of *S. haematobium* was significant (3.9%, p=0.010).

Table 10 and 11 provides schistosomiasis baseline and midterm county prevalence and average intensity, respectively, as well as their relative reductions based on data from 172 schools. Most counties recorded an increase in prevalence rather than reductions with only Homabay (71.7%, p<0.001), Kisii (100%, p<0.001), Kisumu (68.3%, p=0.001) and Nyamira (100%, p<0.001) showing significant reductions in *S. mansoni* infections.

Urine samples were examined for *S. haematobium* infections in 4 counties in the Coast region, with overall and county infection levels and relative reductions shown in tables 10 and 11, only Kwale County indicated a significant reduction in infection of 56.5% (p=0.022).

Schistosomiasis: Treatment coverage

Deworming exercise for schistosomiasis has not been consistent and few counties were covered. Specifically; in year one, only 3 counties were treated (Kilifi, Kwale and Taita taveta), in year two only 7 counties were treated (Busia, Homa bay, Kilifi, Kisumu, Kwale, Migori and Taita taveta) while in year 3 only one county was treated (Busia).

Since 2012, a total of 132,767; 447,403 and 39,446 children (both enrolled and non-enrolled) have been dewormed for schistosomiasis in years 1, 2 and 3 respectively in the 16 counties being monitored by M&E programme. The overall programme treatment coverage was, 96.7%, 83.4% and 84.9% for years 1, 2 and 3 respectively.

A total of 218; 1,368 and 94 primary schools have been dewormed for schistosomiasis in years 1, 2 and 3 respectively in the 16 counties being monitored by M&E programme. The overall school treatment coverage for years 1, 2 and 3 are 96.9%, 93.6% and 95.9% respectively. The median school coverage per county is shown in the table 12.

Discussion

The prevalence and intensity of combined and species specific infections decreased significantly between baseline and the year three midterm surveys conducted in 172 schools after two rounds of MDA delivery. However, the analysis of the subset of schools surveyed yearly pre-and post MDA delivery showed that *A. lumbricoides* infections have not decreased between year 2 preMDA and year 3 preMDA surveys. Reinfections between treatments were higher for *A. lumbricoides* than the other STH species.

The overall relative reductions from baseline to mid-term assessments are compared to results from other deworming programmes in table 13 and show that our findings are largely similar to what these other national programmes have reported, although it is difficult to detect clear trends.

There were considerable variations in overall reduction levels by counties ranging from 20% to 90% for STH combined, 47.7% to 98.7% for hookworm (Taita Taveta county showed an increase in

hookworm prevalence), 9.8% to 100% for *A. lumbricoides* (Busia county showed an increase in *A. lumbricoides* prevalence) and 3.3% to 100% for *T. trichiura* (with Bomet, Busia and Kilifi counties showing increase in *T. trichiura* prevalence). These variations in reduction are likely caused by geographical heterogeneity and varied initial infection levels in these counties, which could affect reinfection rates.

Another study [1], conducted a systematic review and meta-analysis from various studies around the world on efficacy of current drugs against STH infections and reported reductions of 72% for Hookworm, 28% for *T. trichiura*, and 88% for ascaris. This evaluation was not designed as a drug efficacy evaluation, but it is useful to compare immediate (pre- and post-MDA) reductions which show comparable immediate drops in year 1.

The immediate relative reductions for all the three species from year one to three are outlined in table 14 and show that during year one, the reductions were higher except for *T. trichiura*. The year two reductions slightly decreased compared to year one, further the reductions observed in year three were generally lower than the past two years. As the infection levels reduce over the years, the immediate reductions in infection are expectedly smaller. Immediate infection reductions are likely to be influenced by initial prevalence or intensity of infection, treatment coverage, diagnostic limitations (Kato Katz method used by the M&E programme is less sensitive especially when the prevalence is very low) and the length of time between treatment and post-treatment examination. The immediate reductions for light to heavy intensity of infections for STH combined were higher in year one and two than year three. However, for specific species; *A. lumbricoides* and *T. trichiura* immediate reductions have been constant over the three years. Both the overall and immediate relative reductions on moderate to heavy infection intensity for STH are outlined in table 15. After two years of MDA, the programme has successfully reduced heavy and moderate intensity of infection for STH combined by 70.3% and 32.1% respectively. Similar findings were reported in Myanmar, where infections of moderate to heavy intensity reduced from initial prevalence of 18.5% to 7% [2] translating to relative reduction of around 62.2%. However, there the reduction took place after seven years of MDA rather than two.

Results for schistosome infections were haphazard and largely not statistically significant, hence not extensively discussed here, especially because interpretation is confounded bythe to lack of schistosomiasis treatment during year 3. Places like Kwale County, which showed significant reduction for *S. haematobium*, can be attributed to effect of seasonal variations or deworming by other programs. Similarly, counties like Homabay, Kisii, Kisumu and Nyamira showed significant reduction for *S. mansoni*.

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 (WHO, 2011). 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. Maps were created using ArcGIS Desktop version 10.2.2 software (ESRI, Inc., Redlands, CA).

Recommendations to the programme

Generally our results are comparable to what was seen in studies conducted in other countries as shown in Table 13. There is a general fall in infection levels following treatment which begins to climb with time until the next round of treatment is administered according to our observations (figures 3 and 4). The decline is therefore not depicted in a smooth descending line but fluctuates along the years.

The most widely implemented method of controlling STH and schistosomiasis infections is through regular administration of anthelminths drugs. However past studies, have shown that this reduces infection intensity and transmission potential but does not achieve eradication [4], [5]. It would, therefore, be important to consider other intervention measures e.g. WASH alongside preventive chemotherapy for the School – Based Deworming Programme and at household levels through communities to accelerate the elimination these infections. Acceleration of the decline in infections may also be achieved by including the adult population and even children below five years in MDAs in certain set ups, something that the current programme does not focus on.

A total of 5 counties showed an increase in schistosomiasis infection levels while the rest showed non-significant reductions after two years of MDA.

The Kato Katz method of diagnosis used by this programme may not be sensitive enough as a diagnostic tool as infection levels continue to decline as we see in some of the counties. The pursuit for more sensitive methods and strategies is one of the current global concerns.

Conclusion

The analysis of the data from baseline to midterm and pre-post surveys shows that parasite infections are steadily declining overall, and, for specific counties, reducing to very low levels. Kato Katz technique is commonly known to be less sensitive especially at low levels of infection. Therefore, there is need to switch to more sensitive diagnostic methods for detecting STH and schistosome infections especially in counties whose infection levels have significantly declined.

The measurements of the key performance indicators (KPIs) for the programme impact are outlined in the appendix as table A1.

Appendix

Appendix 1: List of Tables

Table 1: Number of schools and children examined by County in year 3

	Pre-MDA		Post-MDA	
County	Number of schools	Number of children	Number of schools	Number of children
BOMET	12	1,298	3	313
BUNGOMA	10	1,035	3	307
BUSIA	18	1,927	6	647
HOMA BAY	24	2,483	6	631
KAKAMEGA	20	2,086	6	608
KERICHO	12	1,297	3	295
KILIFI	10	1,069	3	315
KISII	12	1,265	3	317
KISUMU	10	1,032	3	323
KWALE	18	1,884	6	563
MIGORI	8	863	3	314
MOMBASA	8	844	3	311
NAROK	10	1,062	3	311
NYAMIRA	10	1,073	3	313
TAITA	10	1,068	3	322
VIHIGA	8	825	3	311
Total	200	21,111	60	6,201

Table 2: Year 1 baseline & year 3 mid-term prevalence % (95%CI) and relative reduction (RR) by County, based on data from 172 schools

County	STH combined			Hookworm			A. lumbricoides			T. trichiura		
	Y1 baseline	Y3 mid-term	RR (%)	Y1 baseline	Y3 mid-term	RR (%)	Y1 baseline	Y3 mid-term	RR (%)	Y1 baseline	Y3 mid-term	RR (%)
Overall	33.6 (31.2-36.2)	18.6 (16.4-21.0)	44.7*	15.2 (13.2-17.4)	2.4 (1.8-3.2)	84.2*	20.7 (18.3-23.5)	13.8 (12.0-15.9)	33.3*	6.3 (5.0-8.0)	5.0 (3.7-6.8)	20.0*
BOMET	29.7 (20.1-43.8)	23.3 (15.5-35.2)	21.4*	0.2 (0.0-0.6)	0.1 (0.0-0.5)	50.1	27.9 (18.9-41.3)	20.9 (13.4-32.6)	25.3*	3.9 (2.1-7.3)	5.7 (2.9-11.3)	+
BUNGOMA[$]	49.5 (41.6-58.8)	10.9 (9.5-12.5)	78.0*	44.0 (36.4-53.2)	1.8 (0.7-4.6)	95.9*	30.7 (21.8-43.1)	9.7 (8.6-11.0)	68.3*	0.8 (0.4-1.6)	0	100*
BUSIA	36.1 (31.4-41.6)	25.7 (19.2-34.5)	28.8*	20.9 (16.7-26.1)	3.1 (1.9-5.0)	85.1*	14.4 (10.4-19.8)	15.1 (11.8-19.3)	+	12.5 (8.0-19.3)	14.1 (7.9-25.0)	+
HOMA BAY	30.3 (24.8-37.0)	16.4 (11.6-23.1)	46.1*	14.7 (12.1-18.0)	5.2 (3.4-7.9)	64.8*	17.3 (12.1-24.7)	11.4 (7.1-18.2)	34.1*	5.8 (4.1-8.2)	2.9 (2.0-4.4)	49.2*
KAKAMEGA	31.4 (25.5-38.6)	15.9 (11.0-23.0)	49.3*	23.1 (17.5-30.6)	0.8 (0.4-1.7)	96.5*	23.1 (18.0-29.7)	15.0 (10.1-22.2)	35.4*	0.7 (0.3-1.7)	0.7 (0.3-1.6)	3.3
KERICHO	29.2 (21.3-39.9)	16.7 (11.6-24.0)	42.9*	5.7 (2.9-11.1)	0.1 (0.0-0.5)	98.7*	24.5 (16.9-35.6)	14.6 (9.6-22.0)	40.6*	4.7 (2.6-8.7)	4.0 (2.1-7.6)	15.1
KILIFI	32.7 (30.2-35.5)	5.4 (3.1-9.6)	83.4*	30.9 (28.3-33.6)	3.2 (2.0-5.2)	89.6*	1.2 (0.5-3.3)	0.6 (0.1-4.7)	48.2	1.9 (0.6-5.7)	2.2 (0.7-7.3)	+
KISII	46.8 (40.6-54.1)	26.2 (20.4-33.8)	44.0*	11.1 (6.9-17.8)	1.4 (0.8-2.4)	87.2*	39.7 (32.0-49.1)	25.4 (19.5-33.0)	36.0*	1.3 (0.7-2.3)	1.1 (0.4-3.0)	15.6
KISUMU	17.4 (12.9-23.6)	4.7 (3.3-6.9)	72.8*	8.4 (5.5-12.9)	0.5 (0.2-1.1)	94.3*	7.8 (5.1-12.0)	2.4 (1.5-4.0)	68.9*	4.1 (2.0-8.3)	2.0 (1.3-3.2)	50.4*
KWALE	29.6 (23.0-38.0)	15.6 (9.8-24.6)	47.4*	25.8 (19.3-34.5)	13.5 (8.5-21.4)	47.7*	0.7 (0.3-1.7)	0.6 (0.2-1.8)	9.8	6.0 (3.7-9.9)	3.0 (1.0-9.5)	49.8
MIGORI	22.3 (17.6-28.4)	2.1 (1.3-3.3)	90.7*	20.1 (15.7-25.8)	0.7 (0.4-1.3)	96.5*	3.4 (1.8-6.4)	1.4 (0.7-2.7)	58.6*	0.7 (0.2-2.0)	0.1 (0-0.8)	83.3*
MOMBASA	19.8 (9.1-42.8)	3.0 (1.6-5.7)	85.0*	7.4 (1.5-36.5)	0.7 (0.3-1.7)	91.1*	1.5 (1.0-2.3)	0	100	17.3 (8.5-35.2)	2.3 (1.1-4.9)	86.6*
NAROK	53.0 (47.4-59.2)	39.7 (33.0-47.8)	25.0*	5.0 (2.3-10.9)	0.8 (0.4-1.5)	82.9*	29.3 (20.2-42.3)	20.3 (14.9-27.8)	30.5*	30.2 (20.9-43.5)	26.6 (18.1-39.3)	11.7
NYAMIRA	31.6 (24.1-41.4)	19.1 (14.3-25.5)	39.5*	1.9 (0.9-4.2)	0.4 (0.2-0.8)	80.8*	27.6 (19.0-40.0)	18.8 (14.1-25.2)	31.8*	3.1 (0.6-16.7)	0.5 (0.2-0.9)	84.7*
TAITA	2.8 (1.4-5.5)	0.3 (0-2.3)	88.8	0	0.3 (0-2.3)	+	0.9 (0.1-6.6)	0	100	1.9 (0.7-5.2)	0	100*
VIHIGA	50.2 (43.1-58.6)	35.9 (26.5-48.5)	28.6*	16.0 (9.3-27.6)	1.8 (0.9-3.5)	88.7*	44.4 (36.9-53.4)	33.9 (24.9-46.2)	23.6*	9.9 (5.0-19.5)	7.2 (3.8-13.5)	83.9

* significant reductions

+ indicates an increase in prevalence rather than relative reduction

Table 3: Year 1 baseline & year 3 mid-term average intensity epg (95%CI) and relative reduction (RR) by County, based on data from 172 schools

County	Hookworm			*A. lumbricoides*			T. *trichiura*		
	Y1 baseline	Y3 midterm	RR (%)	Y1 baseline	Y3 midterm	RR (%)	Y1 baseline	Y3 midterm	RR (%)
Overall	62 (50-78)	9 (5-16)	86.2*	1914(1601-2288)	1113(936-1324)	41.8*	36 (11-122)	19 (12-30)	47.5
BOMET	0	0	83.4	3840(2519-5854)	1488(800-2767)	61.3*	6(3-13)	17(7-41)	+
BUNGOMA	270(198-369)	1(1-4)	99.5*	1566(1149-2135)	813(588-1123)	48.1*	10(4-26)	0	100*
BUSIA	112(81-156)	6(3-11)	94.9*	877(598-1285)	1284(939-1757)	+	33(19-59)	59(23-152)	+
HOMA BAY	27(18-40)	30(10-94)	+	1001(569-1761)	798(450-1415)	20.3*	5(3-9)	9(4-18)	+
KAKAMEGA	129(87-192)	1(0-2)	99.4*	1425(1036-1959)	1156(721-1852)	18.9	1(0-3)	1(0-2)	7.4
KERICHO	14(7-32)	0	99.7*	2738(1796-4173)	1232(726-2090)	55.0*	18(7-47)	11(3-42)	41.5
KILIFI	51(32-81)	9(3-27)	83.1*	0(0-1)	0(0-3)	+	2(1-5)	10(2-60)	+
KISII	23(10-53)	11(3-40)	53.9	5147(3560-7440)	2180(1492-3185)	57.6*	1(0-2)	1(0-2)	28.2
KISUMU	15(8-29)	0	97.6*	423(171-1049)	250(134-467)	40.9	11(2-53)	6(2-17)	47.9
KWALE	66(42-105)	38(17-83)	43.3	4(1-22)	41(7-253)	+	4(2-7)	4(1-13)	7.2
MIGORI	19(10-36)	1(0-2)	95.8*	131(63-273)	38(7-199)	70.7	0	0	66.6
MOMBASA	78(14-438)	0	99.9*	94(20-443)	0	100*	11(4-31)	1(0-4)	92.3*
NAROK	44(9-213)	2(0-8)	95.6*	3822(2503-5836)	1539(930-2546)	59.7*	78(40-153)	134(78-227)	+
NYAMIRA	1(0-3)	0	81.5*	3031(1856-4951)	1523(1088-2131)	49.8*	385(54-2730)	3(1-15)	99.2*
TAITA TAVETA	0	0	+	34(5-238)	0	100*	1(0-3)	0	100*
VIHIGA	103(55-195)	11(4-31)	89.7*	3981(3103-5108)	3191(2036-4999)	19.9	31(11-82)	13(5-34)	57.2*

RR; relative reduction in %,

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

+ indicates an increase in intensity rather than relative reduction

Table 4: Prevalence of light, moderate and heavy intensity of infection % (95%CI) in Year 1 & 3, based on data from 172 schools

	Light	Moderate	Heavy
STH combined			
Y1 baseline	23.7 (22.0-25.5)	9.8 (8.3-11.4)	0.2 (0.1-0.5)
Y3 mid-term	11.9 (10.6-13.4)	6.6 (5.6-7.9)	0.0 (0.0-0.1)
Relative reduction	49.7% (p<0.001)	32.1% (p<0.001)	70.3% (p=0.095)
Hookworm			
Y1 baseline	14.9 (13.0-17.1)	0.2 (0.1-0.3)	0.1 (0.0-0.1)
Y3 mid-term	2.3 (1.8-3.1)	0.0 (0.0-0.1)	0.0 (0.0-0.1)
Relative reduction	84.4% (p<0.001)	87.6% (p<0.001)	41.5% (p=0.355)
A. lumbricoides			
Y1 baseline	11.2 (10.0-12.7)	9.5 (8.0-11.2)	NA*
Y3 mid-term	7.5 (6.6-8.6)	6.3 (5.3-7.5)	NA*
Relative reduction	33.1% (p<0.001)	33.5% (p<0.001)	NA*
T. trichiura			
Y1 baseline	6.0 (4.8-7.6)	0.2 (0.1-0.3)	0.1 (0.0-0.7)
Y3 mid-term	4.6 (3.5-6.2)	0.4 (0.2-0.7)	0 (0-0.0)
Relative reduction	22.7% (p=0.002)	Increase (84.3%, p=0.026)	94.0% (p=0.048)

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

Table 5: Year 3 pre- and post-MDA prevalence % (95%CI) by County, based on data from 60 schools

County	STH combined		Hookworm		A. lumbricoides		T. trichiura	
	Y3 Pre-MDA	Y3 Post-MDA	Y3 Pre-MDA	Y3 Post-MDA	Y3 Pre-MDA	Y3 Post-MDA	Y3 Pre-MDA	Y3 Post-MDA
Overall	16.2 (13.1-20.1)	6.3 (4.7-8.5)	2.4 (1.5-3.9)	1.8 (1.1-2.9)	12.7 (9.7-16.5)	2.8 (1.7-4.7)	3.0 (2.0-4.7)	2.3 (1.5-3.7)
BOMET	22.2 (10.6-46.6)	5.0 (0.7-35.1)	0	0	20.7 (10.0-42.4)	0.3 (0.0-2.2)	4.3 (1.1-17.2)	4.5 (0.6-32.8)
BUNGOMA	7.4 (4.9-11.3)	4.9 (1.8-13.5)	0	0	7.4 (4.9-11.3)	4.5 (1.3-15.0)	0	0.3 (0.0-2.2)
BUSIA	19.5 (12.0-31.5)	9.9 (4.9-19.9)	1.2 (0.4-3.8)	1.5 (0.9-2.8)	13.4 (9.0-19.9)	2.3 (1.3-4.2)	8.1 (2.7-24.3)	7.6 (3.0-19.2)
HOMA BAY	21.0 (10.9-40.7)	8.4 (4.5-15.7)	8.7 (4.4-17.5)	5.7 (2.4-13.6)	15.4 (6.6-35.7)	1.4 (0.6-3.5)	3.6 (1.4-9.0)	2.7 (1.3-5.5)
KAKAMEGA	15.9 (9.1-27.6)	3.3 (1.9-5.8)	0.6 (0.2-2.2)	0.7 (0.2-1.8)	14.7 (8.5-25.5)	2.5 (1.3-4.7)	1.1 (0.2-5.9)	0.2 (0.0-1.2)
KERICHO	21.6 (16.5-28.2)	1.7 (0.5-5.4)	0.3 (0.0-2.2)	0	21.3 (16.7-27.2)	1.7 (0.5-5.4)	0.3 (0.0-2.2)	0
KILIFI	5.4 (3.1-9.6)	1.6 (0.5-4.6)	3.2 (2.0-5.2)	0.6 (0.2-1.7)	0.6 (0.1-4.7)	0.3 (0.0-2.3)	2.2 (0.7-7.3)	0.6 (0.2-1.7)
KISII	24.9 (13.1-47.4)	3.8 (0.8-17.0)	2.2 (0.8-5.9)	0.3 (0.0-2.2)	22.7 (11.5-45.1)	3.5 (0.8-15.0)	0.6 (0.2-1.7)	0.3 (0.0-2.2)
KISUMU	5.9 (2.6-13.3)	5.9 (2.4-14.7)	1.0 (0.3-2.9)	1.2 (0.3-4.5)	2.6 (0.8-8.0)	1.5 (0.2-11.0)	2.6 (1.0-6.7)	3.4 (2.1-5.5)
KWALE	10.7 (6.2-18.5)	9.8 (5.8-16.5)	8.9 (4.4-17.8)	7.8 (4.3-14.2)	0.7 (0.2-2.8)	0	1.6 (0.8-3.4)	2.3 (0.9-5.8)
MIGORI	1.9 (1.9-1.9)	1.6 (0.4-6.5)	0.3 (0.0-2.2)	1.6 (0.4-6.5)	1.9 (1.9-1.9)	0.3 (0.0-2.3)	0	0.3 (0.0-2.3)
MOMBASA	3.0 (1.6-5.7)	2.6 (1.1-6.1)	0.7 (2.6-1.7)	0.6 (0.2-1.7)	0	0	2.3 (1.1-4.9)	2.3 (1.1-4.7)
NAROK	24.9 (20.3-30.6)	12.9 (7.3-22.7)	0.6 (0.1-4.4)	0	17.4 (12.5-24.3)	7.7 (4.3-14.0)	10.6 (3.9-28.4)	5.8 (1.3-24.9)
NYAMIRA	25.3 (21.4-30.0)	3.2 (1.6-6.3)	0	0.3 (0.0-2.3)	25.0 (21.5-29.1)	2.9 (1.4-5.9)	0.3 (0.0-2.2)	0
TAITA TAVETA	0.3 (0.0-2.3)	0	0.3 (0.0-2.3)	0	0	0	0	0
VIHIGA	45.9 (35.8-58.8)	21.5 (9.2-50.4)	1.3 (0.8-2.1)	0.3 (0.0-2.2)	43.3 (33.2-56.5)	20.6 (8.5-49.8)	8.3 (4.9-14.0)	2.9 (1.1-7.8)

Table 6: Prevalence of light, moderate and heavy intensity of infection % (95%CI) in Year 1, 2 and 3 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)
Y3 Relative reduction	*56.3% (p<0.001)*	*33.8% (p<0.001)*	*38.3% (p=0.544)*
(Y1 – Y3 pre-MDA)			
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)
Y3 Relative reduction	85.1%(p<0.001)	100%(p<0.001)	*38.3% (p=0.544)*
(Y1 – Y3 pre-MDA)			
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*
Y3 Relative reduction	*34.9% (p<0.001)*	*33.6% (p<0.001)*	*NA**
(Y1 – Y3 pre-MDA)			
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)
Y3 Relative reduction	46.3% (p<0.001)	Increase (54.3%, p=0.182)	0%
(Y1 – Y3 pre-MDA)			

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

Table 7: School treatment coverage by county

County	Year 1		Year 2		Year 3	
	Total schools targeted	Schools treated (coverage %)	Total schools targeted	Schools treated (coverage %)	Total schools targeted	Schools treated (coverage %)
Overall	*12,060*	*11,416 (94.7%)*	*12,843*	*12,521 (97.5%)*	*13,740*	*13,585 (98.9%)*
BOMET	1,005	992 (98.7%)	851	879 (103.3%)	935	955 (102.1%)
BUNGOMA	1,147	1,067 (93.0%)	1,208	1,135 (94.0%)	1,294	1,310 (101.2%)
BUSIA	559	556 (99.5%)	598	567 (94.8%)	654	632 (96.6%)
HOMA BAY	1,264	1,172 (92.7%)	1,381	1,361 (98.6%)	1,430	1,376 (96.2%)
KAKAMEGA	1,107	1,067 (96.3%)	1,215	1,197 (98.5%)	1,380	1,365 (98.9%)
KERICHO	587	561 (95.5%)	808	779 (96.4%)	858	862 (100.5%)
KILIFI	718	675 (94.0%)	758	712 (93.9%)	829	789 (95.2%)
KISII	1,415	1,296 (91.6%)	1,361	1,348 (99.0%)	1,411	1,428 (101.2%)
KISUMU	794	794 (100%)	823	816 (99.1%)	866	861 (99.4%)
KWALE	475	466 (98.1%)	487	451 (92.6%)	506	511 (101.0%)
MIGORI	1,004	982 (97.8%)	1,107	1,081 (97.7%)	1,152	1,150 (99.8%)
MOMBASA	496	456 (91.9%)	585	589 (100.7%)	672	611 (90.9%)
NAROK	263	256 (97.3%)	292	279 (95.5%)	297	303 (102.0%)
NYAMIRA	525	439 (83.6%)	682	637 (93.4%)	702	680 (96.9%)
TAITA TAVETA	237	217 (91.6%)	252	245 (97.2%)	272	270 (99.3%)
VIHIGA	464	421 (90.7%)	435	445 (102.3%)	482	482 (100%)

Table 8: Schistosomiasis: Overall prevalence, average intensity of infection and relative reductions

	S. mansoni	*S. haematobium*
Y1 baseline* Prevalence (%):	2.4 (1.5-4.1)	18.0 (13.0-24.9)
Av. Intensity (epg):	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 (%):	2.7 (0.9-8.1)	6.3 (3.2-12.5)
Av. Intensity (epg):	16 (3-72)	5 (2-11)
Y2 post-MDA Prevalence (%):	0.6 (0.1-2.6)	4.6 (2.0-10.4)
Av. Intensity (epg):	2 (0-9)	4 (2-8)
Y3 mid-term* Prevalence (%):	1.7 (0.8-3.6)	7.9 (3.8-16.2)
Av. Intensity (epg):	6 (2-16)	7 (3-16)
Y3 post-MDA Prevalence (%):	0.8 (0.4-1.5)	5.6 (2.6-12.8)
Av. Intensity (epg):	1 (1-2)	1 (0-3)
Relative Reduction (baseline to mid-term)	PR: 28.6% (p=0.105)	56.2% (p=0.039)
	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

Table 9: Schistosomiasis: Prevalence of light, moderate and heavy intensity of infection % (95%CI) in Year 1 & 3, based on data from 172 schools

Infection	Light	Moderate	Heavy
S. mansoni			
Y1 baseline	1.0 (0.7-1.5)	0.7 (0.4-1.4)	0.7 (0.3-1.8)
Y3 mid-term	0.8 (0.5-1.4)	0.6 (0.2-1.4)	0.3 (0.1-1.0)
Relative reduction	17.2% (p=0.515)	18.1% (p=0.546)	53.7% (p<0.001)
S. haematobium			
Y1 baseline	93.4 (89.9-96.9)	N/A	5.9 (3.5-10.1)
Y3 mid-term	89.7 (85.4-94.2)	N/A	3.2 (1.4-7.3)
Relative reduction	3.9% (p=0.010)	N/A	45.6% (p=0.266)

Table 10: Schistosomiasis: Year 1 baseline & Year 3 mid-term prevalence % (95%CI) and relative reduction % (p-value) by County, based on data from 172 schools

County	*S. mansoni*			*S. haematobium*		
	Y1 baseline	Y3 mid-term	Relative Reduction	Y1 baseline	Y3 mid-term	Relative Reduction
Overall	2.4 (1.5-4.1)	1.7 (0.8-3.6)	28.6 (p=0.105)	18.0 (13.0-24.9)	7.9 (3.8-16.2)	56.2 (p=0.039)
BOMET	0	0.2 (0-0.6)	+ (p<0.001)	-	-	-
BUNGOMA	0	0.1 (0-0.8)	+ (p<0.001)	-	-	-
BUSIA	12.6 (6.1-25.8)	12.1 (5.0-29.6)	3.4 (p=0.837)	-	-	-
HOMA BAY	5.8 (2.9-11.5)	1.7 (1.1-2.5)	71.7 (p<0.001)	-	-	-
KAKAMEGA	0.1 (0-0.4)	0.3 (0.1-1.2)	+ (p=0.280)	-	-	-
KERICHO	0	0.2 (0.1-0.6)	+ (p<0.001)	-	-	-
KILIFI	0	0	0	18.8 (7.2-49.5)	24.0 (7.7-74.3)	+ (p=0.747)
KISII	0.2 (0-0.6)	0	100 (p<0.001)	-	-	-
KISUMU	3.1 (1.4-6.8)	1.0 (0.5-2.0)	68.3 (p=0.001)	-	-	-
KWALE	0.1 (0-0.7)	0.1 (0-0.7)	+ (p=0.972)	17.8 (12.6-25.0)	7.7 (4.2-14.2)	56.5 (p=0.022)
MIGORI	0	0.3 (0.1-1.4)	+ (p<0.001)	-	-	-
MOMBASA	0	0.1 (0-0.8)	+ (p<0.001)	0	0	0
NAROK	1.2 (0.2-8.6)	1.0 (0.2-5.0)	14.7 (p=0.498)	-	-	-
NYAMIRA	0.4 (0.1-1.7)	0	100 (p<0.001)	-	-	-
TAITA TAVETA	0	0	0	0	0	0
VIHIGA	0	0.1 (0-0.9)	+ (p<0.001)	-	-	-

[+] indicates an increase in prevalence between baseline and midterm

Table 11: Schistosomiasis: Year 1 baseline & Year 3 mid-term average intensity epg (95%CI) and relative reduction % (p-value) by County, based on data from 172 schools

County	S. mansoni			*S. haematobium*		
	Y1 baseline	Y3 midterm	RR (%)	Y1 baseline	Y3 midterm	RR (%)
Overall	14 (5-41)	6 (2-16)	55.9*	20 [11-39)	7 (3-16)	63.7
BOMET	0	7(1-50)	+	-	-	-
BUNGOMA	0	0(0-2)	+	-	-	-
BUSIA	123(40-378)	49(17-144)	60.1*	-	-	-
HOMA BAY	6(2-19)	2(1-3)	72.3*	-	-	-
KAKAMEGA	0(0-1)	0(0-1)	+	-	-	-
KERICHO	0	0	0	-	-	-
KILIFI	0	0	0	18(3-109)	22(8-63)	+
KISII	0	0	0	-	-	-
KISUMU	3(1-8)	1(0-2)	63.3*	-	-	-
KWALE	0	0	47.4	21(10-43)	7(3-16)	65.9
MIGORI	0	0	0	-	-	-
MOMBASA	0	0	0	0	0	0
NAROK	4(1-31)	3(0-18)	34.5*	-	-	-
NYAMIRA	0	0	0	-	-	-
TAITA TAVETA	0	0	0	0	0	0
VIHIGA	0	0(0-1)	+	-	-	-

RR; relative reduction in %,

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

+ indicates an increase in intensity rather than relative reduction

Table 12: Schistosomiasis: School treatment coverage by county

County	Year 1		Year 2		Year 3	
	Total schools targeted	Schools treated (coverage %)	Total schools targeted	Schools treated (coverage %)	Total schools targeted	Schools treated (coverage %)
Overall	*225*	*218 (96.9%)*	*1,461*	*1,368 (93.6%)*	*98*	*94 (95.9%)*
BOMET	-	-	-	-	-	-
BUNGOMA	-	-	-	-	-	-
BUSIA	-	-	86	87 (101.2%)	98	94 (95.9%)
HOMA BAY	-	-	505	462 (91.5%)	-	-
KAKAMEGA	-	-	-	-	-	-
KERICHO	-	-	-	-	-	-
KILIFI	71	71 (100%)	101	99 (98.0%)	-	-
KISII	-	-	-	-	-	-
KISUMU	-	-	391	378 (96.7%)	-	-
KWALE	139	129 (92.8%)	204	199 (97.5%)	-	-
MIGORI	-	-	155	124 (80.0%)	-	-
MOMBASA	-	-	-	-	-	-
NAROK	-	-	-	-	-	-
NYAMIRA	-	-	-	-	-	-
TAITA	15	18 (120%)	19	19 (100%)	-	-
VIHIGA	-	-	-	-	-	-

- indicates counties not covered for schistosomiasis treatment

Table 13: Comparison of MDA programmes from other countries

Country	Years of MDA	MDA frequency	Intervention group	Type of anthelmintic	Relative prevalence reduction (%)			Reference
					A. lumbricoides	Hookworms	*T. trichiura*	
Kenya	3	annual	SAC	ALB+PZQ	33.3	84.2	20.0	
Uganda	2	annual	SAC + community in selected locations	ALB+PZQ	78.5	79.0	27.3	[6]
Tanzania	1	annual	SAC	ALB+PZQ	-	19.7	-	[7]
China	2	annual	community	ALB	4.0	93.3	27.7	[8]
	2	bi-annual	community	ALB	50.1	84.3	19.7	
	2	bi-annual[1]	community	ALB	75.0	72.7	41.5	
India	2	annual	community	DEC+ALB	82.7	69.1	62.5	[9]
Indonesia	5	annual	community	DEC+ALB	20.6	85.7	81.8	[10]
Laos	1	bi-annual	PSAC+SAC	MEB	66.7	increase	26.2	[11]
Myanmar	7	bi-annual	PSAC + SAC	ALB	88.0	95.4	67.7	[2]
Sri Lanka	4	annual	community	DEC+ALB	14.9	50.0	increase	[12]

[1]Additional intervention: construction of latrines

Table 14: STH – Summary of overall (172 schools) and immediate (59 schools) relative reductions

Infections	Overall reduction (baseline to midterm)	Immediate reductions (pre-post intervention)		
		Year one	Year two	Year three
STH combined	44.7 (p<0.001)	73.5 (p<0.001)	68.5 (p<0.001)	60.8 (p<0.001)
Hookworm	84.2 (p<0.001)	80.4 (p<0.001)	50.3 (p<0.001)	26.1 (p=0.032)
A. lumbricoides	33.3 (p<0.001)	88.2 (p<0.001)	85.5 (p<0.001)	77.7 (p<0.001)
T. trichiura	20.0 (p=0.012)	20.3 (p=0.077)	48.5 (p<0.001)	24.1 (p=0.021)

Table 15: STH – Summary of overall (172 schools) and immediate (59 schools) relative reductions for moderate to heavy infections

Infections	Overall reduction (baseline to midterm)	Immediate reductions (pre-post intervention)		
		Year one	Year two	Year three
STH combined				
Light	49.7 (p<0.001)	68.0 (p<0.001)	56.0 (p<0.001)	47.5 (p<0.001)
Moderate	32.1 (p<0.001)	90.2 (p<0.001)	91.2 (p<0.001)	87.2 (p<0.001)
Heavy	70.3 (p=0.095)	59.2 (p=0.289)	0 (p<0.001)	32.4 (p=0.705)
Hookworm				
Light	84.4 (p<0.001)	80.3 (p<0.001)	49.6 (p=0.001)	26.7 (p=0.032)
Moderate	87.6 (p<0.001)	88.7 (p=0.006)	49.5 (p=0.278)	0 (p<0.001)
Heavy	41.5 (p=0.355)	79.6 (p=0.151)	0 (p<0.001)	66.2 (p=0.388)
A. lumbricoides				
Light	33.1 (p<0.001)	85.6 (p<0.001)	85.6 (p<0.001)	85.6 (p<0.001)
Moderate	33.3 (p<0.001)	92.0 (p<0.001)	92.0 (p<0.001)	92.0 (p<0.001)
Heavy	NA*	NA*	NA*	NA*
T. trichiura				
Light	22.7 (p=0.002)	21.7 (p<0.049)	21.7 (p=0.049)	21.7 (p=0.049)
Moderate	increase	increase	increase	increase
Heavy	0 (p=0.048)	0 (p<0.001)	0 (p<0.001)	0 (p=0.021)

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	-	-
Relative moderate-heavy prevalence reduction since last pre-MDA survey (%)	*NA*	*19.0 (p=0.006)*	*18.3 (p=0.093)*	-	-
Relative moderate-heavy prevalence reduction since baseline (%)	*NA*	*19.0 (p=0.006)*	*33.8 (p<0.001)*	-	-
Pre-MDA Prevalence (%)	33.2	19.1	16.4	-	-
Relative prevalence reduction since last pre-MDA survey (%)	*NA*	*42.3 (p<0.001)*	*14.3 (p=0.035)*	-	-
Relative prevalence reduction since baseline (%)	*NA*	*42.3 (p<0.001)*	*50.6 (p<0.001)*	-	-
Post-MDA prevalence (%)	8.8	6.0	6.3	-	-
Relative prevalence reduction since pre-MDA survey (%)	*73.5 (p<0.001)*	*68.5 (p<0.001)*	61.4 (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	-	-
Relative moderate-heavy prevalence reduction since last pre-MDA survey (%)	*NA*	*+ (p=0.001)*	*20.0 (p=0.374)*	-	-
Relative moderate-heavy prevalence reduction since baseline (%)	*NA*	*+ (p=0.001)*	*+ (p=0.605)*	-	-
Pre-MDA prevalence (%)	26.6	15.4	14.9	-	-
Relative prevalence reduction since last pre-MDA survey (%)	*NA*	*42.3 (p=0.012)*	*3.0 (p=0.885)*	-	-
Relative prevalence reduction since baseline (%)	*NA*	*42.3 (p=0.012)*	*44.1 (p=0.052)*	-	-
Post MDA prevalence (%)	**	6.8	8.5	-	-
Relative prevalence reduction since pre-MDA survey (%)	*+ (p<0.001)*	*56.0 (p=0.001)*	*42.9 (p=0.044)*	-	-

+ indicates an increase in prevalence instead of relative reduction

Table A2: List of 27 schools from Coast surveyed approximately one month prior to year 3 MDA and excluded in the analysis

County	Latitude	Longitude	School Code	School Name
Mombasa	-4.02255	39.60965	103062	Mother Teresa
Kwale	-4.212305	39.583024	105064	Tiwi
Taita Taveta	-3.39497	38.36075	110014	Sungululu
Kilifi	-2.85497	40.07775	107096	Yedhi
Taita Taveta	-3.46565	38.31616	110113	Nyolo
Kilifi	-3.1388	39.72132	107071	Mkondoni
Kilifi	-3.18787	39.90264	107059	Jilore
Kwale	-4.36247	39.19519	105001	Mbegani
Kilifi	-3.14281	39.82192	107075	Marikano
Kwale	-4.411134	39.346262	109056	Eshu
Kilifi	-3.2341	40.0973	107029	Airport
Taita Taveta	-3.50869	38.3743	110086	Kitivo
Mombasa	-4.08952	39.6538	103046	Mrima
Taita Taveta	-3.39525	38.581	110163	Kalela
Taita Taveta	-3.84608	38.66515	110146	Bungule
Mombasa	-4.0204	39.62696	103026	St. Charles Lwanga
Kwale	-4.46977	39.41091	109077	Kizumbani
Kwale	-4.467961	39.31961	109051	Mwambalazi
Taita Taveta	-3.33101	38.42814	110077	Wongonyi
Kwale	-4.280391	39.564341	109110	Mwakigwena
Kilifi	-3.28771	40.11408	107033	Bakhita
Taita Taveta	-3.36243	38.38449	110010	Ngilinyi
Mombasa	-3.97595	39.60123333	103059	Mreroni
Mombasa	-4.0285	39.62876	103064	Kipevu
Kwale	-4.335368	39.136868	109022	Mwereni
Kwale	-4.294378	39.554802	109107	Magutu
Kilifi	-2.835099	39.98041	107004	Adu

Table A3: STH: Year 1 baseline & Year 3 mid-term prevalence % (95%CI) by County, based on data from 28 schools[$]

County	School (children)	STH combined		Hookworm		A. lumbricoides		T. trichiura	
		Y1 baseline	Y3 mid-term	Y1 baseline	Y3 mid-term	Y1 baseline	Y3 mid-term	Y1 baseline	Y3 mid-term
Overall	28 (6,374)	24.8 (18.9-32.5)	2.8 (1.5-5.3)	18.0 (12.5-26.1)	1.8 (0.7-4.7)	1.2 (0.6-2.1)	0.3 (0.1-1.0)	8.6 (5.6-13.1)	1.1 (0.7-1.8)
BUNGOMA	1 (560)	47.9 ()	5 ()	46.9 ()	0	3.1 ()	5.0 ()	0	0
KILIFI	7 (1,512)	33.9 (25.8-44.4)	1.9 (0.9-3.8)	27.0 (18.3-39.7)	0.7 (0.2-1.8)	2.4 (1.0-5.5)	0.3 (0-1.9)	8.5 (5.0-14.4)	1.1 (0.6-1.9)
KWALE	8 (1,726)	38.5 (30.1-49.4)	5.8 (2.2-15.5)	30.0 (20.3-44.2)	5.0 (1.6-15.3)	0.9 (0.3-3.2)	0.2 (0.1-0.8)	12.4 (5.4-28.2)	1.7 (0.9-3.5)
MOMBASA	5 (1,069)	17.0 (12.7-23.0)	2.2 (1.1-4.3)	4.4 (1.2-16.5)	0.9 (0.2-4.2)	0.9 (0.3-2.8)	0	14.6 (10.5-20.3)	1.5 (0.5-4.0)
TAITA TAVETA	7 (1,507)	2.4 (1.3-4.4)	0.4 (0.1-1.6)	1.3 (0.4-4.0)	0	0.1 (0-0.9)	0	1.2 (0.8-1.8)	0.4 (0.1-1.6)

[$] 27 schools were excluded from the analysis since treatment was delivered only 1 month before the year 3 surveys, also one school was replaced since baseline and is therefore excluded together with the replacement school

Table A4: Schistosomiasis: Year 1 baseline & Year 3 mid-term prevalence % (95%CI) and relative reduction % (p-value) by County, based on data from 28 schools[$]

County	School (children)	*S. mansoni*			*S. haematobium*		
		Y1 baseline	Y3 mid-term	Relative Reduction	Y1 baseline	Y3 mid-term	Relative Reduction
Overall	28 (6,374)	0	0	0	0	0	0
BUNGOMA	1 (560)	0	0	0	-	-	-
KILIFI	7 (1,512)	0	0	0	0	0	0
KWALE	8 (1,726)	0	0	0	0	0	0
MOMBASA	5 (1,069)	0	0	0	0	0	0
TAITA TAVETA	7 (1,507)	0	0	0	0	0	0

[$] 27 schools were excluded from the analysis since treatment was delivered only 1 month before the year 3 surveys, also one school was replaced since baseline and is therefore excluded together with the replacement school

Table A5: STH: Year 3 mid-term prevalence % (95%CI) of moderate – heavy intensity of infection by County, based on data from 172 schools

County	STH combined			Hookworm			A. lumbricoides			T. trichiura		
	light	moderate	heavy	light	moderate	heavy	light	moderate	heavy	light	moderate	heavy
Overall	11.9(10.6-13.4)	6.6(5.6-7.9)	0.0(0-0.1)	2.3(1.8-3.1)	0.0(0-0.1)	0.0(0-0.1)	7.5(6.6-8.6)	6.3(5.3-7.5)	-	4.6(3.5-6.2)	0.4(0.2-0.7)	0.0(0-0)
BOMET	14.2(9.9-20.3)	9.2(4.9-17.2)	0	0.1(0-0.5)	0	0	11.9(7.8-18.0)	9.0(4.8-17.1)	-	5.4(2.7-10.6)	0.3(0.1-0.7)	0
BUNGOMA	7.1(5.2-9.7)	3.9(2.7-5.5)	0	1.8(0.7-4.6)	0	0	5.9(4.5-7.6)	3.9(2.7-5.5)	-	0	0	0
BUSIA	17.3(12.8-23.6)	8.4(5.9-12.0)	0	3.1(1.9-5.0)	0.1(0-0.4)	0	7.7(6.0-9.8)	7.4(5.4-10.2)	-	12.8(7.3-22.4)	1.2(0.4-3.6)	0
HOMA BAY	11.6(8.5-15.9)	4.6(2.6-7.9)	0.2(0-0.7)	5.0(3.3-7.7)	0	0.2(0-0.7)	7.0(4.4-11.0)	4.4(2.5-7.8)	-	2.7(1.8-4.0)	0.2(0.1-0.6)	0
KAKAMEGA	9.3(6.9-12.6)	6.6(4.0-10.9)	0	0.8(0.4-1.7)	0	0	8.3(5.9-11.7)	6.6(4.0-10.9)	-	0.7(0.3-1.6)	0	0
KERICHO	9.7(6.9-13.6)	6.9(3.9-12.3)	0	0.1(0-0.5)	0	0	7.7(5.1-11.6)	6.9(3.8-12.3)	-	3.9(2.0-7.4)	0.2(0-1.1)	0
KILIFI	5.1(3.1-8.4)	0.3(0-2.2)	0	3.2(2.0-5.2)	0	0	0.6(0.1-4.7)	0	-	1.9(0.6-5.7)	0.3(0-2.2)	0
KISII	13.4(10.6-17.0)	12.6(8.8-18.2)	0.2(0-1.1)	1.3(0.8-2.1)	0	0.2(0-1.1)	12.7(9.9-16.3)	12.6(8.8-18.2)	-	1.1(0.4-3.0)	0	0
KISUMU	3.3(2.1-5.1)	1.5(0.8-2.6)	0	0.5(0.2-1.1)	0	0	1.1(0.5-2.5)	1.4(0.7-2.5)	-	1.9(1.2-3.1)	0.1(0-0.7)	0
KWALE	15.0(9.5-23.7)	0.4(0.1-1.2)	0.2(0.1-0.7)	13.1(8.4-20.5)	0.2(0.1-0.7)	0.2(0.1-0.7)	0.4(0.1-1.2)	0.2(0-1.4)	-	3.0(1.0-9.5)	0	0
MIGORI	2.0(1.3-3.0)	0.1(0-0.8)	0	0.7(0.4-1.3)	0	0	1.3(0.7-2.3)	0.1(0-0.8)	-	0.1(0-0.8)	0	0
MOMBASA	3.0(1.6-5.7)	0	0	0.7(0.3-1.7)	0	0	0	0	-	2.3(1.1-4.9)	0	0
NAROK	28.4(22.9-35.2)	11.2(7.4-17.0)	0.1(0-0.7)	0.8(0.5-1.5)	0	0	11.7(8.7-15.6)	8.7(5.0-15.1)	-	23.5(16.3-34.1)	3.0(1.4-6.4)	0.1(0-0.7)
NYAMIRA	10.3(7.4-14.5)	8.8(6.3-12.2)	0	0.4(0.2-0.8)	0	0	10.2(7.3-14.2)	8.7(6.1-12.3)	-	0.4(0.2-0.8)	0.1(0-0.7)	0
TAITA	0.3(0-2.3)	0	0	0.3(0-2.3)	0	0	0	0	-	0	0	0
VIHIGA	18.1(14.0-23.3)	17.8(12.0-26.5)	0	1.7(0.9-3.3)	0.1(0-0.9)	0	16.4(12.8-21.0)	17.6(11.7-26.3)	-	7.0(3.7-13.4)	0.1(0-0.9)	0

Appendix 2: List of Boxes

STH combined:	PR 14.5% (p=0.032)
	IR 16.2 % (p=0.134)
Hookworm:	PR 46.1% (p=0.002)
	IR 66.4% (p=0.001)
A. lumbricoides:	Prevalence increase (1.2%, p=0.863)
	IR 15.0% (p=0.175)
T. trichiura:	PR 40.7% (p<0.001)
	IR 44.5% (p=0.032)

Box 1: Y3 pre-MDA relative reduction in prevalence (PR) and intensity of infection (IR) compared to Y2 pre-MDA survey in 60 schools

STH combined:	PI 11.1% (p<001)
	II 504 epg (p<001)
Hookworm:	PI 2.3% (p<0.001)
	II 5 epg (p<0.001)
A. lumbricoides:	PI 7.2% (p<0.001)
	IR 493 epg (p<0.001)
T. trichiura:	PI 2.8% (p<0.001)
	II 6 epg (p<0.001)

Box 2: Y3 pre-MDA absolute increase (reinfection) in prevalence (PI) and intensity of infection (II) compared to Y2 post-MDA survey in 60 schools

STH combined:	PR 60.9% (p<0.001)
	IR 86.1% (p<0.001)
Hookworm:	PR 26.2% (p=0.032)
	IR 5.5% (p=0.879)
A. lumbricoides:	PR 77.9% (p<0.001)
	IR 87.1% (p<0.001)
T. trichiura:	PR 23.6% (p=0.023)
	IR 27.6% (p=0.294)

Box 3: Y3 pre- and post-MDA relative reduction in prevalence (PR) and intensity of infection (IR) in 60 schools

		S. mansoni	***S. haematobium***
Y1 to Y2 pre-MDA:	PR:	+ (p=0.003)	64.8% (p=0.001)
	IR:	+ (p<0.001)	66.2% (p<0.001)
Y2 to Y3 pre-MDA:	PR:	36.2% (p=0.022)	+ (p=0.378)
	IR:	48.7% (p=0.002)	+ (p=0.170)
Y1 to Y3 pre-MDA:	PR:	3.4% (p=0.815)	50.1% (p=0.117)
	IR:	+ (p=0.186)	38.2% (p=0.373)
Y3 post-MDA reduction:	PR:	56.6% (p=0.184)	35.7% (p=0.059)
	IR:	85.9% (p=0.002)	89.8% (p<0.001)

+ indicates an increase in relative reductions

Box 4: Schistosomiasis*:* Relative reductions by each treatment round based on 59 schools

Appendix 3: List of Figures

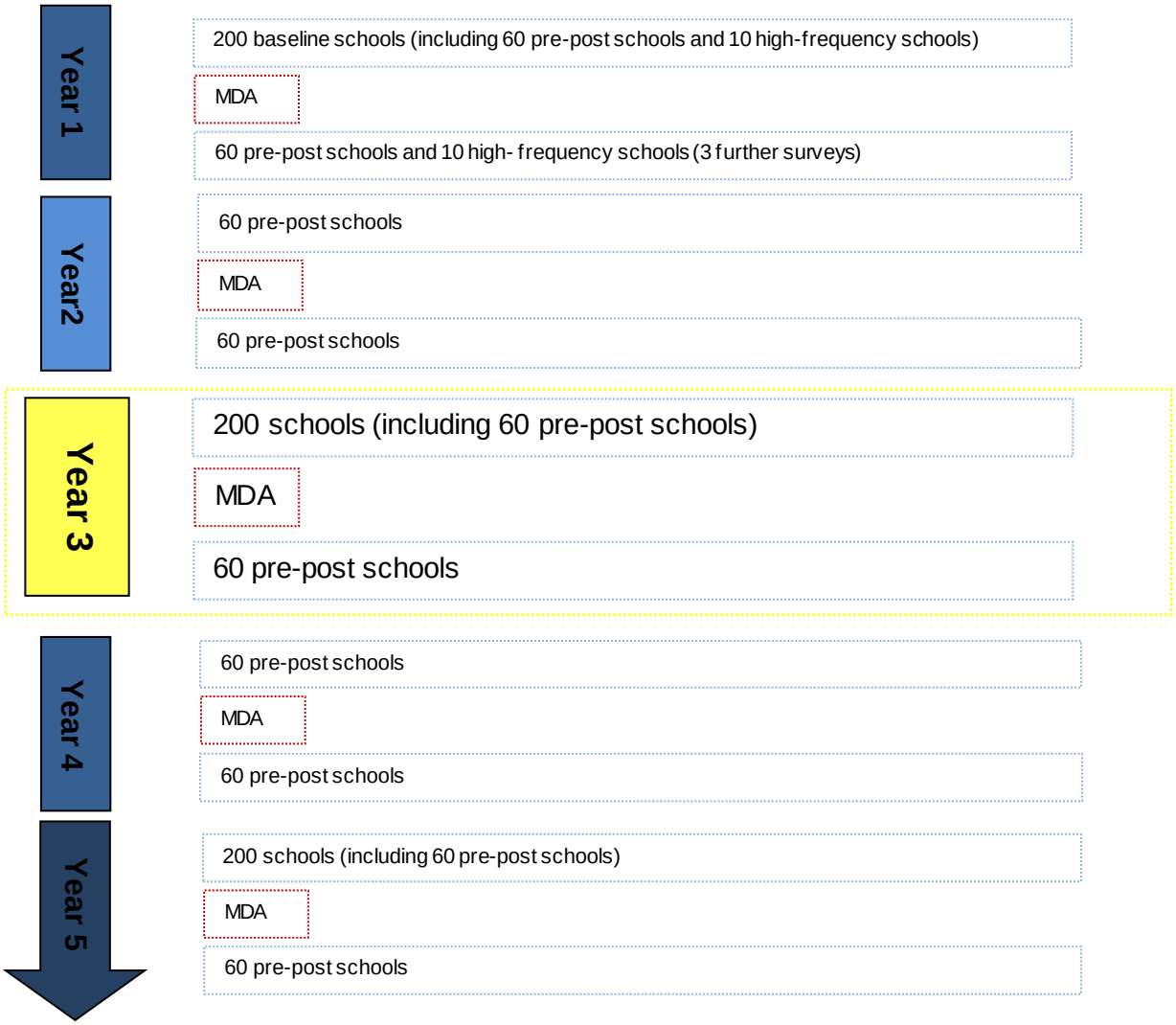


Figure 1: Outline of the 5-year M&E programme

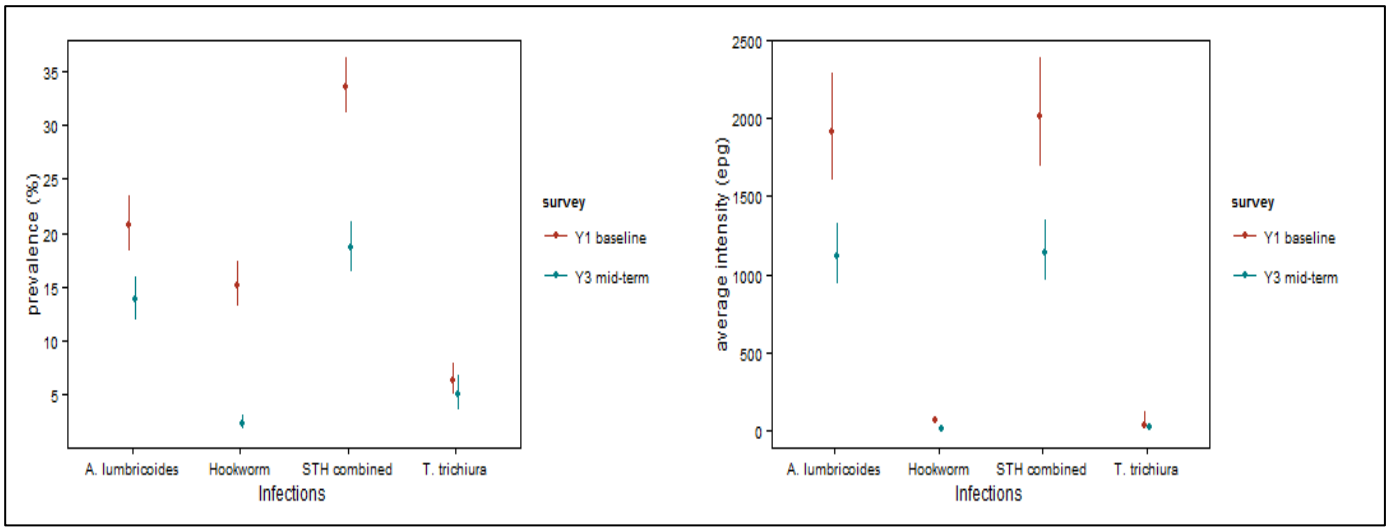


Figure 2: Prevalence and average intensity of infection in 172 schools at baseline and Y3 mid-term

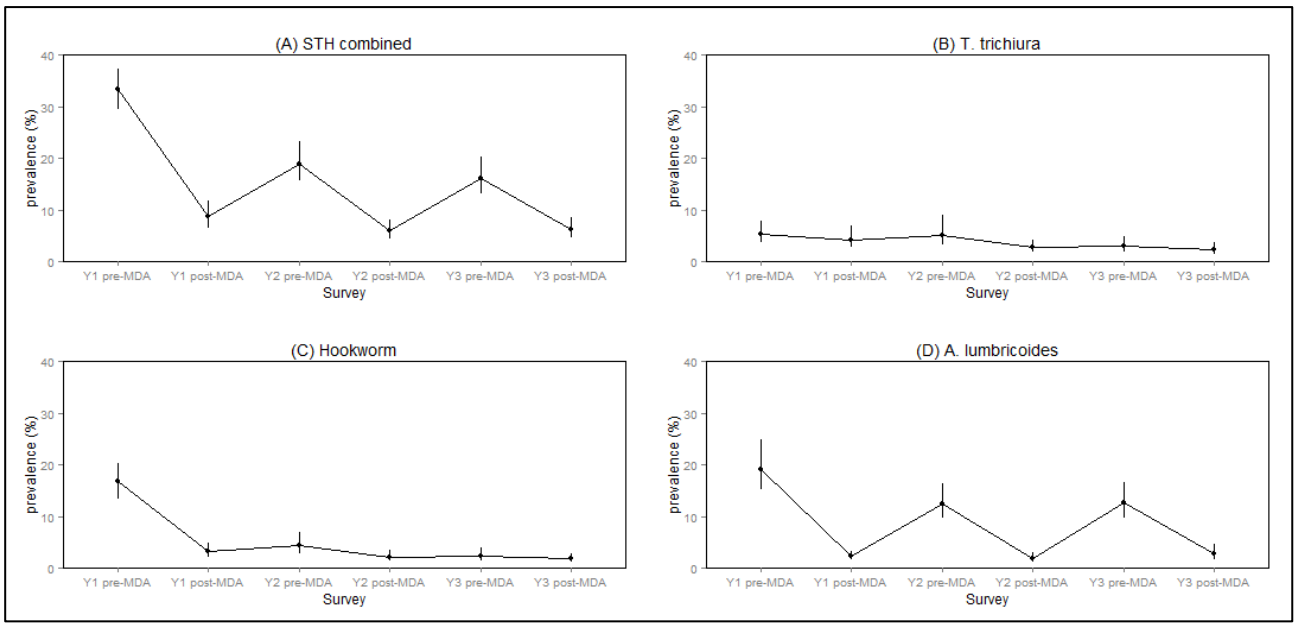


Figure 3: Prevalence (%) of STHs Infections from Y1 pre-MDA to Y3 post-MDA based on 59 schools

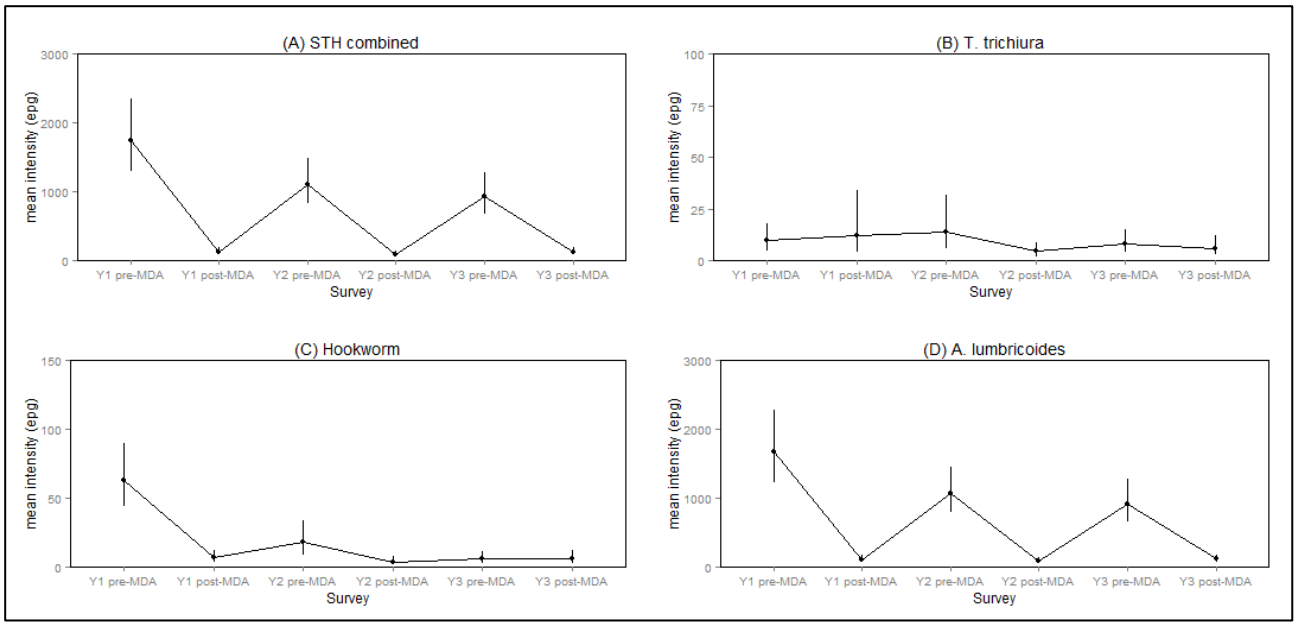


Figure 4: Average Intensity (epg) of STHs Infections from Y1 pre-MDA to Y3 post-MDA based on 59 schools

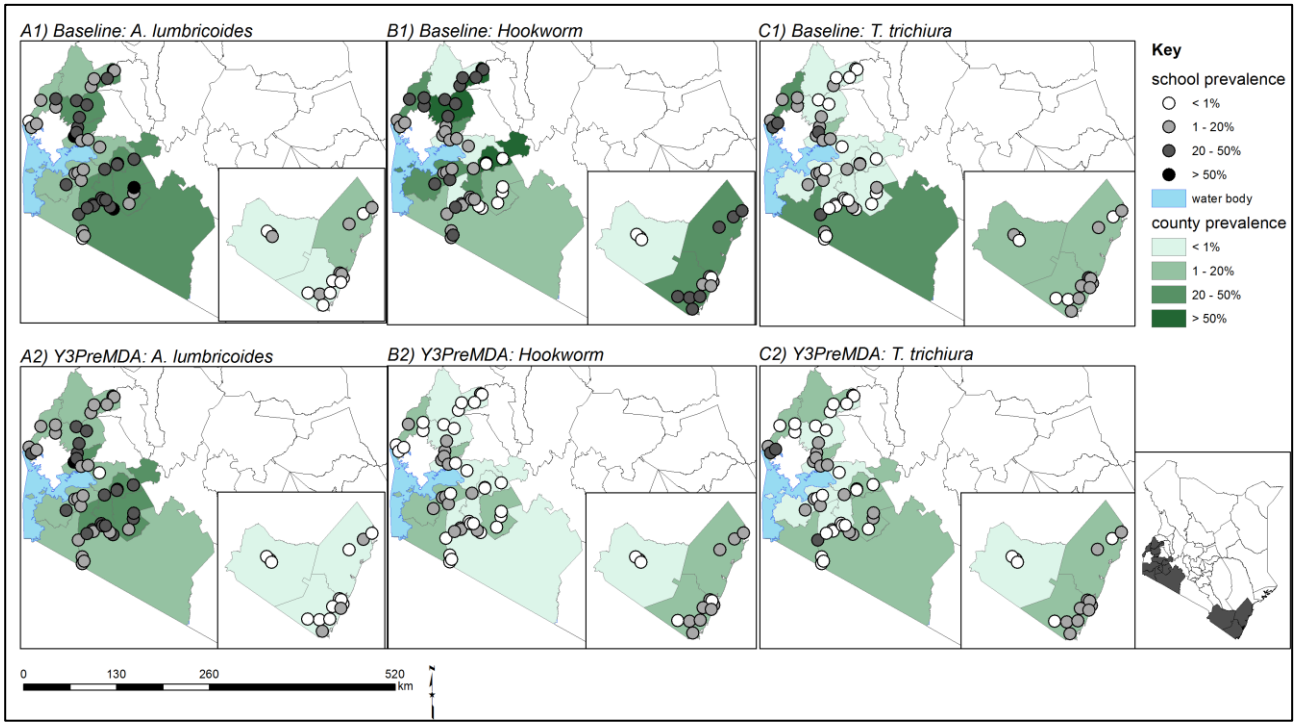


Figure 5: Infections prevalence in baseline and Y3preMDA surveys in 59 schools

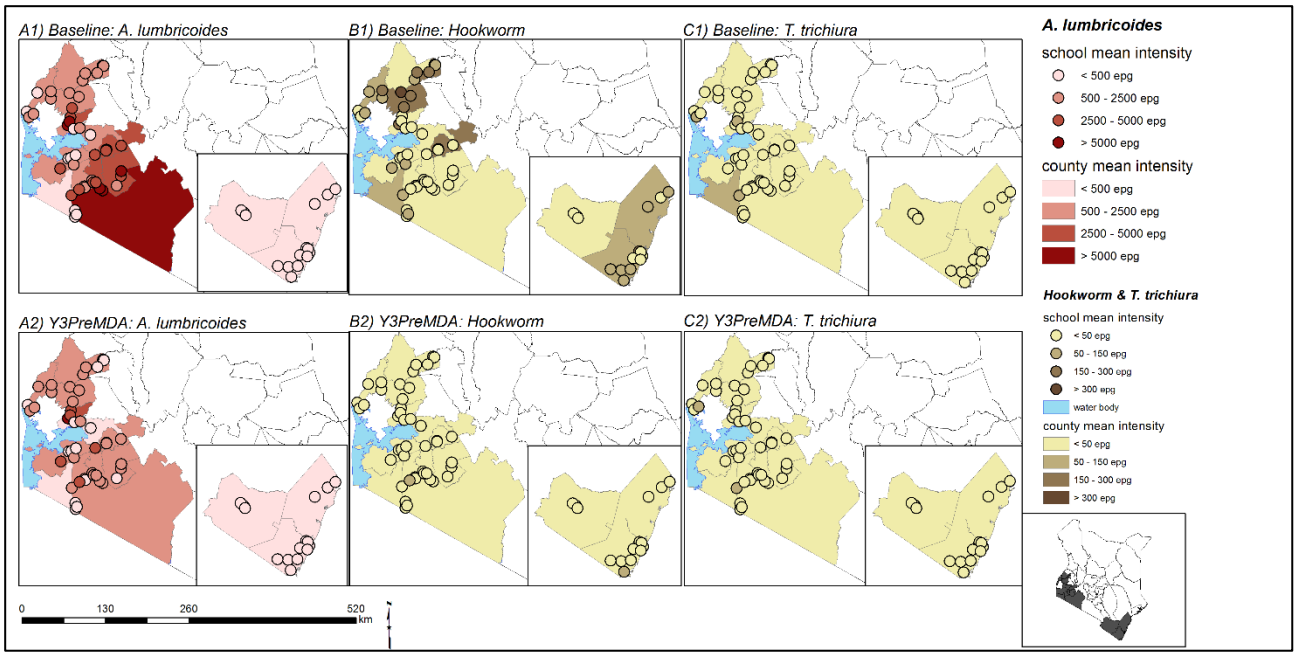


Figure 6: Infections average intensity in baseline and Y3preMDA surveys in 59 schools

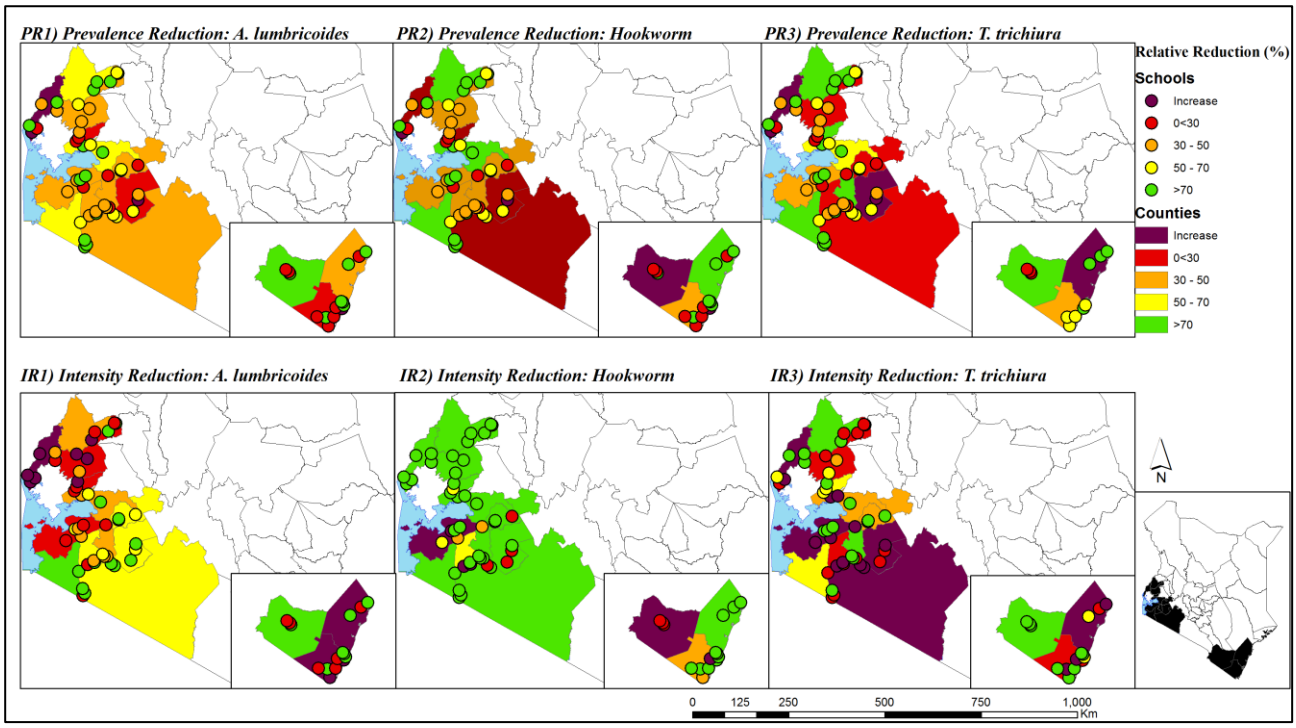
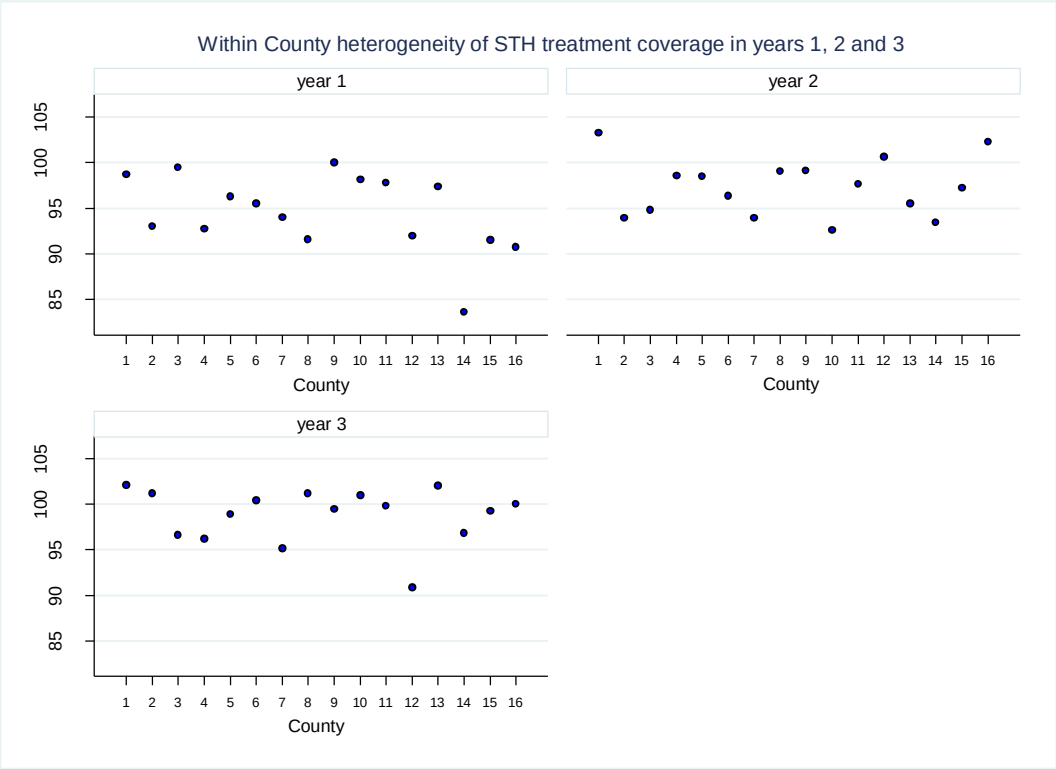


Figure 7: Infections relative reductions (%) in prevalence and average intensity in baseline and Y3preMDA surveys in 59 schools



1 – Bomet, 2 – Bungoma, 3 – Busia, 4 – Homa bay, 5 – Kakamega, 6 – Kericho, 7 – Kilifi, 8 – Kisii, 9 – Kisumu, 10 – Kwale, 11 – Migori, 12 – Mombasa, 13 – Narok, 14 – Nyamira, 15 – Taita taveta, 16 - Vihiga

Figure 8: Median school treatment coverage (%) by county for years 1, 2 and 3

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