Kenya National Deworming Programme

Year 2(2013-2014) Impact Analysis

July 30th, 2014

Introduction

From the year 2012, the ministries of health and of education of Kenya plan to deworm all school –age children who live in 66 districts identified as having a high prevalence of soil-transmitted helminth (STH) infection and schistosomiasis in four provinces. The impact of the Kenyan school-based deworming will be 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. This report presents the results of 60 schools pre and post MDA delivery evaluated in the 2nd year of the M&E programme.

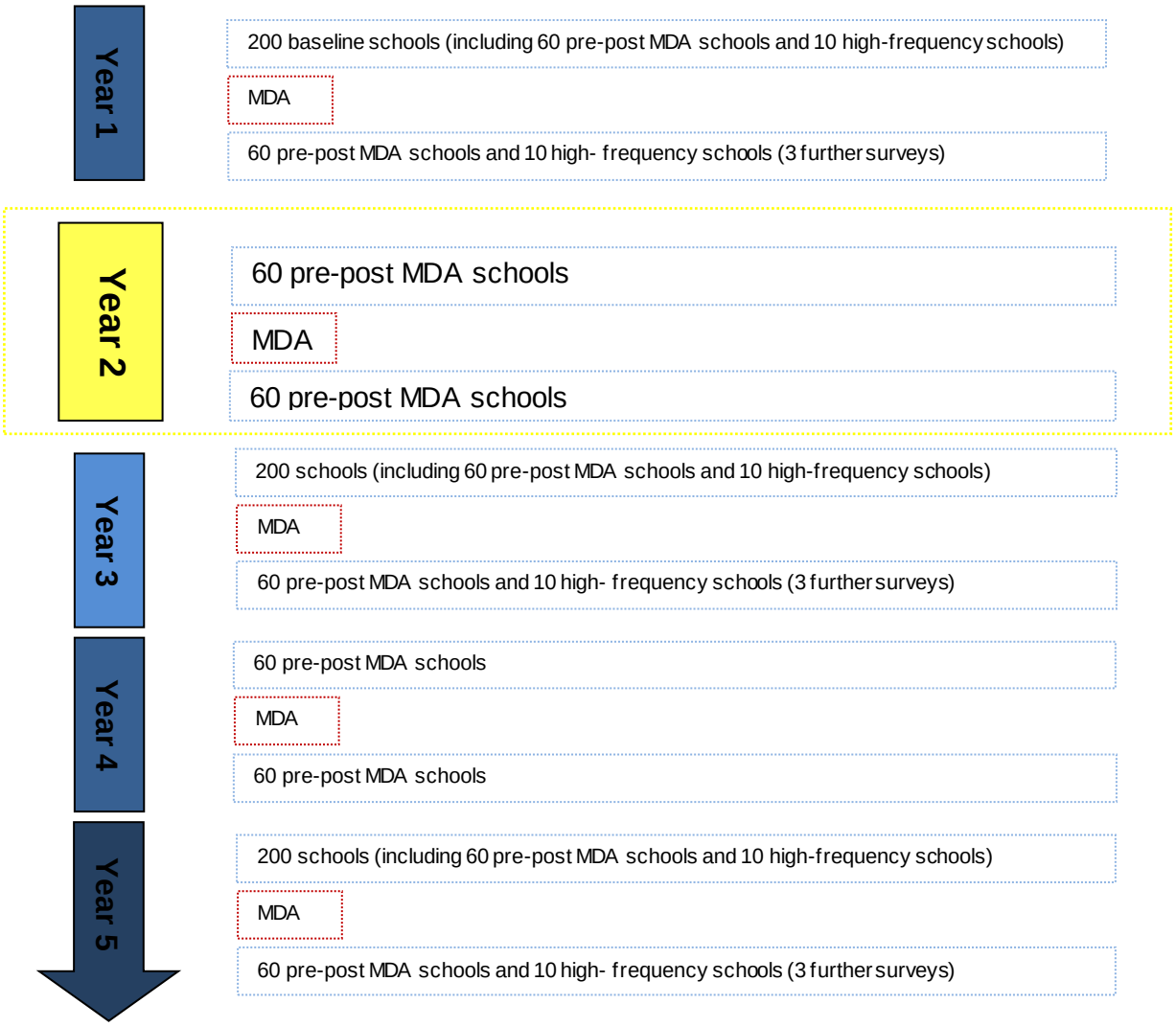


Figure 1 Outline of the 5-year M&E programme

Analysis

Findings in 60 "Pre-post" treatment schools

In Year 2 (Y2), 6,364 and 6,322 children were examined in 60 schools pre and post MDA delivery, respectively. These schools were from Coast, Western, Nyanza and Rift Valley Provinces. The number of schools and examined children per County are summarised in Table 1.The age of surveyed children ranged from 3 to 19 years with a mean age of 10.0 years (sd= 2.6 years) and 50.7% children were male.

County	Number schools	Number children pre-MDA (%)	Number children post-MDA (%)
BOMET	3	313 (4.9)	319 (5.1)
BUNGOMA	3*	297 (4.7)	324 (5.1)
BUSIA	6	641 (10.1)	643 (10.2)
HOMA BAY	6	646 (10.2)	634 (10.0)
KAKAMEGA	6	641 (10.1)	644 (10.2)
KERICHO	3	312 (4.9)	279 (4.4)
KILIFI	3	324 (5.1)	324 (5.1)
KISII	3	320 (5.0)	318 (5.0)
KISUMU	3	295 (4.6)	313 (5.0)
KWALE	6	648 (10.2)	648 (10.3)
MIGORI	3	323 (5.1)	314 (5.0)
MOMBASA	3	324 (5.1)	324 (5.1)
NAROK	3	322 (5.1)	274 (4.3)
NYAMIRA	3	321 (5.0)	320 (5.1)
TAITA	3	318 (5.0)	324 (5.1)
VIHIGA	3	319 (5.0)	320 (5.1)
Total	60	6,364	6,322

Table 1: Number of schools and children examined by County in Year 2 (* 1 school was replaced in Y2)

Soil transmitted helminths - Y2 Pre-MDA survey: Changes since Y1 baseline survey

In the Y2 pre-MDA survey, 19.0% (95% confidence interval (CI) 15.6-23.1) of children in the 60 schools were infected with any STH species. *A. lumbricoides* infections were most common with a prevalence of 12.5% (95%CI 9.6-16.3), followed by *T. trichiura* with 5.1% (95%CI 3.3-8.0). Hookworm was least prevalent with 4.5% (95%CI 2.9-6.8). This compares to the Year 1 (Y1) baseline survey, where STH prevalence was of 33.4% (95%CI 29.7-37.6). *A. lumbricoides* and hookworm were the most common STH species with 19.2% (95%CI 15.1- 24.5) and 16.9% (95%CI 13.7-20.9) prevalence, respectively. Only 5.4% (95%CI 3.8-7.8) of children were infected with *T. trichiura*. The overall prevalence and average intensity of infection by survey are summarised in Table 2.

The changes in overall STH prevalence since the baseline survey are shown in Figure 2. Overall, compared to the baseline survey, STH prevalence was reduced by 43.2% (95%CI 34.1-51.0, p<0.001) and average intensity of infection by 36.3% (95%CI 23.8-46.8, p<0.001). Species specific reductions in prevalence and intensity compared to the baseline survey are summarized in Box 1. *T. trichiura* prevalence and intensity of infection increased insignificantly.

	Y1 baseline Prevalence % (95%CI)	**Y1 post-MDA** Prevalence % (95%CI)	**Y2 pre-MDA** Prevalence % (95%CI)	**Y2 post-MDA** Prevalence % (95%CI)
STH combined	33.4 (29.7-37.6)	8.7 (6.5-11.6)	19.0 (15.6-23.1)	6.0 (4.5-7.9)
Hookworm	16.9 (13.7-20.9)	3.2 (2.2-4.8)	4.5 (2.9-6.8)	2.2 (1.4-3.5)
A. lumbricoides	19.2 (15.1-24.5)	2.3 (1.6-3.2)	12.5 (9.6-16.3)	1.9 (1.1-3.0)
T. trichiura	5.4 (3.8-7.8)	4.3 (2.7-6.9)	5.1 (3.3-8.0)	2.7 (1.8-4.0)
	Avg. Intensity epg (95%CI)	Avg. Intensity epg (95%CI)	Avg. Intensity epg (95%CI)	Avg. Intensity epg (95%CI)
STH combined	1730 (1289-2321)	126 (84-188)	1101 (822-1475)	89 (55-146)
Hookworm	65 (45-92)	7 (4-12)	18 (9-34)	4 (2-8)
A. lumbricoides	1656 (1217-2252)	107 (67-170)	1070 (791-1446)	81 (48-137)
T. trichiura	10 (5-18)	12 (4-34)	14 (6-32)	5 (2-9)

Table 2 Prevalence (%) and average intensity of infection (eggs per gram faeces -epg) of the Y1 baseline and post-MDA surveys and Y2 pre- and post-MDA surveys.

Box 1: Y2 pre-MDA reduction in prevalence (PR) and intensity of infection (IR) compared to Y1 baseline survey

STH combined: PR 43.2% (95%CI 34.1-51.0, p<0.001)

IR 36.3% (95%CI23.8-46.8, p<0.001)

Hookworm: PR 73.6% (95%CI 60.6-82.3, p<0.001)

IR 72.8% (95%CI46.2-86.3, p<0.001)

A. lumbricoides: PR 34.9% (95%CI 24.9-43.6, p<0.001)

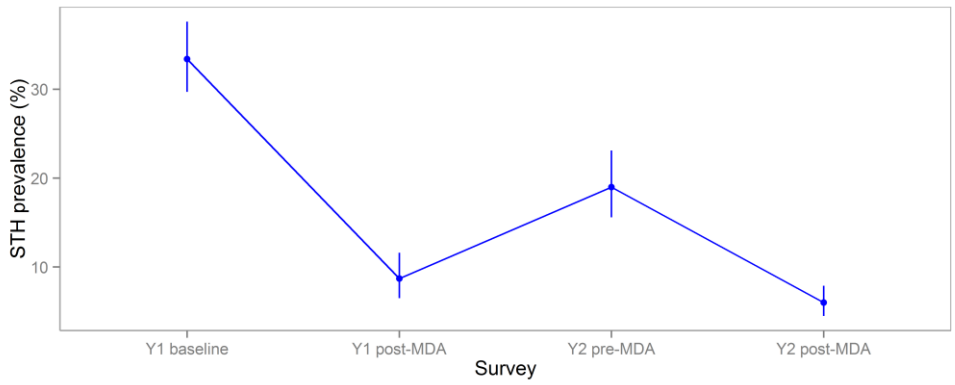
IR 35.4% (95%CI 22.0-46.5, p<0.001)

T. trichiura: PR 5.8% (95%CI *-29.1, p=0.684)

Intensity increase 45.7% (95%CI *-150, p=0.174)

*CI overlaps with increase/decrease

A



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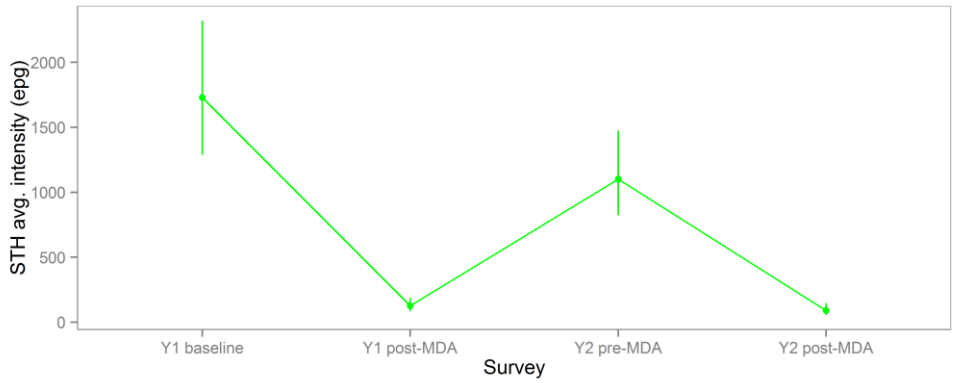

Figure 2 Prevalence (A) and average intensity (B) of STH infections by survey

In the Y2 pre-MDA survey, STH school prevalence ranged from 0-51.9%. STH prevalence was highest in Narok and Vihiga County with 40.1% (95%CI 22.7-70.6%) and 36.4% (95%CI 30.8-43.0), respectively. Average intensity of infection was highest in Vihiga and Kericho County with 3,332 epg (95%CI 2,050-5,415) and 2,756 epg (95%CI 1,734-4,381), respectively. The prevalence and intensity of infections by County is summarised in Tables 3- 4 and Figures 3- 4. Y1 baseline prevalence and average intensity of infection by County are provided in Tables 9-10 in the appendix.

The relative reductions in prevalence and intensity of STH infections are summarised in Table 5. A significant increase in STH intensity compared to the Y1 baseline survey was observed in Kwale County together with a non-significant reduction in STH prevalence. Overall, in 6 and 12 schools STH infections one year after first treatment delivery were higher than in the Y1 baseline survey in terms of prevalence or intensity of infections, respectively.

	STH combined		Hookworm		*A. lumbricoides*		*T. trichiura*	
County	**Y2 Pre-MDA**	**Y2 Post-MDA**	**Y2 Pre-MDA**	**Y2 Post-MDA**	**Y2 Pre-MDA**	**Y2 Post-MDA**	**Y2 Pre-MDA**	**Y2 Post-MDA**
BOMET	24.0 (12.3-46.8)	8.8 (2.3-33.4)	0	0	22.7 (11.8-43.7)	2.2 (0.8-6.0)	5.4 (2.0-14.9)	7.2 (1.3-39.0)
BUNGOMA	18.9 (10.6-33.4)	3.1 (1.5-6.3)	5.1 (0.9-27.8)	0.3 (0.0-2.2)	14.1 (7.9-25.3)	1.5 (0.5-4.4)	1.0 (0.2-6.6)	1.9 (0.6-5.7)
BUSIA	26.1 (16.9-40.2)	8.7 (4.0-18.7)	5.8 (3.1-10.6)	3.6 (1.3-10.0)	14.7 (8.6-25.1)	1.7 (0.6-4.5)	11.9 (4.5-31.1)	4.7 (1.6-13.7)
HOMA BAY	18.4 (9.4-36.0)	11.8 (7.3-19.1)	6.3 (1.9-20.9)	9.3 (6.0-14.3)	11.8 (4.3-32.4)	2.4 (0.7-7.9)	3.3 (1.4-7.4)	3.0 (1.0-9.3)
KAKAMEGA	18.3 (11.1-30.1)	1.7 (0.6-4.7)	2.7 (0.8-8.4)	0.6 (0.2-1.6)	16.2 (10.2-25.9)	0.8 (0.3-2.0)	1.2 (0.4-3.6)	0.3 (0.0-2.2)
KERICHO	22.4 (14.0-36.0)	0.7 (0.1-4.7)	0	0.4 (0.1-2.4)	21.2 (14.2-31.5)	0	3.8 (1.4-10.3)	0.4 (0.1-2.4)
KILIFI	2.5 (0.5-12.3)	0.9 (0.3-2.9)	1.5 (0.2-11.0)	0.9 (0.3-2.9)	0.3 (0.0-2.2)	0	0.9 (0.3-2.9)	0
KISII	26.9 (22.6-31.9)	13.2 (6.1-28.8)	2.2 (1.1-4.6)	0.9 (0.1-6.6)	26.6 (22.4-31.5)	12.6 (5.8-27.2)	0.6 (0.1-4.4)	0
KISUMU	4.7 (2.2-10.4)	2.2 (0.5-10.7)	2.0 (1.1-3.9)	0.3 (0.0-2.3)	1.7 (0.7-4.0)	0	2.7 (0.9-8.1)	1.9 (0.4-8.6)
KWALE	22.2 (12.5-39.5)	7.6 (3.7-15.3)	17.6 (9.2-33.5)	5.2 (2.0-13.6)	0.6 (0.2-1.6)	0.3 (0.0-1.1)	5.6 (2.2-13.7)	2.9 (1.3-6.9)
MIGORI	3.1 (1.0-9.2)	1.3 (0.5-3.4)	2.5 (0.7-8.4)	1.3 (0.5-3.4)	0	0	0.6 (0.2-1.7)	0.3 (0.1-2.2)
MOMBASA	9.3 (3.0-28.7)	6.5 (2.6-15.9)	2.8 (1.0-7.5)	0.6 (0.1-4.4)	0	0.3 (0.0-2.2)	7.4 (2.2-24.8)	5.9 (1.2-16.7
NAROK	40.1 (22.7-70.6)	13.5 (8.6-21.1)	2.2 (0.3-15.5)	0.4 (0.0-3.4)	24.5 (9.5-63.5)	4.0 (1.7-9.5)	19.9 (5.5-71.5)	10.2 (5.3-19.7)
NYAMIRA	20.6 (14.7-28.7)	3.4 (0.8-14.6)	1.2 (0.3-4.5)	0.3 (0.0-2.2)	19.3 (14.7-25.3)	3.4 (0.8-14.6)	0.3 (0.0-2.2)	0
TAITA	0	0.9 (0.1-6.6)	0	0.3 (0.0-2.2)	0	0	0	0.6 (0.1-4.4)
VIHIGA	36.4 (30.8-43.0)	5.9 (2.2-15.9)	4.4 (0.9-20.5)	0.3 (0.0-2.3)	33.9 (29.7-38.6)	2.8 (1.0-7.6)	15.4 (5.5-42.6)	3.8 (1.4-10.1)

Table 3 Y2 pre- and post-MDA prevalence % (95%CI) by County.

	STH combined		Hookworm		*A. lumbricoides*		*T. trichiura*	
County	**Y2 Pre-MDA**	**Y2 Post-MDA**	**Y2 Pre-MDA**	**Y2 Post-MDA**	**Y2 Pre-MDA**	**Y2 Post-MDA**	**Y2 Pre-MDA**	**Y2 Post-MDA**
BOMET	2,331 (1198-4534)	201 (76-536)	0	0	2,321 (1195-4510)	175 (65-468)	10 (4-26)	27 (4-181)
BUNGOMA	1,635 (646-4140)	52 (8-323)	12 (2-76)	0 (0-1)	1,621 (633-4152)	49 (7-325)	2 (0-14)	2 (1-7)
BUSIA	1,314 (759-2273)	95 (30-295)	16 (8-33)	6 (1-27)	1,267 (733-2190)	78 (22-280)	31 (7-128)	10 (3-33)
HOMA BAY	831 (263-2618)	74 (22-247)	18 (3-109)	15 (7-30)	808 (247-2644)	58 (13-264)	4 (1-17)	2 (0-8)
KAKAMEGA	995 (659-1504)	85 (29-248)	5 (1-18)	0 (0-1)	989 (657-1490)	85 (29-247)	2 (0-5)	0 (0-2)
KERICHO	2,756 (1734-4381)	0 (0-1)	0	0 (0-1)	2,750 (1729-4372)	0	7 (3-16)	0
KILIFI	44 (6-309)	3 (1-13)	31 (4-222)	3 (1-13)	12 (2-89)	0	1 (0-2)	0
KISII	1,622 (870-3025)	361 (94-1386)	4 (1-9)	0 (0-1)	1,619 (867-3022)	361 (94-1386)	0 (0-1)	0
KISUMU	137 (57-331)	2 (0-8)	1 (1-2)	0 (0-0)	132 (54-324)	0	4 (1-11)	2 (0-8)
KWALE	130 (61-276)	63 (12-337)	101 (45-224)	15 (4-54)	20 (4-97)	44 (7-290)	9 (3-25)	4 (1-16)
MIGORI	2 (1-7)	1 (0-5)	2 (1-7)	1 (0-5)	0	0	0 (0-1)	0
MOMBASA	19 (5-67)	11 (10-12)	5 (2-14)	3 (0-20)	0	0	14 (4-57)	8 (4-17)
NAROK	2,245 (749-6735)	215 (112-414)	5 (1-39)	0 (0-1)	2,132 (634-7172)	201 (98-412)	108 (17-703)	13 (6-33)
NYAMIRA	1,449 (935-2247)	7 (2-34)	1 (0-2)	0 (0-3)	1,448 (935-2245)	7 (2-31)	0 (0-1)	0
TAITA	0	0 (0-2)	0	0 (0-0)	0	0	0	1 (0-1)
VIHIGA	3,332 (2050-5415)	311 (71-1367)	5 (1-26)	0 (0-1)	3,288 (2036-5312)	303 (68-1355)	39 (13-120)	7 (3-22)

Table 4 Y2 pre- and post-MDA average intensity of infection epg (95%CI) by County.

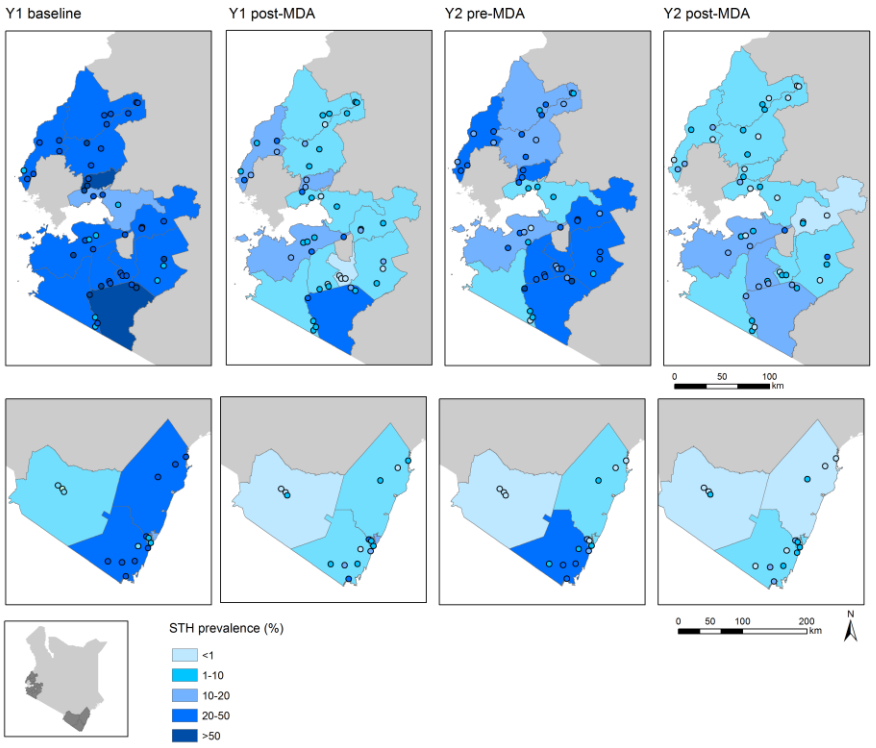

Figure 3 STH prevalence in the Y1 baseline and post-MDA survey and Y2 pre- and post- MDA surveys by County and school.

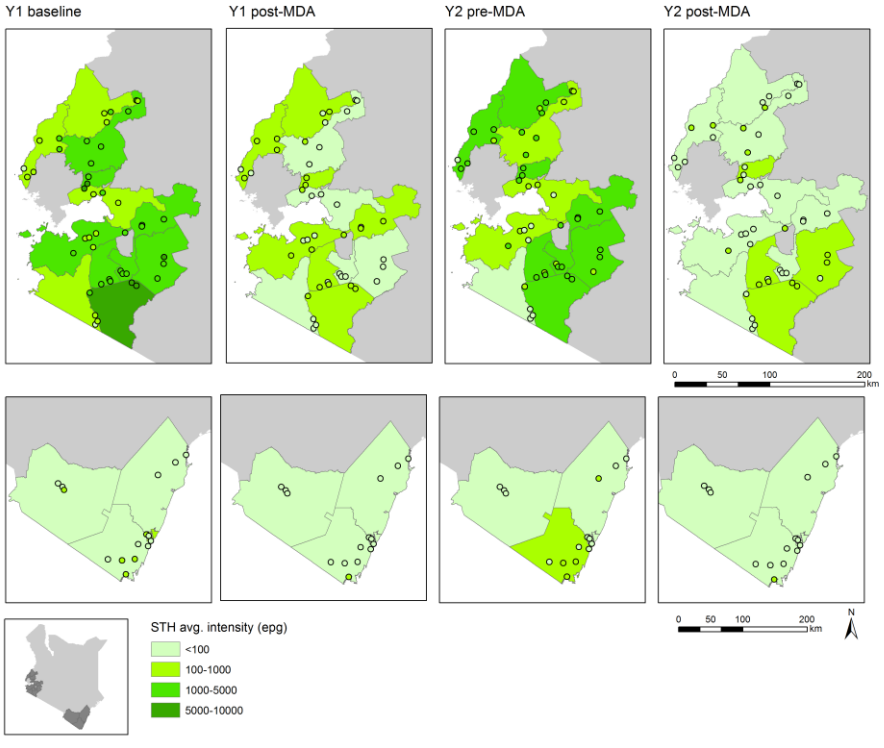

Figure 4 STH average intensity of infection in the Y1 baseline and post-MDA survey and Y2 pre and post- MDA surveys by County and school.

County	PR % (95%CI)	p-value	IR % (95%CI)	p-value
BOMET	24.6 (*-72.5)	0.583	45.0 (8.0-67.1)	0.023
BUNGOMA	56.1 (22.6-75.1)	0.004	* (*-34.9)	0.23
BUSIA	16.8 (*-46.8)	0.418	* (*-22.7)	0.223
HOMA BAY	42.1 (*-68.1)	0.073	42.4 (11.7-62.4)	0.011
KAKAMGA	57.6 (40.0-70.1)	<0.001	48.2 (25.9-63.7)	<0.001
KERICHO	30.8 (9.3-47.2)	0.008	28.5 (7.9-44.6)	0.01
KILIFI	92.5 (65.2-98.4)	0.001	15.7 (*-82.4)	0.83
KISII	42.3 (36.4-47.7)	<0.001	33.9 (*-59.3)	0.094
KISUMU	73.0 (49.7-85.5)	<0.001	83.9 (28.9-96.3)	0.016
KWALE	24.7 (*-50.0)	0.176	* (*-*)	<0.001
MIGORI	85.9 (50.3-96.0)	0.002	97.6 (95.3-98.8)	<0.001
MOMBASA	53.1 (5.1-76.8)	0.035	89.8 (80.7-94.6)	<0.001
NAROK	25.4 (*-54.4)	0.243	61.7 (20.2-81.6)	0.01
NYAMIRA	48.0 (29.3-61.7)	<0.001	45.4 (7.8-67.7)	0.024
TAITA	100		100	
VIHIGA	33.4 (29.7-37.0)	<0.001	30.7 (19.8-40.1)	<0.001

Table 5 Relative reductions in prevalence (PR) and intensity (IR) of STH infections in Y2 pre-MDA survey compared to the Y1 baseline survey (as % of baseline prevalence or average intensity). * indicates an increase

Compared to the Y1 baseline survey, the decrease in the prevalence of heavy intensity infections in the Y2 pre-MDA survey was non-significant for hookworm (p=0.679), however heavy infection prevalence was generally low with 0.08% and 0.06%, respectively. None of the children in the Y1 baseline and Y2 pre-MDA survey were diagnosed with heavy *T. trichiura* infections. *A. lumbricoides* egg counts were truncated below the heavy intensity threshold (eggs were counted up to 24000 epg). The prevalence of moderate intensity infections decreased significantly for *A. lumbricoides* (p=0.009) and with some evidence for hookworm infections (p=0.082); however, increased insignificantly for *T. trichiura* (p=0.075). The prevalence of light infections decreased significantly for hookworm (p<0.001) and *A. lumbricoides* (p<0.001), however not significantly for *T. trichiura* (p=0.584). Prevalence and changes in prevalence of light, moderate and heavy intensity infections are summarized in Box 2.

Box 2: Prevalence of light, moderate and heavy intensity of infection (95%CI) in Y1 baseline and Y2 pre-MDA surveys

	light	moderate	heavy
Hookworm:			
Y1baseline :	16.6 (13.4-20.5)	0.3% (0.1-0.6)	0.1 (0.0-0.2)
Y2 pre-MDA:	4.3 (2.8-6.6)	0.1% (0.0-0.3)	0.1 (0.0-0.2)
Reduction:	74.0 (61.3-82.5, p<0.001)	66.2 (*-90.0, p=0.082)	18.8 (*-17.0, p=0.679)
A. lumbricoides:			
Y1 baseline:	11.3 (8.9-14.4)	7.9% (5.9-10.7)	NA**
Y2 pre-MDA :	6.1 (4.6-8.1)	6.4% (4.7-8.7)	NA**
Reduction:	46.0 (32.8-56.6, p<0.001)	19.1% (5.2-31.0, p=0.009)	NA**
T. trichiura:			
Y1 baseline:	5.3 (3.7-7.6)	0.1% (0.0-0.3)	0
Y2: pre-MDA:	4.9 (3.2-7.5)	0.2% (0.1-0.7)	0
Reduction/ **Increase:**	7.7 (*-30.7, p=0.584)	**77.6% (*-234.3, p=0.075)**	NA

*CI overlaps decrease/increase

** egg counts were truncated at 24000 epg

Soil transmitted helminths - Y2 Pre-MDA survey: Changes since Y1 Post-MDA survey

Compared to the Y1 post-MDA survey, STH prevalence increased by 117.6 % (95%CI 71.0-177.0) in the Y2 pre-MDA survey, while intensity of infection increased by 775.3% (95%CI 517.1-1,141.4). Prevalence and intensity increases were statistically significant for *A. lumbricoides*, the increase in intensity also for hookworm. However, neither prevalence nor intensity increased significantly for *T. trichiura*. Species specific increases are summarized in Box 3. The overall species specific Y1 post-MDA prevalence and intensity of infection are provided in Table 2.

The Y1 post-MDA prevalence and intensity of infection by County are summarized in Figures 3-4 and Tables 11 -12 in the appendix.

Box 3: Y2 pre-MDA increase in prevalence and intensity of infection compared to Y1 post-MDA survey

STH combined: Prevalence increase 117.6% (95%CI 71.0-177.0, p<0.001)
Intensity increase 775.3% (95%CI 517.1-1141.4, p<0.001)

Hookworm: Prevalence increase 39.2% (95 %CI *-108.4, p=0.108)
Intensity increase 141.2% (95%CI 19.2-387.7, p=0.014)

A. lumbricoides: Prevalence increase 447.9% (95%CI 325.3-605.8, p<0.001)
Intensity increase 903.6% (95%CI 579.1-1383.0, p<0.001)

T. trichiura: Prevalence increase 17.8% (95%CI *- 48.7, p=0.169)
Intensity increase 16.3% (95%CI *-87.5, p=0.536)

*CI overlaps with decrease/increase

Soil transmitted helminths - Y2 Post-MDA survey

Post-MDA delivery, STH prevalence dropped to 6.0% (95%CI 4.5-7.9) with *T. trichiura* as most prevalent species with 2.7% (95%CI 1.8-4.0). A similar trend was also observed in the Y1 post-MDA survey. Intensity of infection remains highest for *A. lumbricoides* in both pre- and post-MDA surveys. School level STH prevalence ranged from 0-20.4%. The overall prevalence and average intensity of infections for the Y2 pre-post surveys and the baseline survey are summarized in Table 2, prevalence and average intensity by County in Tables 3-4.

Overall, after MDA delivery in Y2, the prevalence of STH infection decreased by 68.5% (95%CI 60.4-74.9, p<0.001) and intensity by 91.9% (95CI 87.7-94.6, p<0.001). The overall species specific reductions in prevalence and intensity are summarized in Box 4. Species specific prevalence and intensity reductions by County are summarized in Tables 6-7 and Figure 5. STH prevalence reduction was lowest in Mombasa and Homa Bay Counties. Prevalence reductions were not statistically significant in Bomet, Homa Bay, Kisumu and Migori County where pre-MDA prevalence was low. In Taita County, where pre MDA prevalence was 0%, a few cases were detected in the post-MDA survey. STH intensity reduction was lowest and not significant in Kwale, Migori, and Mombasa Counties where pre-MDA average intensity was low.

The prevalence or intensity of STH infections after Y2 treatment delivery increased in 5 schools (3 for prevalence, 3 for intensity, respectively).

Box 4: Y2 post-MDA reduction in prevalence (PR) and intensity of infection (IR) compared to pre-MDA survey

STH combined: PR 68.5% (95%CI 60.4-74.9, p<0.001)
IR 91.9% (95%CI 87.7-94.6, p<0.001)

Hookworm: PR 50.7% (95%CI 25.1-67.6, p=0.001)
IR 67.7% (95%CI 59.6-86.5, p<0.001)

A. lumbricoides: PR 85.2% (95%CI 77.5-90.3, p<0.001)
IR 92.4% (95%CI 88.2-95.2, p<0.001)

T. trichiura: PR 48.1% (95%CI 26.0-63.7, p<0.001)
IR 67.2% (95%CI 21.6-86.3, p<0.001)

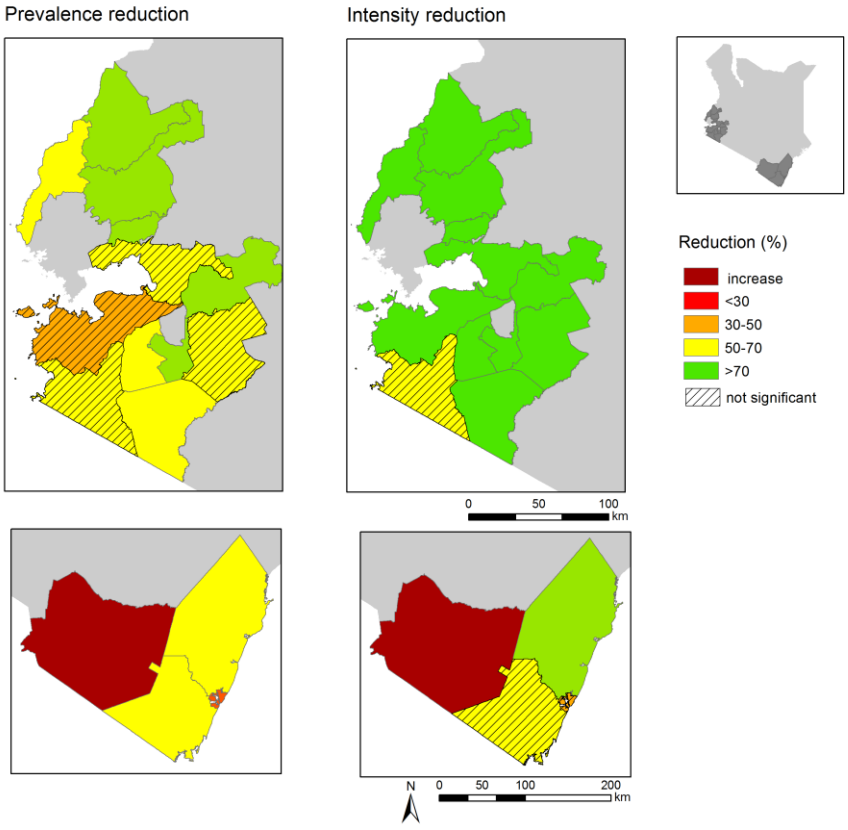

Figure 5 Reduction in STH prevalence and average intensity of infection Y2 post-MDA compared to Y2 pre-MDA by County. In Taita County, a slight increase from 0% prevalence to 0.9% was observed.

County	STH Prev. reduction % (95%CI)	p-value	Hookworm Prev. reduction % (95%CI)	p-value	*A. lumbricoides* Prev. reduction % (95%CI)	p-value	*T. trichiura* Prev. reduction % (95%CI)	p-value
BOMET	63.4 (*-88.8)	0.096	NA		90.3 (86.2-93.2)	<0.001	* (*-77.0)	0.751
BUNGOMA	83.6 (49.8-94.7)	0.002	93.9 (91.1-95.8)	<0.001	89.1 (56.3-97.3)	0.002	*(*-31.6)	0.228
BUSIA	66.6 (44.5-79.9)	<0.001	38.0 (*-66.7)	0.131	88.3 (68.6-95.7)	<0.001	60.6 (33.3-76.8)	0.001
HOMA BAY	35.8 (*-63.4)	0.123	*(*-61.8)	0.577	79.9 (75.0-83.8)	<0.001	7.8 (*-57.8)	0.838
KAKAMEGA	90.6 (81.3-95.3)	<0.001	76.6 (10.0-93.9)	0.035	95.2 (91.4-97.3)	<0.001	75.1 (1.7-93.7)	0.047
KERICHO	96.8 (86.4-99.2)	<0.001	***		100		90.7 (74.1-96.7)	<0.001
KILIFI	62.5 (23.9-81.5)	0.007	40.0 (*-80.6)	0.376	100		100	
KISII	50.9 (8.9-73.5)	0.024	56.9 (*-95.2)	0.452	52.6 (11.1-74.8)	0.020	100	
KISUMU	52.9 (*-78.5)	0.060	84.3 (32.7-96.3)	0.013	100		29.3 (*-61.9)	0.270
KWALE	66.0 (56.9-73.1)	<0.001	70.2 (55.3-80.1)	<0.001	50 (*-76.6)	0.074	47.2 (32.4-58.8)	<0.001
MIGORI	58.9 (*-87.7)	0.148	48.6(*-83.8)	0.259	NA		48.6 (*-90.4)	0.438
MOMBASA	30.0(7.4-47.1))	0.013	77.8 (*-96.6))	0.118	***		20.8(*-42.8)	0.158
NAROK	66.3 (16.2-86.4)	0.019	83.2 (77.7-87.3)	<0.001	83.6 (39.6-95.6)	0.007	48.6 (*-81.3)	0.197
NYAMIRA	83.3 (27.5-96.1)	0.017	74.9 (*-98.0)	0.287	82.2 (23.8-95.8)	0.020	100	
TAITA	***		***		NA		***	
VIHIGA	83.7 (63.0-92.8)	<0.001	92.9 (*-99.7)	0.091	91.7 (80.2-96.5)	<0.001	75.6 (52.2-87.5)	<0.001

Table 6 Reduction in prevalence Y2 post-MDA compared to Y2 pre-MDA. (* CI overlaps with increase, *** slight increase from 0 prevalence, NA where prevalence remained 0%)

	STH		Hookworm		*A. lumbricoides*		*T. trichiura*	
	Int. reduction % (95% CI)	p-value	Int. reduction % (95% CI)	p-value	Int. reduction % (95% CI)	p-value	Int. reduction % (95% CI)	p-value
BOMET	91.4 (87.8-93.9)	<0.001	NA		92.5 (88.1-95.3)	<0.001	* (*-50.5)	0.255
BUNGOMA	96.8 (91.8-98.8)	<0.001	98.5 (98.1-98.8)	<0.001	97.0 (91.9-98.9)	<0.001	* (*-60.8)	0.785
BUSIA	92.8 (75.2-97.9)	<0.001	61.5 (*-86.8)	0.080	93.8 (74.9-98.5)	<0.001	66.0 (34.8-82.3)	0.001
HOMA BAY	91.1 (87.1-93.9)	<0.001	21.1 (*-90.8)	0.830	92.8 (87.3-96.0)	<0.001	59.5 (46.5-69.4)	<0.001
KAKAMEGA	91.4 (82.1-95.9)	<0.001	96.1 (95.0-97.0)	<0.001	91.4 (82.0-95.9)	<0.001	83.4 (56.6-93.7)	<0.001
KERICHO	100 (100-100)	<0.001	***		100		99.3 (97.1-99.9)	<0.001
KISII	77.7 (41.7-91.5)	0.002	95.8 (87.2-98.6)	<0.001	77.7 (41.6-91.5)	0.002	100	
KILIFI	92.1 (81.7-96.6)	<0.001	88.9 (73.5-95.3)	<0.001	100		100	
KISUMU	98.7 (93.9-99.7)	<0.001	97.2 (87.6-99.4)	<0.001	100		52.9 (15.1-73.8)	0.012
KWALE	51.4 (*-87.5)	0.297	85.0 (68.9-92.8)	<0.001	* (*-80.8)	0.522	61.1 (17.1-81.7)	0.014
MIGORI	50.1 (*-92.0)	0.455	45.0 (*-91.9)	0.539	NA		87.1 (*-98.4)	0.056
MOMBASA	43.7 (*-85.5)	0.408	42.9 (*-92.0)	0.577	***		44.2 (*-87.9)	0.455
NAROK	90.4 (70.6-96.9)	<0.001	41.0 (*-94.6)	0.666	90.6 (70.7-97.0)	<0.001	87.6 (37.6-97.5)	0.011
NYAMIRA	99.5 (97.5-99.9)	<0.001	41.0 (*-94.6)	0.666	99.5 (97.7-99.9)	<0.001	100	
TAITA	***		***		NA		***	
VIHIGA	90.7 (65.8-97.5)	<0.001	98.4 (59.3-99.9)	0.012	90.8 (65.2-97.6)	<0.001	80.9 (76.1-84.8)	<0.001

Table 7 Reduction in average intensity of infection Y2 post-MDA compared to Y2 pre-MDA. (* CI overlaps with increase, *** slight increase from 0, NA where intensity remained 0)

Schistosomiasis

In the Y2 pre-MDA survey, *S. mansoni* infections were overall low with a prevalence of 2.7% (95%CI 0.9-8.0) and an average intensity of 15 epg (95%CI 3-71). School level *S. mansoni* prevalence ranged from 0-86.1%. This compares to a prevalence of 1.8% (95%CI 0.5-6.0) and an average intensity of infection of 6 epg (95%CI 1-33) in the Y1 baseline survey. Y1 treatment was delivered only in Coast Province where the baseline *S. mansoni* prevalence and intensity were of 0.1% (95%CI 0.0-0.4) and 0 epg (95%CI 0-0) respectively. Y2 pre-MDA prevalence and intensity of infection in Coast were of 4.4% (95%CI 2.4-8.2) and 0 epg (95%CI 0-0); the increase was not statistically significant (p=0.999 and p=0.843). In the Y2 post-MDA survey, after treatment delivery in Western, Rift Valley, Nyanza and Coast Province, overall *S. mansoni* prevalence and average intensity dropped to 0.6% (95%CI 0.1-2.5) and 2 epg (95%CI 0-9), respectively. This means a 77.2% (95%CI 63.3-85.8) reduction in prevalence and an 88.3% (95%CI 85.6-90.5) reduction in intensity of infection. School level prevalence in the Y2 post-MDA survey ranged from 0-25.9%. Table 8 shows average and maximum school prevalence and intensity by County as well as the % reduction of prevalence and average intensity. *S. mansoni* prevalence and average intensity of infection by County and school are shown in Figures 6-7.

Box 5: *S. mansoni* prevalence, average intensity of infection and reductions

Y1 baseline: Prevalence 1.8% (95%CI 0.5-6.0)
Coast 0.1% (95%CI 0.0-0.4)
Avg. intensity 6 epg (95%CI 1-33)
Coast 0 epg (95%CI 0-0)

Y2 pre-MDA*: Prevalence 2.7% (95%CI 0.9-8.0)
Coast 4.4% (95%CI 2.4-8.2)
Avg. intensity 15 epg (95%CI 3-71)
Coast 0 epg (95%CI 0-0)

Y2 post MDA: Prevalence 0.6% (95%CI 0.1-2.5)
Avg. Intensity 2 epg (95%CI 0-9)**Y2 post-MDA reduction:** Prev. reduction 77.2% (95%CI 63.3-85.8, p<0.001)
Int. reduction 88.3% (95%CI 85.6-90.5, p<0.001)

* Y1 treatment was only delivered in Coast Province

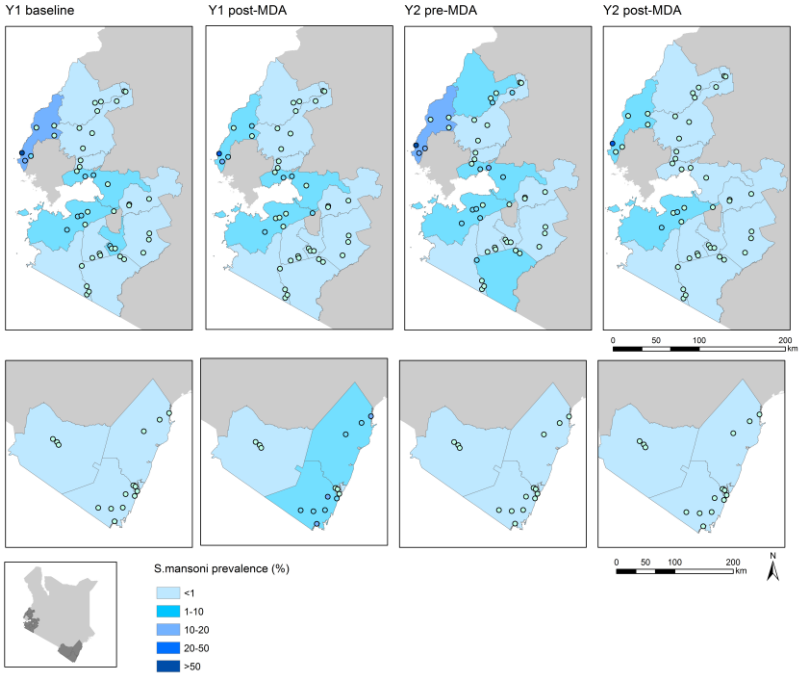

Figure 6 *S. mansoni* prevalence in the Y1 baseline and post-MDA survey and Y2 pre- and post- MDA surveys by County and school. Y1 treatment was only delivered in Coast Province (lower figures).

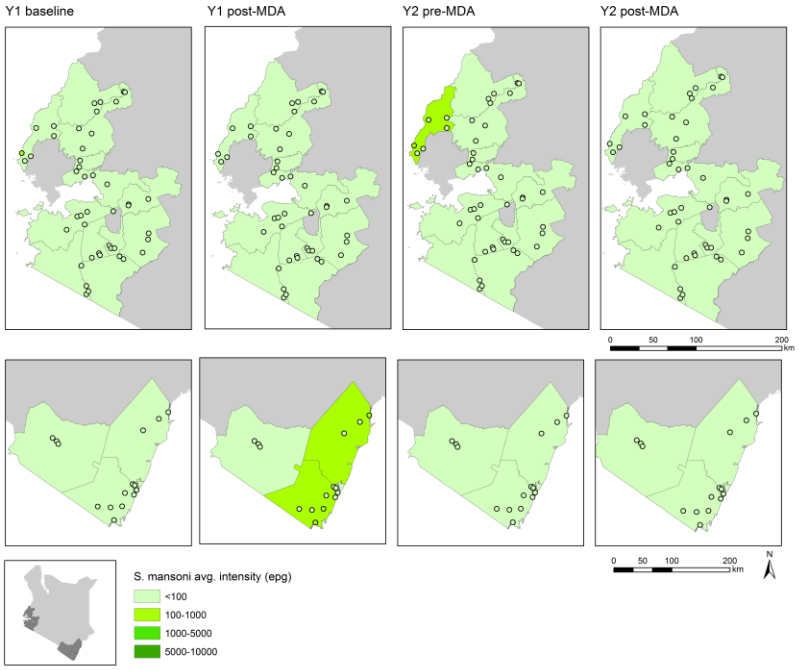

Figure 7 *S. mansoni* average intensity of infection in the Y1 baseline and post-MDA survey and Y2 pre- and post- MDA surveys by County and school. Y1 treatment was only delivered in Coast Province (lower figures).

	Y2 Pre-MDA		Y2 Post-MDA		Y2 Pre-MDA		Y2 Post-MDA			
	Prevalence % (95%CI)	Max school prev %	Prevalence % (95%CI)	Max school prev %	Avg. intensity epg (95%CI)	Max school intensity (epg)	Avg. intensity epg (95%CI)	Max school intensit y (epg)	Prevalence reduction % (95%CI)	Intensity reduction % (95%CI)
BOMET	0	0	0	0	0	0	0	0	NA	NA
BUNGOMA	1.7 (0.3-11.0)	4.6	0.6 (0.2-1.6)	0.9	5 (1-34)	14	3 (1-23)	10	63.3 (*-92.2)	33.7 (26.0-40.6)
BUSIA	18.9 (4.5-79.1)	86.1	4.5 (0.7-29.5)	25.9	128 (21-777)	709	15 (2-98)	85	76.1 (60.0-85.7)	88.6 (87.0-90.0)
HOMA BAY	2.0 (0.9-4.3)	4.6	1.1 (0.4-3.3)	3.8	12 (3-56)	59	1 (0-5)	5	45.1 (*-72.4)	92.3 (90.5-93.7)
KAKAMEGA	0.5 (0.1-1.8)	1.9	0	0	0 (0-1)	1	0	0	100	100
KERICHO	0	0	0	0	0	0	0	0	NA	NA
KISII	0	0	0	0	0	0	0	0	NA	NA
KILIFI	0	0	0	0	0	0	0	0	NA	NA
KISUMU	6.4 (2.2-19.3)	14.1	0	0	14 (4-50)	32	0	0	100	100
KWALE	0.2 (0.0-1.1)	0.9	0	0	0 (0-0)	0	0	0	100	100
MIGORI	0	0	0	0	0	0	0	0	NA	NA
MOMBASA	0	0	0.3 (0.0-2.2)	0.9	0	0	1 (0-6)	3	*	*
NAROK	2.8 (0.4-19.9)	8.4	0	0	7 (1-53)	22	0	0	100	100
NYAMIRA	0	0	0	0	0	0	0	0	NA	NA
TAITA	0	0	0	0	0	0	0	0	NA	NA
VIHIGA	0.31 (0.0-2.2)	0.9	0	0	1 (0-3)	1	0	0	100	100

Table 8 Average and max. school *S. mansoni* prevalence (%) and intensity of infection (epg) (*increase)

Urine samples were examined for *S. haematobium* infections in 9 schools in Coast Province in Kilifi and Kwale Counties. In the Y2 pre-MDA survey, *S. haematobium* prevalence was of 10.5% (95%CI 6.1-18.2) and an average intensity of 8 eggs/10ml urine (95%CI 4-16). School level *S. haematobium* prevalence ranged from 1.0-24.9%. This compares to a prevalence of 18.0% (95%CI 12.6-25.6) and an average intensity of infection of 14 eggs/10ml urine (95%CI 7-30) in the Y1 baseline survey. In the Y2 post-MDA survey, *S. haematobim* prevalence and average intensity dropped to 7.6% (95%CI 3.7-15.6) and 6 eggs/10ml urine (95%CI 3-13), respectively. This means a 27.5% (95%CI *-65.2, p=0.39) reduction in prevalence and 24.1% (95%CI *-63.9) reduction in intensity of infection. Both reductions were statistically not significant. School level prevalence in the Y2 post-MDA survey ranged from 0-22.2%.

Conclusions

Overall, STH prevalence and intensity of infection in the Y2 pre-MDA survey was lower than in the Y1 baseline survey. Moreover, the Y2 MDA delivery achieved a significant reduction in prevalence and intensity for each of the three STH species. Counties with not significant reductions had low pre-MDA prevalence and intensities. *S. mansoni* infection prevalence and intensity decreased significantly after Y2 MDA.

The observed re-occurrence of STH infections to higher than baseline values in 6 schools might be related to the sampling or diagnostic error. However, it should be monitored if the same schools continue to have high re-infection rates in Y3 to potentially adapt the treatment strategy. Similarly, the trend in Kwale County, where STH infection intensity increased since Y1 baseline, should be monitored. Treatment data should be obtainedfor the 5 schools with increased infection prevalence or intensity after Y2 MDA delivery to investigate if treatment was delivered as planned.

Methods of analysis

Infection prevalence and average intensity of infection was calculated for any STH and for each species overall and for each County. 95% confidence intervals (CI) of prevalence were calculated using binomial regression taking into account clustering by school. CIs of average intensity of infection were obtained by negative binomial regression adjusting for school clusters. Relative reductions in prevalence and average intensity of infections (provided as % of baseline prevalence or average intenstiy) were estimated by binomial regression and negative binomial regression, respectively, taking into account school clusters. P-values were obtained by Wald-test. Moderate intensity infections were classified according to WHO guidelines as 2000-3999 epg for hookworm, 5000-49000 epg for *A. lumbricoides*, and 1000-9999 epg for *T. trichiuris.* Heavy intensity infections were classified as >=4000 epg, >=50000 epg, and >=10000 epg, respectively.

Maps of school and County level prevalence and intensity of infection were produced using ArcGIS Desktop 10.

Appendix

County	STH combined	Hookworm	*A. lumbricoides*	*T. trichiura*	*S. mansoni*
BOMET	31.8 (12.8-78.8)	0.3 (0.0-2.2)	29.6 (12.9-68.1)	3.4 (0.5-24.1)	0
BUNGOMA	42.9 (38.2-48.2)	42.3 (38.1-47.0)	7.7 (4.5-13.2)	0.6 (0.1-4.4)	0
BUSIA	31.3 (24.7-39.7)	16.0 (10.7-24.0)	13.7 (8.2-23.1)	11.0 (5.7-20.9)	13.3 (2.8-61.9)
HOMA BAY	31.8 (21.2-47.7)	17.1 (12.7-23.1)	19.4 (8.8-42.7)	5.1 (2.5-10.4)	2.6 (0.9-7.7)
KAKAMEGA	43.1 (35.4-52.3)	37.3 (31.6-44.2)	34.1 (27.4-42.5)	1.2 (0.3-5.0)	0
KERICHO	32.4 (26.2-40.1)	0.6 (0.2-1.6)	31.5 (26.2-37.9)	1.5 (0.7-3.4)	0
KILIFI	32.7 (30.2-35.5)	30.9 (28.3-33.6)	1.2 (0.5-3.3)	1.9 (0.6-5.7)	0
KISII	46.6 (36.3-59.8)	15.7 (11.3-22.0)	38.0 (27.9-51.6)	0.9 (0.3-2.9)	0.3 (0-2.2)
KISUMU	17.6 (12.2-25.3)	7.7 (3.2-18.7)	8.0 (4.5-14.5)	3.4 (1.1-10.9)	1.9 (1.1-3.3)
KWALE	29.5 (20.7-42.0)	25.6 (16.5-39.7)	0.6 (0.2-1.6)	6.2 (3.0-12.8)	0.2 (0.0-1.1)
MIGORI	21.9 (13.6-35.4)	21.0 (12.8-34.3)	1.5 (0.5-4.4)	0.9 (0.1-6.6)	0
MOMBASA	19.8 (9.1-42.8)	7.4 (1.5-36.5)	1.5 (1.0-2.3)	17.3 (8.5-35.2)	0
NAROK	53.7 (47.5-60.7)	5.9 (1.0-35.7)	41.4 (30.5-56.1)	17.0 (4.4-65.8)	0
NYAMIRA	39.5 (31.1-50.3)	4.0 (3.5-4.7)	37.3 (28.8-48.5)	0.6 (0.2-1.6)	1.2 (0.3-4.5)
TAITA	2.8 (1.4-5.5)	0	0.9 (0.1-6.6)	1.9 (0.7-5.2)	0
VIHIGA	54.6 (47.6-62.7)	10.8 (5.2-22.4)	49.4 (41.2-59.1)	12.0 (6.1-23.8)	0

Table 9 Y1 baseline prevalence % (95%CI) by County

County	STH combined	Hookworm	*A. lumbricoides*	*T. trichiura*	*S. mansoni*
BOMET	4,236 (1,980-9,060)	0 (0-0)	4,227 (1,981-9,021)	8 (1-59)	0
BUNGOMA	831 (471-1,467)	167 (139-200)	655 (315-1,361)	10 (1-68)	0
BUSIA	859 (501-1,475)	97 (45-211)	744 (432-1,282)	18 (7-47)	53 (9-325)
HOMA BAY	1,442 (557-3,735)	31 (19-49)	1,408 (533-3,716)	4 (1-10)	1 (0-3)
KAKAMEGA	1,920 (1,273-2,896)	232 (148-363)	1,686 (1,073-2,650)	2 (0-10)	0
KERICHO	3,856 (3,058-4,864)	0 (0-1)	3,855 (3,057-4,862)	1 (0-2)	0
KILIFI	53 (32-86)	51 (32-81)	0 (0-1)	2 (1-5)	0
KISII	2,454(1,639 -3,674)	17 (10-30)	2,436 (1,622-3,658)	0 (0-1)	0 (0-0)
KISUMU	853 (212-3,432)	15 (3-73)	837 (200-3,502)	1 (0-3)	1 (0-3)
KWALE	72 (41-124)	67 (37-121)	0 (0-2)	5 (2-10)	0 (0-1)
MIGORI	104 (37-289)	25 (7-92)	79 (21-293)	0 (0-2)	0
MOMBASA	182 (38-892)	78 (14-438)	94 (20-443)	11 (4-31)	0
NAROK	5,858 (3,513-9,770)	19 (3-133)	5,795 (3,391-9,902)	45 (8-263)	0
NYAMIRA	2,655 (1,811-3,892)	2 (1-6)	2,652 (1,807-3,892)	0 (0-1)	0 (0-1)
TAITA	35 (5-229)	0	34 (5-238)	1 (0-3)	0
VIHIGA	4,806 (3,374-6,845)	67 (19-245)	4,685 (3,310-6,630)	53 (15-186)	0

Table 10 Y1 baseline average intensity of infection epg (95%CI) by County

County	STH combined	Hookworm	*A. lumbricoides*	*T. trichiura*	*S. mansoni*
BOMET	5.9 (1.5-22.7)	0	3.4 (0.8-14.6)	3.1 (0.8-12.2)	0
BUNGOMA	2.5 (1.2-5.1)	1.8 (0.9-3.5)	0.7 (0.2-2.2)	0	0
BUSIA	13.7 (7.2-26.3)	4.5 (1.5-13.1)	4.2 (2.5-7.0)	6.6 (2.5-18.0)	10.0 (3.6-28.1)
HOMA BAY	14.0 (7.9-25.0)	9.7 (5.1-18.4)	2.8 (1.0-8.2)	4.1 (2.0-8.3)	1.1 (0.5 -2.4)
KAKAMEGA	6.5 (3.1-13.5)	4.9 (2.1-11.8)	1.9 (1.1-3.3)	0.5 (0.2-1.1)	0
KERICHO	7.4 (3.1-17.5)	0	6.2 (2.4-15.7)	1.5 (0.7-3.4)	0
KILIFI	3.1 (1.0-9.7)	1.6 (0.7-3.6)	0	1.6 (0.4-6.7)	7.0 (2.1-23.1)
KISII	4.6 (1.6-13.1)	0	4.0 (1.2-13.0)	1.9 (0.7-4.9)	0
KISUMU	2.2 (1.2-3.8)	0.6 (0.2-1.6)	0.3 (0.0-2.2)	1.2 (0.8-2.0)	2.2 (0.6-7.3)
KWALE	9.2 (4.5-18.6)	6.1 (2.6-14.3)	0.3 (0.1-1.1)	3.7 (1.2-11.2)	7.5 (4.6-12.2)
MIGORI	2.7 (1.6-4.4)	2.2 (1.4-3.6)	0.4 (0.1-2.6)	0	0
MOMBASA	11.5 (3.2-41.5)	2.6 (0.5-12.4)	0	10.5 (3.1-35.8)	0
NAROK	23.8 (8.0-70.6)	2.5 (0.3-17.5)	2.8 (2.8-2.8)	21.0 (6.1-72.0)	0
NYAMIRA	0.6 (0.2-1.6)	0.3 (0.0-2.2)	0.6 (0.2-1.6)	0	0
TAITA	1.0 (0.1-6.6)	0	0	1.0 (0.1-6.6)	0
VIHIGA	19.4 (14.6-25.9)	1.9 (0.6-5.7)	8.0 (6.9-9.3)	13.6 (7.3-25.3)	0

Table 11 Y1 post-MDA prevalence % (95%CI) by County

County	STH combined	Hookworm	*A. lumbricoides*	*T. trichiura*	*S. mansoni*
BOMET	23 (4-135)	0	11 (2-59)	11 (2-78)	0
BUNGOMA	105 (21-533)	16 (5-56)	89 (16-486)	0	0
BUSIA	146 (66-325)	6 (2-16)	133 (56-314)	8 (2-34)	19 (7-52)
HOMA BAY	203 (68-603)	19 (5-68)	182 (54-615)	2 (1-3)	1 (0-2)
KAKAMEGA	74 (21-255)	13 (4-50)	60 (17-209)	0 (0-1)	0
KERICHO	274 (103-727)	0	274 (103-726)	0 (0-1)	0
KISII	164 (61-437)	0	131 (43-401)	33 (5-225)	0
KILIFI	11 (2-67.4)	10 (2-62)	0	1 (0-5)	250 (38-1652)
KWALE	55 (11-267)	12 (5-30)	37 (5-264)	5 (2-18)	125 (39-400.0)
KISUMU	4 (1-25)	0 (0-0)	4 (1-28)	0 (0-1)	4(1-14)
MIGORI	4 (1-17)	1 (1-2)	3 (1-17)	0	0
MOMBASA	27 (7-103)	11 (2-54)	0	16 (5-52)	0
NAROK	290 (212-396)	4 (1-30)	159 (61-415)	126 (21-746)	0
NYAMIRA	3 (1-12)	0 (0-2)	3 (1-10)	0	0
TAITA	1 (0-4)	0	0	1 (0-4)	0
VIHIGA	605 (308-1,189)	3 (1-7)	588 (284-1,220)	14 (4-55)	0

Table 12 Y1 post-MDA average intensity of infection epg (95%CI) by County