CHAPTER IV

RESULTS

4.1 GENERAL CHARACTERISTICS OF THE PARTICIPANTS (BASELINE ASSESSMENT)

The demographic and socioeconomic characteristics of the participants are shown in Table 4.1. Four hundred and ninety eight school children aged between 6 and 12 years, with a median age of 9 years (IQR 8 – 11 years) had participated in this study. The children were from 20 villages in Lipis, Pahang. Of these children, 50.6% were boys and 49.4% were girls. In general, poverty prevails in these communities and about two thirds of the families had low monthly income (<RM500, ~ 156 USD); the poverty income threshold in Malaysia. Moreover, about half and 40.2% of the mothers and fathers, respectively, had no formal education. A majority of the mothers and two thirds of the fathers are not working. Those working were mainly engaged in agriculture (rubber and oil palm plantations), forestry, fishing, and related occupations. Almost half of the houses are without toilets and it was found that Orang Asli people preferred to defecate at the site of the streams. The data from the questionnaire survey indicated none of the children had received anthelmintic treatment in the 6 months prior to the study.

TABLE 4.1: General characteristics of Orang Asli children who participated in the study (n=498).

Characteristics	n (%)
Age groups	
< 10 years	290 (58.2)
≥ 10 years	208 (41.8)
Gender	
Boys	252 (50.6)
Girls	246 (49.4)
Socioeconomic status	
Fathers' education level (at least primary)	298 (59.8)
Mothers' education level (at least primary)	249 (50.0)
Low household income (<RM500)	317 (63.7)
Working fathers	176 (35.3)
Working mothers	66 (13.3)
Large family size (≥ 7 members)	247 (49.6)
Piped water supply	243 (48.8)
Electricity	364 (73.1)
Presence of toilet in house	231 (46.4)
Presence of domestic animals at household	356 (71.5)

All values are number (%). RM, Malaysian Ringgit; (US$ 1 = RM 3.20).

4.2 OVERALL PREVALENCE AND DISTRIBUTION OF INTESTINAL PARASITIC INFECTIONS (BASELINE ASSESSMENT)

Fecal samples were screened by different techniques for the presence of intestinal parasites and the results are presented in Table 4.2. Overall, 98.4% (490/498) of the children were found to be infected with at least one intestinal parasite species. The results showed that *Trichuris* was the predominant species with a prevalence rate of 95.6% (476/498), followed by *Ascaris* (47.8%), *Giardia* (28.3%) and then hookworm (27.9%). With regard to the intensity of infections (Figure 4.1), the results showed that almost two thirds (71.4%) and 52.9% of the *Trichuris* and *Ascaris* infections, respectively, were of moderate-to-heavy intensity (mean epg of ≥ 5000 for *Ascaris* and ≥ 1000 for *Trichuris*), while all hookworm infections were of light intensity (mean epg of ≥ 2000).

The detection rates of *Trichuris*, *Ascaris*, hookworm, *Giardia* and *Entamoeba* by formalin-ether sedimentation method were found to be 93.4%, 46.6%, 21.9%, 25.9% and 12.0%, respectively. On the other hand, lower detection rates were noted with the Kato-Katz technique; *Trichuris* (86.7%), *Ascaris* (45%) and hookworm (10.6%). However, the detection rate of hookworm was substantially higher (22.5) by Harada Mori technique while almost similar detection rates for *Giardia* (23.5%) and *Entamoeba spp.* (11.4%) were observed using trichrome staining technique when compared with the results obtained by the formalin-ether sedimentation method.

TABLE 4.2: Prevalence of intestinal parasitic infections according to parasite species and number of infections

Infections	No. positive	%
Parasite species (n=498)		
Trichuris trichiura	476	95.6
Ascaris lumbricoides	238	47.8
Hookworm	139	27.9
Giardia duodenalis	141	28.3
Entamoeba spp	70	14.1
Cryptosporidium spp	26	5.2
Type of infection (490)		
Monoparasitism	140	28.6
Polyparasitism	350	71.4
No. of parasite species (350)		
Two	189	54.0
Three	88	25.1
Four	54	15.4
Five	19	5.4

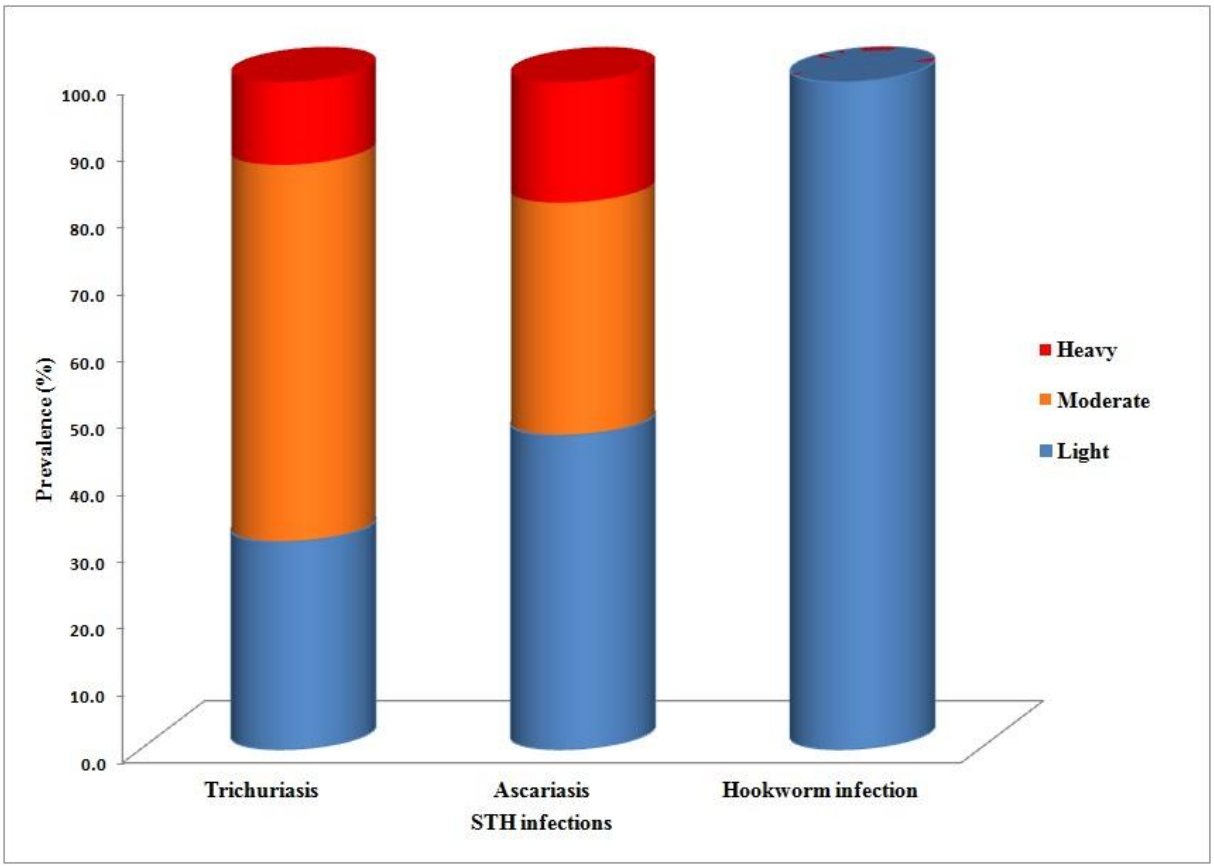

FIGURE 4.1: Prevalence of STH infections according to intensity of infection.

The age-associated prevalence of different reported IPI is illustrated in Figure 4.2. The age-associated patterns of infection prevalence were generally similar among the different parasite species. Trichuriasis was the most prevalent infection in all ages followed by ascariasis and *Giardia* infection. All IPI, except *Cryptosporidium*, occurred in all ages with the highest prevalence noted among children aged 9 years. When comparing the results according to gender, boys were noted to have higher prevalence of hookworm and *Giardia*, while other IPI were higher among the girls. However, the differences were not statistically significant (statistical analysis not shown). On the other hand, *Cryptosporidium* was not reported among children aged 6 years and the highest prevalence was reported among girls aged 9 years (17.9%).

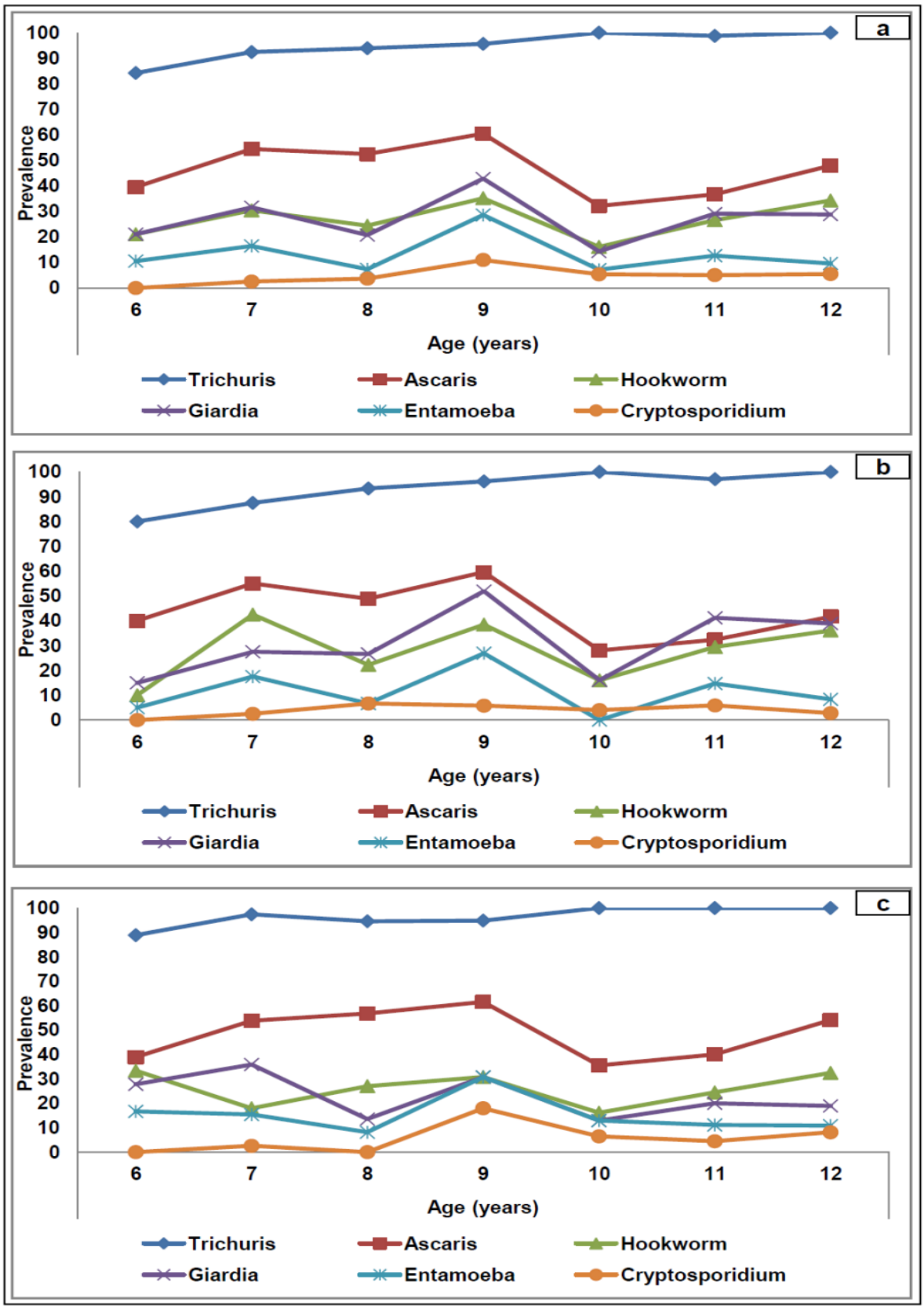

FIGURE 4.2: Age-associated prevalence of intestinal parasitic infections among Orang Asli children in Lipis, Pahang (n=498).

a: Overall b: Boys c: Girls

Of the infected children, 71.4% had polyparasitism, while the remaining 28.6% were infected with a single parasite species. Of those who had polyparasitism, 189 (54.0%) and 88 (25.1%) had double and triple infections, respectively. Moreover, 5.4% of them harbored five different parasite species concurrently. Trichuriasis and ascariasis were the most prevalent co-infection representing 54.0% of the polyparasitism prevalence followed by the combination of trichuriasis and giardiasis (28.4%). Moreover, 18.6% of the infected children had the triad helminths (*Trichuris, Ascaris* and hookworm). Fecal samples were also examined for the presence of other intestinal parasites and the children were found to be positive for *Entamoeba coli* (15.5%), *Blastocystis* sp. (15.1%), *Iodamoeba bütschlii* (6.8%), *Chilomastix mesnili* (4.8%), and *Endolimax nana* (2.6%). On the other hand, *S. stercoralis* larvae were not detected among these children.

4.3 ASSOCIATION OF STH INFECTIONS WITH POTENTIAL RISK FACTORS - UNIVARIATE ANALYSIS

Tables 4.3, 4.4 and 4.5 show the associations of STH infections (trichuriasis, ascariasis and hookworm infection) with demographic, socioeconomic, environmental and personal hygiene factors.

Table 4.3 shows that the prevalence rate of moderate-to-heavy trichuriasis was significantly higher among children belong to families with low household monthly income compared to children belong to families with monthly income of ≥ RM500 (70.1% vs 58.3%; $P = 0.008$). Similarly, children of mothers' with low educational level had significantly higher trichuriasis prevalence when compared with children of mothers with at least 6 years of formal education (71.9% vs 59.8%). Moreover, children who live in houses without toilets (74.0%) and those who use unsafe sources for drinking water (73.0%) had higher prevalence rate of trichuriasis when compared to

those who live in houses with toilets (58.8%) and use piped water (59.1%). The presence of infected family members increased the odds of infection by 3 times ($P < 0.001$).

With regard to personal hygiene practices, the prevalence rate of infection was significantly higher among children who do not wash their hands before eating (75.8%), walk barefooted (79.3%), do not cut their fingernails periodically (70.0%), do not wash fruits before eating (71.1%) and do not wash vegetables before eating (72.1%) when compared to their counterparts. Likewise, the prevalence was significantly higher among those who practice open defecation (indiscriminate defecation) compared to those who used toilets (69.9% vs 57.4; $P = 0.006$).

Table 4.4 shows that the prevalence rate of ascariasis among children aged below 10 years was significantly higher than the prevalence rate among children aged ≥ 10 years (53.8% vs 39.4%; $P = 0.002$). Similarly, the prevalence rate of ascariasis among children of mothers' with low educational level had significantly higher trichuriasis prevalence when compared with children of mothers with at least 6 years of formal education (52.6% vs 43.0; $P = 0.031\%$). On the other hand, children belonging to working fathers had significantly lower prevalence compared to those belonging to unemployed fathers (44.4% vs 54.0%; $P = 0.041$). Moreover, children who live in houses with no toilet facilities (56.7%) and/or supply of safe drinking water (57.4%) or those who live with other infected family members (56.5%) had higher prevalence when compared with their counterparts ($P < 0.001$).

A significant association between ascariasis and personal hygiene practices was also reported as the prevalence was found to be higher among children who do not practice hand washing before eating (53.8%) when compared to those who practice hand washing before eating (38.7%). Similarly, children who do not cut their fingernails periodically (56.2%), do not wash fruits before eating (53.9%) and do not wash

vegetables before eating (55.3%) had significantly higher prevalence of ascariasis when compared with those who cut their nails (38.1%), wash fruits (39.7%) and wash vegetables (55.3%) before eating.

Table 4.5 shows that the prevalence of hookworm infections among children who lived in houses without safe drinking water supplies (37.3%) and those who had domestic animals at households (25.1%) was significantly higher compared to their counterparts. Moreover, the results showed that the prevalence of infection was significantly associated with mother's employment status (P = 0.029), household monthly income (P = 0.003) and the presence of infected family member (P = 0.004). Likewise, the prevalence was significantly higher among children who used nearby rivers or bushes for defecation (31.5%) when compared to those who used the toilets (20.4%). Moreover, children who walk barefooted had significantly higher prevalence compared to those who wear shoes or slippers when go outside (41.5% vs 15.2%; $P <$ 0.001). Similarly, the associations of hookworm infection with fruits (P = 0.030) and vegetables ($P < 0.001$) washing before eating were significant.

TABLE 4.3: Univariate analysis of factors associated with moderate-to-heavy *Trichuris* infection among Orang Asli school children in Lipis, Pahang (n=498).

Variables	*Trichuris* infection		**OR(95% CI)**	***P* value**
	No. examined	**Infected n (%)**		
DEMOGRAPHIC FACTORS				
Age				
< 10 years	290	184 (63.4)	0.8 (0.5, 1.1)	0.180
≥ 10 years	208	144 (69.2)	1	
Gender				
Boys	252	161 (63.9)	0.8 (0.6, 1.2)	0.347
Girls	246	167 (67.9)	1	
Family size				
≥ 7 members (large)	247	169 (68.4)	1.3 (0.9, 1.8)	0.232
< 7 members	251	159 (63.3)	1	
SOCIOECONOMIC FACTORS				
Father's educational level				
Non educated (< 6 years)	200	131 (65.5)	0.9 (0.7, 1.4)	0.889
Educated (≥ 6 years)	298	197 (66.1)	1	
Mother's educational level				
Non educated (< 6 years)	249	179 (71.9)	1.7 (1.2, 2.5)	0.005*
Educated (≥ 6 years)	249	149 (59.8)	1	
Father's employment status				
Not working	322	218 (67.7)	1.2 (0.9, 1.8)	0.242
Working	176	110 (62.5)	1	
Mother's employment status				
Not working	432	288 (66.7)	1.3 (0.8, 2.2)	0.333
Working	66	40 (60.6)	1	
Household monthly income				
< RM500	317	223 (70.1)	1.7 (1.1, 2.5)	0.008*
≥ RM500	181	105 (58.3)	1	

Presence of toilet in house				
No	231	171 (74.0)	2.0 (1.4, 3.0)	< 0.001*
Yes	267	157 (58.8)	1	
Presence of domestic animals				
Yes	356	230 (64.8)	0.8 (0.6, 1.3)	0.425
No	142	98 (68.5)	1	
Source of drinking water				
Unsafe source (river, rain)	243	178 (73.0)	1.9 (1.3, 2.8)	0.001*
Safe source (pipe)	255	150 (59.1)	1	
Presence of infected family member				
Yes	207	163 (78.7)	2.9 (1.9, 4.3)	< 0.001*
No	291	165 (56.7)	1	
PERSONAL HYGIENE FACTORS				
Washing hands before eating				
No	297	227 (75.8)	3.1 (2.1, 4.5)	< 0.001*
Yes	201	101 (50.8)	1	
Washing hands after defecation				
No	296	201 (67.9)	1.2 (0.8, 1.8)	0.245
Yes	202	127 (62.9)	1	
Indiscriminate defecation				
Yes	336	235 (69.9)	1.7 (1.2, 2.5)	0.006*
No	162	93 (57.4)	1	
Habit of eating soil (Geophagy)				
Yes	125	82 (65.6)	1.0 (0.6, 1.5)	0.943
No	373	246 (66.0)	1	
Cutting nails periodically				
No	267	187 (70.0)	1.5 (1.0, 2.2)	0.035*
Yes	231	141 (61.0)	1	
Wearing shoes when outside				
No	240	191 (79.3)	3.3 (2.3, 5.0)	< 0.001*
Yes	258	137 (53.3)	1	

Washing fruits before eating				
No	262	202 (71.1)	1.7 (1.2, 2.5)	0.004*
Yes	236	126 (57.7)	1	
Washing vegetables before eating				
No	262	189 (72.1)	1.9 (1.2, 2.7)	0.002*
Yes	236	139 (58.9)	1	
Boiling water before drinking				
No	363	243 (66.9)	1.2 (0.7, 1.8)	0.405
Yes	135	85 (63.0)	1	

RM, Malaysian Ringgit; (US$1 = RM3.2). OR, Odds ratio. CI, Confidence interval.

Significant association (unadjusted $P < 0.05$).

***** Significant association (using the Bonferroni correction for multiple comparisons)

TABLE 4.4: Univariate analysis of factors associated with *Ascaris* infection among Orang Asli school children in Lipis, Pahang (n=498).

Variables	*Ascaris* infection		**OR(95% CI)**	***P* value**
	No. examined	**Infected n (%)**		
DEMOGRAPHIC FACTORS				
Age				
< 10 years	290	156 (53.8)	1.8 (1.3, 2.6)	0.002*
≥ 10 years	208	82 (39.4)	1	
Gender				
Boys	252	116 (46.0)	0.8 (0.6, 1.2)	0.426
Girls	246	122 (49.6)	1	
Family size				
≥ 7 members (large)	247	116 (47.0)	0.9 (0.7, 1.3)	0.714
< 7 members	251	122 (48.6)	1	
SOCIOECONOMIC FACTORS				
Father's educational level				
Non educated (< 6 years)	200	90 (45.0)	0.8 (0.6, 1.2)	0.307
Educated (≥ 6 years)	298	148 (49.7)	1	
Mother's educational level				
Non educated (< 6 years)	249	131 (52.6)	1.5 (1.0, 2.1)	0.031*
Educated (≥ 6 years)	249	107 (43.0)	1	
Father's employment status				
Not working	322	143 (44.4)	0.7 (0.5, 0.9)	0.041*
Working	176	95 (54.0)	1	
Mother's employment status				
Not working	432	209 (48.4)	1.2 (0.7, 2.0)	0.501
Working	66	29 (43.9)	1	
Household monthly income				
< RM500	317	159 (50.0)	1.3 (0.9, 1.8)	0.190
≥ RM500	181	79 (43.9)	1	

Presence of toilet in house				
No	231	131 (56.7)	2.0 (1.4, 2.8)	< 0.001*
Yes	267	107 (40.1)	1	
Presence of domestic animals				
Yes	356	195 (46.8)	0.8 (0.6, 1.3)	0.468
No	142	72 (50.3)	1	
Source of drinking water				
Unsafe source (river, rain)	243	140 (57.4)	2.1 (1.5, 3.1)	< 0.001*
Safe source (pipe)	255	98 (38.6)	1	
Presence of infected family member				
Yes	207	117 (56.5)	1.8 (1.3, 2.6)	0.001*
No	291	121 (41.6)	1	
PERSONAL HYGIENE FACTORS				
Washing hands before eating				
No	297	161 (53.8)	1.9 (1.3, 2.7)	0.001*
Yes	201	77 (38.7)	1	
Washing hands after defecation				
No	296	149 (50.3)	1.3 (0.9, 1.8)	0.168
Yes	202	89 (44.1)	1	
Indiscriminate defecation				
Yes	336	157 (46.7)	0.9 (0.6, 1.3)	0.493
No	162	81 (50.0)	1	
Habit of eating soil (Geophagy)				
Yes	125	67 (53.6)	1.4 (0.9, 2.0)	0.133
No	373	171 (45.8)	1	
Cutting nails periodically				
No	267	150 (56.2)	2.1 (1.5, 3.0)	< 0.001*
Yes	231	88 (38.1)	1	
Wearing shoes when outside				
No	240	118 (49.0)	1.1 (0.8, 1.6)	0.612
Yes	258	120 (46.7)	1	

Washing fruits before eating				
No	262	153 (53.9)	1.8 (1.2, 2.6)	0.002*
Yes	236	85 (39.7)	1	
Washing vegetables before eating				
No	262	145 (55.3)	1.9 (1.3, 2.7)	< 0.001*
Yes	236	93 (39.4)	1	
Boiling water before drinking				
No	363	167 (46.0)	0.8 (0.5, 1.1)	0.191
Yes	135	71 (52.6	1	

RM, Malaysian Ringgit; (US$1 = RM3.2). OR, Odds ratio. CI, Confidence interval.

Significant association (unadjusted $P < 0.05$).

***** Significant association (using the Bonferroni correction for multiple comparisons)

TABLE 4.5: Univariate analysis of factors associated with hookworm infections among Orang Asli school children in Lipis, Pahang (n=498).

Variables	Hookworm infections		**OR(95% CI)**	***P* value**
	No. examined	**Infected n (%)**		
DEMOGRAPHIC FACTORS				
Age				
< 10 years	290	84 (29.0)	1.1 (0.8, 1.7)	0.536
≥ 10 years	208	55 (26.4)	1	
Gender				
Boys	252	76 (30.2)	1.3 (0.8, 1.9)	0.258
Girls	246	63 (25.6)	1	
Family size				
≥ 7 members (large)	247	70 (28.3)	1.0 (0.7, 1.5)	0.833
< 7 members	251	69 (27.5)	1	
SOCIOECONOMIC FACTORS				
Father's educational level				
Non educated (< 6 years)	200	59 (29.5)	1.1 (0.8, 1.7)	0.517
Educated (≥ 6 years)	298	80 (26.8)	1	
Mother's educational level				
Non educated (< 6 years)	249	75 (30.1)	1.2 (0.8, 1.8)	0.272
Educated (≥ 6 years)	249	64 (25.7)	1	
Father's employment status				
Not working	322	95 (29.5)	1.3 (0.8, 1.9)	0.284
Working	176	44 (25.0)	1	
Mother's employment status				
Not working	432	128 (29.6)	2.1 (1.1, 4.2)	0.029*
Working	66	11 (16.7)	1	
Household monthly income				
< RM500	317	103 (32.4)	1.9 (1.2, 3.0)	0.003*
≥ RM500	181	36 (20.0)	1	

Presence of toilet in house				
No	231	74 (32.0)	1.5 (0.9, 2.2)	0.056
Yes	267	65 (24.3)	1	
Presence of domestic animals				
Yes	356	89 (25.1)	0.6 (0.4, 0.9)	0.026*
No	142	50 (35.0)	1	
Source of drinking water				
Unsafe source (river, rain)	243	91 (37.3)	2.6 (1.7, 3.8)	< 0.001*
Safe source (pipe)	255	48 (18.9)	1	
Presence of infected family member				
Yes	207	72 (34.8)	1.8 (1.2, 2.6)	0.004*
No	291	67 (23.0)	1	
PERSONAL HYGIENE FACTORS				
Washing hands before eating				
No	297	88 (29.4)	1.2 (0.8, 1.8)	0.354
Yes	201	51 (25.6)	1	
Washing hands after defecation				
No	296	87 (28.7)	1.1 (0.7, 1.7)	0.617
Yes	202	52 (26.7)	1	
Indiscriminate defecation				
Yes	336	106 (31.5)	1.8 (1.2, 2.8)	0.009*
No	162	33 (20.4)	1	
Habit of eating soil (Geophagy)				
Yes	125	37 (29.6)	1.1 (0.7, 1.7)	0.627
No	373	102 (27.3)	1	
Cutting nails periodically				
No	267	78 (29.2)	1.2 (0.8, 1.7)	0.486
Yes	231	61 (26.4)	1	
Wearing shoes when outside				
No	240	100 (41.5)	4.0 (2.6, 6.1)	< 0.001*
Yes	258	39 (15.2)	1	

Washing fruits before eating				
No	262	90 (31.7)	1.6 (1.1, 2.2)	0.030*
Yes	236	49 (22.9)	1	
Washing vegetables before eating				
No	262	97 (37.0)	2.7 (1.8, 4.1)	< 0.001*
Yes	236	42 (17.8)	1	
Boiling water before drinking				
No	363	95 (26.2)	0.7 (0.5, 1.1)	0.156
Yes	135	44 (32.6)	1	

RM, Malaysian Ringgit; (US$1 = RM3.2). OR, Odds ratio. CI, Confidence interval.

Significant association (unadjusted $P < 0.05$).

***** Significant association (using the Bonferroni correction for multiple comparisons)

4.4 MULTIVARIATE ANALYSIS

The possible risk factors of STH infections were identified using multiple logistic regression and the results are shown in Table 4.6.

For moderate-to-heavy trichuriasis, the results of multiple logistic regression for the significant factors confirmed that children who live in houses without toilets and used unsafe sources for drinking water had significantly higher odds of having trichuriasis when compared to those living in houses with functioning toilets (OR = 2.9; 95% CI = 1.9, 4.9) and supplied with piped water (OR = 2.0; 95% CI = 1.3, 3.2). Similarly, the presence of other infected family members doubled the odds of infections (OR = 2.0; 95% CI = 1.3, 3.1). Moreover, children who do not wash their hands before eating and do not wear shoes or slippers when go outside had higher odds (2.4 and 2.5, respectively) when compared with their counterparts.

For ascariasis, the results of multivariate analysis for the significant factors showed that children aged below 10 years were at double odds for *Ascaris* infection when compared with children aged ≥ 10 years (OR = 2.0; 95% CI = 1.3, 3.1). Moreover, children who used unsafe sources for drinking water had significantly higher odds of having ascariasis when compared to those living in houses supplied with piped water (OR=1.8; 95% CI=1.2, 2.8). Similarly, not washing hands before eating, not cutting nails and not washing vegetables before eating increased the odds of infections by 2.1, 2.2 and 1.8 times, respectively.

With regard to hookworm infection, the multiple logistic regression model retained three factors associated significantly with hookworm infection; absence of toilet in the house (OR = 2.2; 95% CI = 1.0, 4.7), not wearing shoes or slippers when go outside (OR = 3.4; 95% CI = 2.1, 5.4) and not washing vegetables before eating (OR = 2.4; 95% CI = 1.4, 4.0).

Population attributable risk fraction (PARF) was calculated for STH based on the results of multivariate analysis and showed that the number of STH cases would be reduced by 17.2%, 15.6%, 13.9%, and 7.8% if all children had good standards of personal hygiene namely wearing shoes when outside the house, washing vegetables before eating, washing hands before eating, and cutting nails periodically respectively. Moreover, 14.9%, 11.2% and 6.1% of STH infections could be reduced when the houses were supplied with a provision of safe drinking water, proper toilet facilities, and had no other family members infected with STH, respectively.

TABLE 4.6: Multivariate analysis of factors associated with STH infections among Orang Asli school children in Lipis, Pahang (n = 498).

Variables	Moderate-to-heavy trichuriasis		Ascariasis		Hookworm infection	
	Adjusted OR (95% CI)	**P-value**	**Adjusted OR (95% CI)**	**P-value**	**Adjusted OR (95% CI)**	**P-value**
DEMOGRAPHIC FACTORS						
Age (< 10 years)	1.0 (0.6, 1.6)	0.853	2.0 (1.3, 3.1)	0.002*	1.5 (0.9, 2.4)	0.112
Gender (boys)	0.8 (0.5, 1.2)	0.338	0.8 (0.5, 1.2)	0.265	1.3 (0.8, 2.1)	0.196
SOCIOECONOMIC FACTORS						
Low mother's educational level (< 6 years)	1.2 (0.8, 1.9)	0.402	1.2 (0.8, 1.9)	0.345	-	-
Working fathers	1.1 (0.7, 1.8)	0.469	0.7 (0.4, 1.1)	0.109	-	-
Working mothers	-	-	-	-	0.8 (0.5, 1.2)	0.274
Low household income (< RM500)	1.2 (0.8, 1.9)	0.338	1.0 (0.6, 1.5)	0.920	1.5 (0.9, 2.4)	0.134
Absence of toilet in house	2.9 (1.9, 4.6)	< 0.001*	1.4 (0.9, 2.1)	0.121	2.2 (1.0, 4.7)	0.042*
Presence of domestic animals	-	-	-	-	0.7 (0.4, 1.1)	0.077
Source of drinking water (unsafe water)	2.0 (1.3, 3.2)	0.003*	1.8 (1.2, 2.8)	0.022*	1.2 (0.7, 1.8)	0.589
Presence of infected family member	2.0 (1.3, 3.1)	0.003*	1.3 (0.9, 1.9)	0.244	1.1 (0.7, 1.7)	0.651

PERSONAL HYGIENE FACTORS

Not washing hands before eating	2.4 (1.6, 3.7)	< 0.001*	2.1 (1.3, 3.3)	0.017*	-	-
Not washing hands after defecation	-	-	1.1 (0.7, 1.7)	0.565	-	-
Indiscriminate defecation	1.3 (0.8, 1.6)	0.127	-	-	1.4 (0.9, 3.1)	0.0.063
Not cutting nails periodically	1.4 (0.9, 2.1)	0.143	2.2 (1.5, 3.2)	< 0.001*	-	-
Not wearing shoes when outside	2.5 (1.6, 3.8)	< 0.001*	-	-	3.4 (2.1, 5.4)	< 0.001*
Not washing fruits before eating	1.2 (0.8, 2.0)	0.384	1.3 (0.8, 2.1)	0.196	0.9 (0.5, 1.6)	0.812
Not washing vegetables before eating	1.1 (0.7, 1.8)	0.384	1.8 (1.0, 2.9)	0.027*	2.4 (1.4, 4.0)	0.001*

OR, Odds ratio. CI, Confidence interval.

* Significant association ($P < 0.05$).

4.5 RISK FACTORS OF POLYPARASITISM

The possible risk factors of intestinal polyparasitism were also investigated and the results showed that similar socioeconomic, environmental and personal hygiene factors were significantly associated with the high prevalence rate of polyparasitism among these children. Table 4.7 shows that the multiple logistic regression model identified 7 variables as significant risk factors of polyparasitism. Hosmer–Lemeshow test, used for the inferential goodness-of-fit test, showed that the model fits the data well ($\chi 2 = 9.276$; $P = 0.320$). The results of the logistic regression model including all 15 factors confirmed that children who use unsafe sources for drinking water and/or live in houses without proper toilets had double odds of having polyparasitism when compared with their counterparts. Likewise, the presence of other family members infected with multiple parasitic infections increased the children's odds for the polyparasitism by 1.7 times.

It was found that not washing vegetables before consumption increased children's odds for polyparasitism when compared with always washing vegetables by 2.5 times. Furthermore, children who do not wash their hands before eating had 1.6 times odds while those who do not cut their nails periodically and/or walk barefooted were at twice the odds of polyparasitism when compared with their counterparts. When stratified by age group (< 10 and ≥ 10 years), similar risk factors were identified among both groups.

PARF analysis showed that the number of polyparasitism cases would be reduced by 18.0%, 13.6%, 11.9%, and 6.8% if all children had good standards of personal hygiene; namely, washing vegetables before consumption, washing hands before eating, cutting nails periodically, and wearing shoes when outside the house, respectively. Moreover, 13.5%, 12.1% and 10.3% of the polyparasitism cases could be

reduced when the children in this population had a provision of clean and safe drinking water, had toilet facilities at home, and had no other family members infected with polyparasitism, respectively.

TABLE 4.7: Multivariate analysis of factors associated with polyparasitism among Orang Asli children in Lipis, Pahang (n = 498).

Variables	**Polyparasitism**			
	Adjusted OR	**95% CI**	**Wald**	**Wald-test P-value**
DEMOGRAPHIC FACTORS				
Age (< 10 years)	1.3	0.8, 2.3	1.463	0.207
Gender (boys)	0.8	0.5, 1.3	0.678	0.410
SOCIOECONOMIC FACTORS				
Low mother's educational level (< 6 years)	1.2	0.8, 1.9	0.546	0.460
Low household income (< RM500)	1.4	0.9, 2.3	2.128	0.145
Absence of toilet in house	1.9	1.1, 3.1	5.909	0.014
Presence of domestic animals	1.3	0.7, 2.5	1.451	0.228
Source of drinking water (unsafe water)	2.0	1.3, 3.2	8.871	0.003
Presence of infected family member	1.7	1.1, 2.8	4.937	0.026
PERSONAL HYGIENE FACTORS				
Not washing hands before eating	1.6	1.0, 2.6	3.977	0.047
Not washing hands after defecation	1.1	0.7, 1.8	0.135	0.714
Habit of eating soil (Geophagy)	1.4	0.9, 2.5	2.668	0.106
Not cutting nails periodically	1.9	1.2, 2.9	6.656	0.010
Not wearing shoes when outside	1.6	1.0, 2.3	3.853	0.049
Not washing fruits before eating	1.2	0.7, 2.0	0.578	0.447
Not washing vegetables before eating	2.5	1.4, 4.2	11.020	0.001

OR, Odds ratio. CI, Confidence interval.

Significant association ($P < 0.05$).

4.6 KAP OF ORANG ASLI TOWARDS STH INFECTIONS (BASELINE ASSESSMENT)

The KAP of Orang Asli towards STH infections was assessed by administrating the questionnaire to 256 households at the two locations (174 Pos Betau and 82 Kuala Koyan) and the results are shown in Tables 4.8 and 4.9. It was found that 204 (79.9%) of the respondents had heard about the intestinal worms. Almost one third (38.3) of them did not remember the source of information while 56 (27.6%) indicated that the main source of their information about worms was from the health clinic. On the other hand, only six participants (2.9%) have heard about the worms from the school. With regard to the types of intestinal helminths they might know, only 32 (15.8%) mentioned pinworm and 23 (11.3%) mentioned roundworms.

The results also showed that there was a lack of knowledge on the signs and symptoms of intestinal helminth infections among these people. Only 47.2% (96/256) of the participants were able to mention at least one symptom. The main signs and symptoms mentioned were abdominal pain and diarrhoea followed by pale face and abdominal distension. Overall, 36.1% (74/256) of the respondents have knowledge about the ways of intestinal helminths transmission. Only 21.5% of these respondents mentioned eating contaminated food and dirty hands. With regard to prevention, only 39.5% (81/256) of the respondents had knowledge about how to prevent intestinal helminth infections. Of them, 39 and 31 participants mentioned taking deworming drugs and hand washing before eating, respectively.

TABLE 4.8: Knowledge about intestinal helminths, symptoms, transmission and prevention among Orang Asli people in Lipis, Pahang

Variable	N	%
Heard about intestinal worms	204	79.9
Source of information (n=204)		
Clinic/hospitals	56	27.6
Health workers	31	15.0
Mass media	7	3.5
Other people	26	12.8
School/school children	6	2.9
Do not remember	78	38.3
Type of worms (n=204)		
Earthworm	9	4.6
Roundworm	23	11.3
Tapeworm	7	3.5
Pinworm	32	15.8
Whipworm	1	0.7
Signs and symptoms (n=204)		
Know at least one symptom	96	47.2
Abdominal pain	30	14.7
Abdominal distention	21	10.2
Diarrhoea	30	14.7
Vomiting	13	6.5
Loss of appetite	17	8.1
Pale face	22	10.9
Body weakness	18	8.7
Perianal itching	16	7.8
Blood in stool	6	2.9
Transmission (n=204)		
Know at least one way of transmission	74	36.1
Eating contaminated food	24	11.6
Dirty hands	20	9.9
Walking barefooted	17	8.5

Drinking untreated water	11	5.3
Playing with soil	12	5.9
Not cutting nails regularly	9	4.3
Eating soil (geophagy)	15	7.3
Stagnant water	17	8.5
Prevention (n=204)		
Know at least one way for prevention	81	39.5
Taking de-worming drugs	39	19.2
Washing hands before eating	31	15.1
Wearing shoes when outside the house	18	8.9
Boiling untreated drinking water	16	7.7
Cutting fingernails regularly	3	1.5

Overall, 146 (56.9%) respondents considered the intestinal helminths as harmful to people's health. With regard to the respondents practices, 106 (41.5%) do not wash their hands before eating, 104 (40.6%) do not wash their hands after defecation and 138 (53.8%) do not wear shoes when going outside. Moreover, almost half (57.7%) of the respondents do not wash fruits/vegetables before eating. In terms of treatment-seeking behavior, almost all (99.9%) of the participants indicated that they go to the nearest clinic to seek treatment in case of diarrhoea and/or abdominal pain.

TABLE 4.9: Attitude and perceived practices towards intestinal helminths among Orang Asli people in Lipis, Pahang

Variable	N	%
Effects of intestinal helminths		
Harmful to peoples' health	136	53.3
Do not know	119	46.7
Feces as source of infections		
Yes	97	37.9
No	8	3.0
Do not know	151	59.1
Practices		
Washing hands before eating	106	41.5
Washing hands after defecation	104	40.6
Washing hands with soap	49	19.3
Wearing shoes when outside the house	138	53.8
Cutting fingernails regularly	112	43.9
Washing vegetables before eating	126	49.3
Washing of fruits before eating	108	42.3
Boiling untreated drinking water	68	26.5
Indiscriminate defecation	170	66.4
Seeking treatment for diarrhoea and abdominal pain from clinic	255	99.9

4.7 DEVELOPMENT OF THE HEALTH EDUCATION LEARNING PACKAGE (HELP)

The details of the development process and components of the package are provided in the previous chapter (3.7). In brief, the target population was identified and the possible risk factors of STH infections among this population were identified. Then, 9 health messages were used to provide the proper health education on STH infections mainly on the transmission, signs and symptoms and prevention. The messages were focused on the good personal hygiene practices as follows:

1- Washing hands before eating

2- Washing hands after playing with soil

3- Washing hands after using toilet

4- Wearing slippers or shoes when go outside

5- Avoiding open (indiscriminate) defecation

6- Washing vegetables and fruits before consumption

7- Drink clean (boiled) water

8- Covering food from flies

9- Cutting nails periodically

A half-day workshop on STH infections was organized for teachers in the intervention school. The teachers were educated about STH and were trained on how to encourage and follow-up the children to follow what they learned from the package. Besides that, a teacher's guide booklet on STH infections was distributed to each teacher. Different means were used to deliver the 9 key health messages and these include posters, a comic book, 2 nursery video songs, drawing activity, puppets drama show, aid kit and a sanitary bag. Moreover, the children were trained and encouraged to deliver the messages on STH to their families and act as health messengers to their community.

4.8 EVALUATING THE IMPACT OF HELP ON STH INFECTIONS

4.8.1 General characteristics and prevalence of intestinal parasitic infections

In total, 317 school children (48.9% males and 51.1% females) aged between 6 and 12 years, with median age of 9 years (IQR = 8, 11) had agreed to participate in the intervention part of this study (172 from SKPB and 145 SKKK). Poverty is predominant in these communities; about two thirds of the families had low monthly income (< RM500). Moreover, 42.3% and 56.2% of the fathers and mothers, respectively, had no formal education. Only 30.6% and 5.7% of the fathers and mothers, respectively, were working; mainly as farmers or workers in rubber and oil palm plantations, forestry, fishing and related occupations. Almost half of the houses (47.9%) were without toilets and 46.7% were without tap water supply.

Overall, 99.4% (315/317) of the children who participated in the intervention part of this study were found to be infected by at least one parasite species. Of those infected, 74.1% had polyparasitism (the concurrent infection with multiple parasite species) while 25.9% had single infection (monoparasitism). The prevalence of trichuriasis, ascariasis and hookworm infections were 96.2%, 51.4% and 34.1%, respectively. Almost two-thirds and half of the trichuriasis, and ascariasis, respectively, were of moderate-to-heavy intensities while all hookworm infections were of light intensity. With regard to intestinal protozoa, the prevalence of *Giardia duodenalis*, *Entamoeba histolytica/dispar/moshkovskii* and *Cryptosporidium* species infections were 28.4%, 15.8% and 4.4%, respectively.

After the allocation of groups, there were no significant differences in the variables and characteristics between the intervention school and the control school, which indicated the similarity between different Orang Asli communities in terms of socioeconomic and epidemiological characteristics (Table 4.10).

TABLE 4.10: Baseline characteristics of the school children in the intervention (HELP) and control schools*

Characteristics	HELP	Control
N	172	145
Male/Female	82/90	73/72
Age (years) [a]	9 (8, 11)	9 (7, 11)
Fathers' education level (at least 6 years)	106 (61.6)	77 (53.1)
Mothers' education level (at least 6 years)	80 (46.5)	59 (40.7)
Working fathers	55 (32.0)	42 (29.0)
Working mothers	8 (4.7)	10 (6.9)
Low household income (<RM500)	112 (65.1)	99 (68.3)
Large family size (> 7 members)	84 (48.8)	80 (55.2)
Piped water supply	86 (50.0)	83 (57.2)
Electricity	134 (77.9)	117 (80.7)
Presence of toilet in house	82 (47.7)	83 (57.2)
Trichuriasis	164 (95.3)	141 (97.2)
Ascariasis	90 (52.3)	73 (50.3)
Hookworm infection	63 (36.6)	45 (31.0)
Giardiasis	54 (31.4)	36 (24.8)
Amoebiasis	23 (13.4)	27 (18.6)
Cryptosporidiosis	5 (2.9)	9 (6.2)

All values are number (%)

[a] Median (Interquartile range)

[*]No significant differences in the variables and characteristics between intervention and control schools

4.8.2 Impact of HELP on the STH re-infection rates

After a complete deworming, the children were screened for the presence of STH infections monthly over the next 6 months. The baseline prevalence and incidence rates of trichuriasis, ascariasis and hookworm infections are shown in Figures 4.3, 4.4 and 4.5, respectively. In Figure 4.3, the incidence of trichuriasis in HELP group at the 1st month assessment was significantly lower than the incidence in control group (3.5% vs 10.3%; $P = 0.014$). After that, there was no significant difference in the incidence between both groups. Similarly, Figure 4.4 shows that the incidence rates of ascariasis throughout the 6 months were lower in the HELP group compared to the control group, however the difference was only significant in the second month (5.8% vs 13.1%; $P > 0.025$) and third month (14.0% vs 23.4%; $P > 0.029$) assessments. Interestingly, Figure 4.5 shows that the incidence rates of hookworm infection throughout the 6 months assessment were significantly lower among children in the HELP group compared to those in the control group ($P < 0.05$). It was found that the re-infection rates of trichuriasis and ascariasis among the control group after 6 months of complete deworming was almost 83.0%, 82.3% and 75.5%, respectively of the prevalence at baseline compared to 79.3%, 63.3% and 39.6%, respectively among the HELP group.

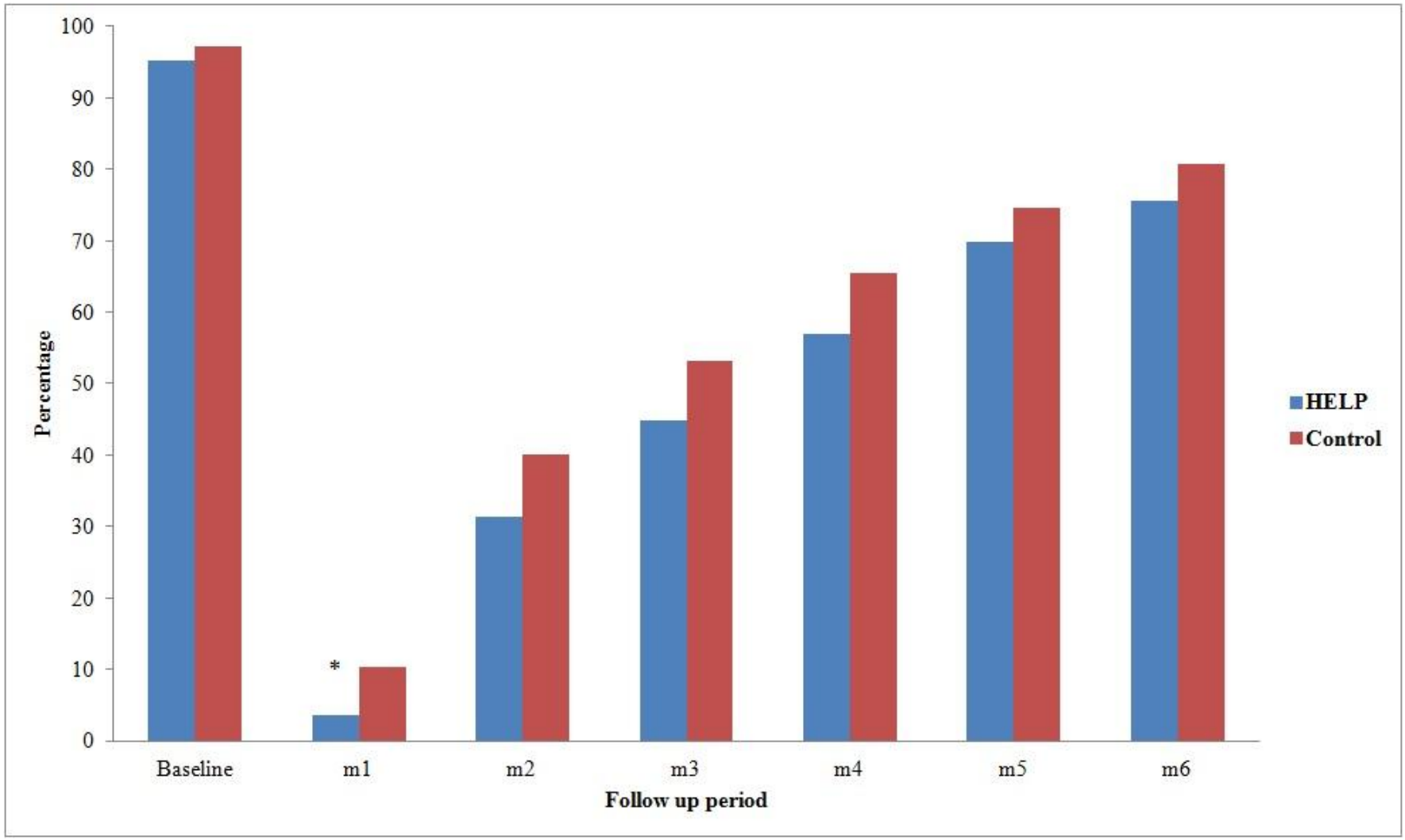

FIGURE 4.3: Prevalence and incidence of *Trichuris* infection among intervention and control group.

* Significant difference ($P < 0.05$); m, month

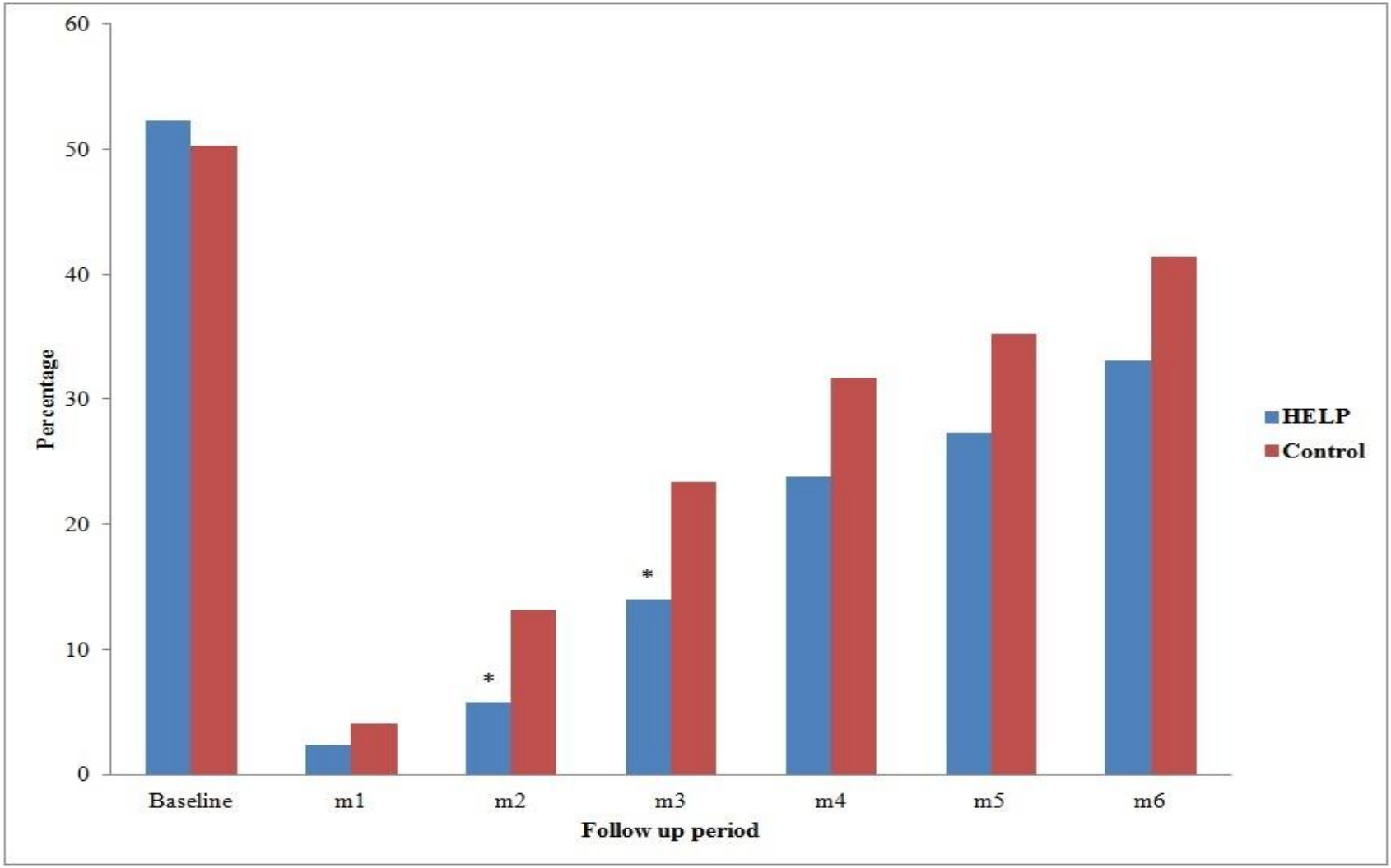

FIGURE 4.4: Prevalence and incidence of *Ascaris* infection among intervention and control group.
* Significant difference ($P < 0.05$) ; m, month

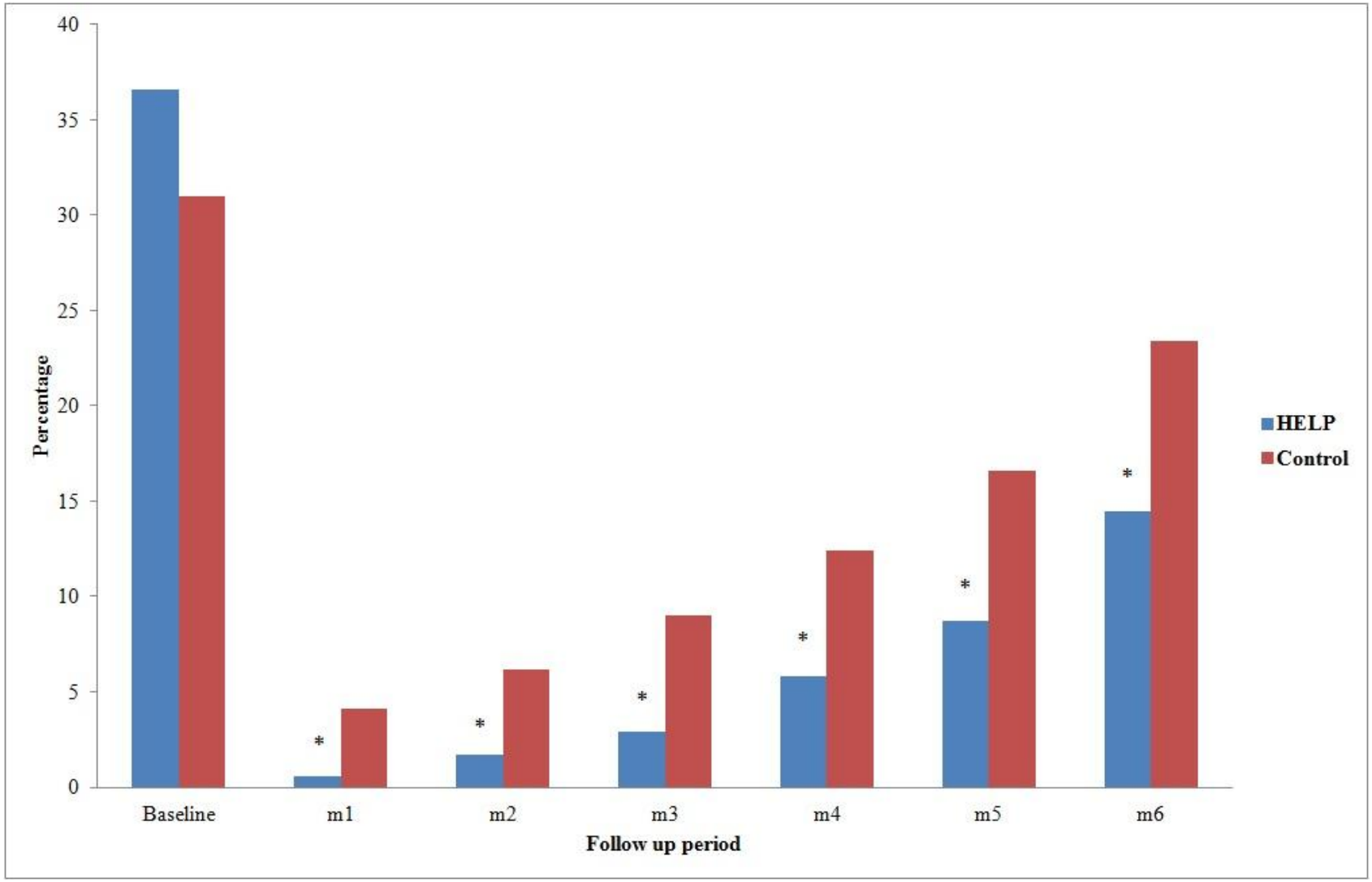

FIGURE 4.5: Prevalence and incidence of hookworm infection among intervention and control group.
* Significant difference ($P < 0.05$) ; m, month

4.8.3 Impact of HELP on the STH intensity

Figures 4.6, 4.7 and 4.8 show the baseline and re-infection intensities of trichuriasis, ascariasis, and hookworm infections, respectively. It was found that HELP has a positive impact in protecting children from severe STH infections. The intensity of infections (all three STH species) indicated by the egg counts (epg) was found to be significantly lower among the children in the HELP group compared to those in the control group. After 6 months, the intensity of *Trichuris*, *Ascaris* and hookworm infections were reduced by 38.7%, 43.4% and 71.0%, respectively among the intervention group compared to 19.3%, 10.2% and 5.6%, respectively among the control group. The significant difference was obvious with regard to hookworm infection throughout all assessments stages ($P < 0.05$). Although the intensity of trichuriasis was significantly lower in the HELP group compared to the control group, but the difference by month 6 was not statistically significant ($P > 0.05$).

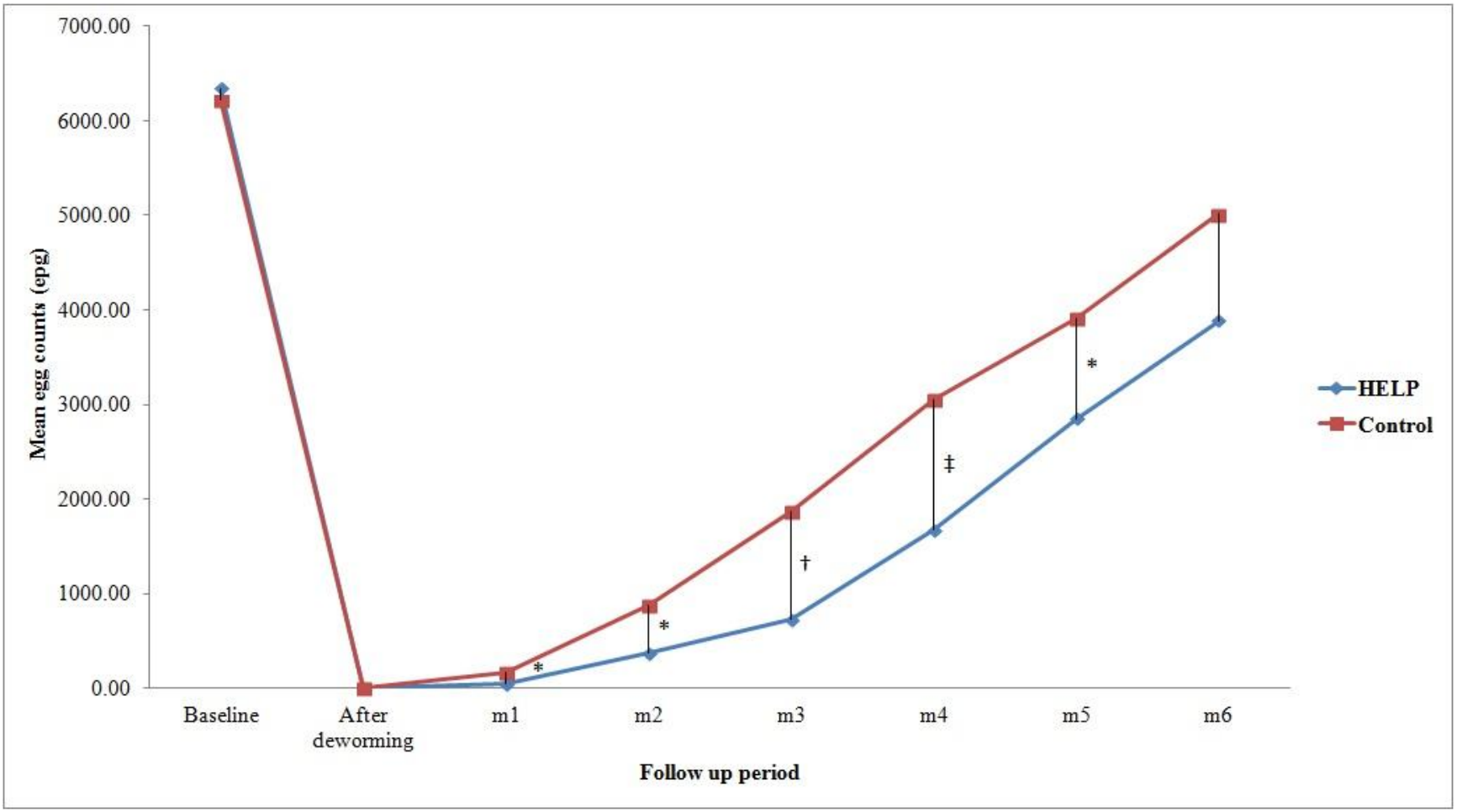

FIGURE 4.6: Intensity of *Trichuris* infection among intervention and control group over the study period. Significant difference (* $P < 0.05$; † $P < 0.01$) ; m, month

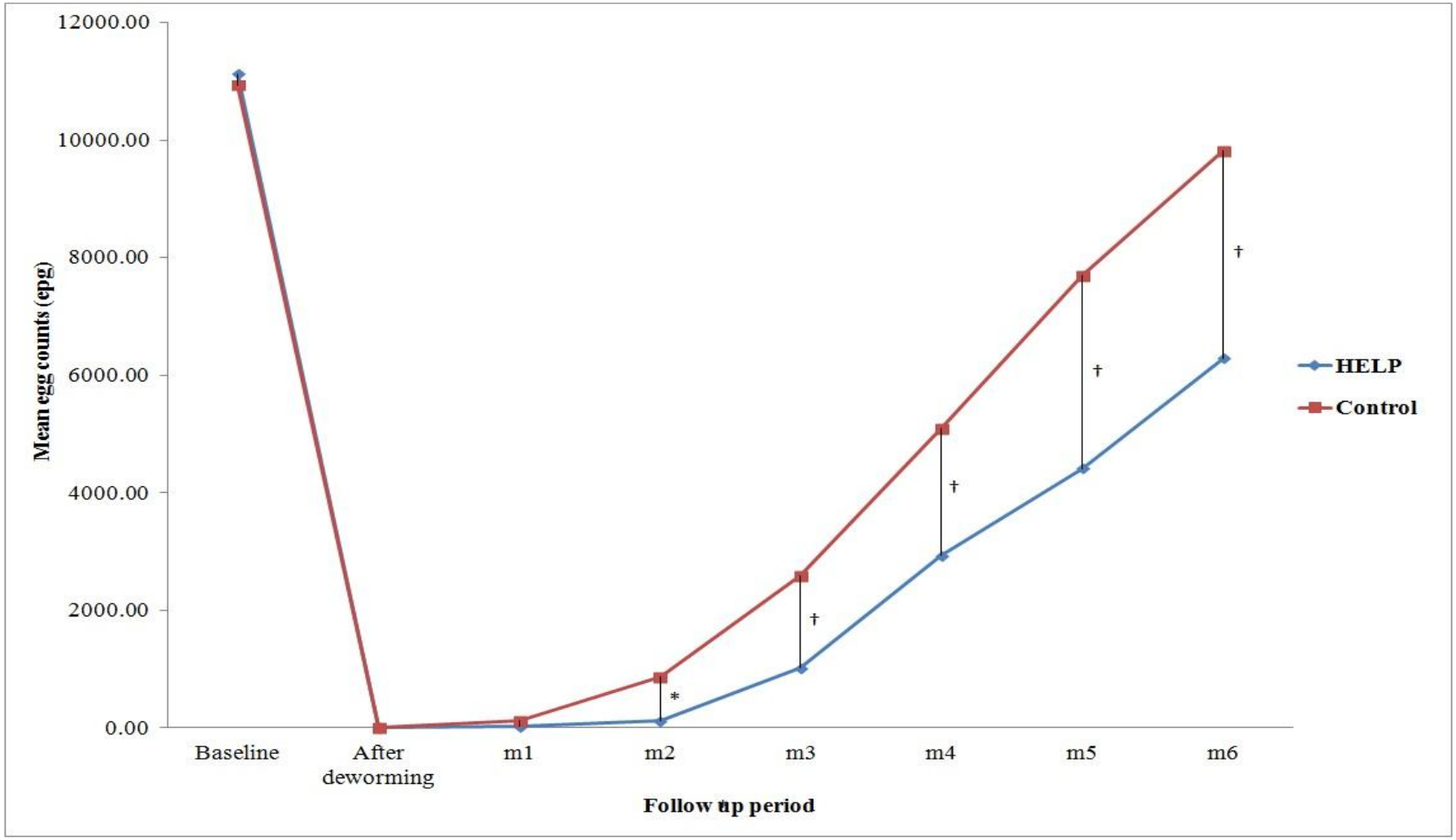

Figure 4.7: Intensity of *Ascaris* infection among intervention and control group over the study period. Significant difference (* $P < 0.05$; † $P < 0.01$); m, month

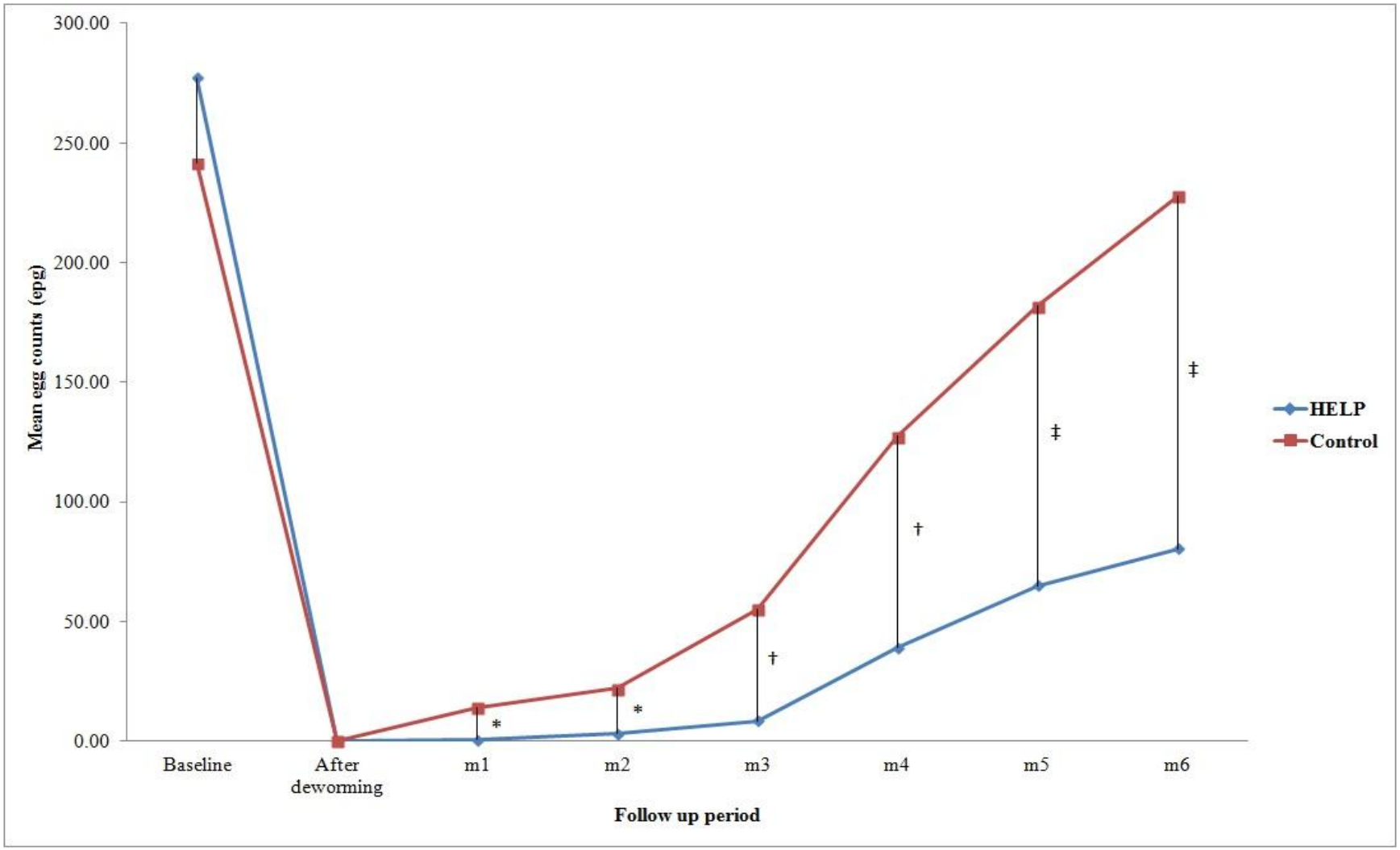

Figure 4.8: Intensity of hookworm infection among intervention and control group over the study period. Significant difference (* $P < 0.05$; † $P < 0.01$; ‡ $P < 0.001$); m, month

4.8.4 Impact of HELP on the KAP of Orang Asli towards STH infections

The KAP of Orang Asli people from both locations was assessed at baseline and 3 months after starting the intervention study and the results for those who were involved in the intervention part of this study are presented in Tables 4.11 and 4.12.

The participated children belonged to 165 households (89 from Pos Betau and 76 from Kuala Koyan). Overall, the KAP of people at both locations was found to be similar. At baseline, it was found that 117 respondents had heard about intestinal worm (62 from Pos Betau and 55 from Kuala Koyan). The results showed that knowledge about the role of dirty hands in the transmission of STH was significantly higher among participants from HELP group compared to those from control group (17.7% vs 5.5%; P = 0.041) while there was no significant difference in other variables of KAP towards STH infections between heads of households from both groups (P > 0.05).

Three months after introducing HELP, the KAP regarding STH infections was reassessed among participants from both schools, with the results showing a significantly higher percentage of people who had heard about intestinal worms among the HELP group, with a notable increment from baseline assessment, compared to the control group (89.9% vs 78.7%; $P = 0.046$). Among them, the percentages of school children and posters acting as sources of information about STH were significantly higher among the HELP group compared to the control. Overall, the knowledge of respondents in the HELP group on intestinal worms has obviously improved. A significantly higher percentage of participants from the HELP group mentioned roundworms (32.1% vs 13.6%; $P = 0.012$) and hookworms (30.9% vs 0.0%; $P < 0.001$) when compared with the control group. Likewise, the percentage of participants who knew at least one sign or symptom of STH infection was significantly higher in the HELP group compared to the control (75.0% vs 55.9%; $P = 0.018$); with 25.0% of the

respondents in the HELP group mentioning the poor school performance compared to none in the control group ($P < 0.001$).

Interestingly, the knowledge surrounding the transmission and prevention of STH was significantly improved among the HELP group compared to the control group with significantly higher percentages of respondents who mentioned dirty hands, drinking untreated water, walking barefooted, not cutting nails regularly and flies as ways of transmissions ($P < 0.001$). Similarly, percentages of respondents who mentioned washing of hands before eating, wearing shoes/slippers when going outside and washing vegetables before consumption were significantly higher among HELP group compared to control group ($P < 0.001$). It is clear that the posters as source of information, hookworm as an example of worms, poor school performance as a symptom, flies as a way of transmission and washing vegetables before consumption as a preventive measure were only mentioned at 3 months assessment and by HELP group.

TABLE 4.11: Knowledge about intestinal helminths, symptoms, transmission and prevention among Orang Asli people in both groups

Variable	Baseline assessment				3 months assessment			
	HELP n (%)	**Control n (%)**	**OR (95% CI)**	***P***	**HELP n (%)**	**Control n (%)**	**OR (95% CI)**	***P***
Heard about intestinal worms	62 (69.7)	55 (72.4)	0.9 (0.4, 1.7)	0.703	80 (89.9)	59 (78.7)	1.6 (1.0, 2.7)	0.046
Source of information								
Clinic/hospitals	11 (17.5)	11 (20.1)	0.9 (0.6, 1.5)	0.755	15 (18.8)	16 (26.7)	0.8 (0.5, 1.2)	0.264
Mass media	2 (3.2)	2 (3.7)	0.9 (0.3, 2.5)	0.890*	2 (2.5)	2 (2.5)	0.9 (0.3, 2.3)	0.760*
School/schoolchildren	3 (4.8)	2 (3.7)	1.2 (0.4, 3.5)	0.762*	27 (33.3)	4 (6.8)	3.9 (1.5, 8.9)	< 0.001
Posters	0	0	NA	-	44 (55.0)	0 (0.0)	NA	< 0.001
Do not remember	28 (44.4)	22 (40.0)	1.1 (0.7, 1.6)	0.626	3 (3.8)	19 (32.2)	0.4 (0.3, 0.6)	< 0.001
Type of worms								
Roundworm	9 (14.3)	6 (10.9)	1.2 (0.6, 2.3)	0.583	26 (32.1)	8 (13.6)	2.0 (1.1, 3.9)	0.012
Pinworm	9 (14.5)	9 (16.4)	0.9(0.6, 1.5)	0.782	15 (18.8)	10 (16.9)	1.1 (0.6, 1.8)	0.785
Hookworm	0	0	NA	-	25 (30.9)	0 (0.0)	NA	< 0.001
Whipworm	0 (0.0)	1 (1.8)	NA	0.470	7 (8.6)	2 (3.4)	1.9 (0.6, 5.6)	0.211
Signs and symptoms								
Know at least one symptom	26 (41.9)	25 (45.5)	0.9 (0.6, 1.4)	0.702	60 (75.0)	33 (55.9)	1.6 (1.1, 2.3)	0.018
Abdominal pain	6 (9.5)	10 (18.2)	0.7 (0.5, 1.1)	0.171	30 (37.5)	16 (27.1)	1.3 (0.8, 2.1)	0.199
Abdominal distention	4 (6.5)	5 (9.1)	0.8 (0.4, 1.5)	0.733*	16 (20.0)	5 (8.5)	1.9 (0.9, 4.2)	0.061
Diarrhoea	9 (14.5)	9 (16.4)	0.9 (0.6 (1.5)	0.782	29 (35.8)	13 (22.0)	1.5 (0.9, 2.5)	0.079
Vomiting	3 (4.8)	3 (5.5)	0.9 (0.4, 2.1)	0.881*	8 (10.0)	3 (5.1)	1.6 (0.6, 4.2)	0.289
Loss of appetite	2 (3.2)	4 (7.3)	0.7 (0.4, 1.3)	0.481*	13 (16.2)	5 (8.5)	1.6 (0.7, 3.4)	0.177
Pale face	2 (3.2)	1 (1.8)	1.4 (0.3, 3.7)	0.831*	9 (11.1)	3 (5.1)	1.7 (0.6, 4.7)	0.208
Body weakness	6 (9.5)	6 (10.9)	0.9 (0.5, 1.7)	0.804	15 (18.8)	7 (11.9)	1.4 (0.7, 2.7)	0.272
Perianal itching	7 (11.1)	8 (14.8)	0.8 (0.5, 1.4)	0.550	12 (15.0)	12 (20.3)	0.8 (0.5, 1.3)	0.410

Blood in stool	2 (3.2)	1 (1.8)	1.4 (0.3, 7.1)	0.762*	3 (3.8)	1 (1.7)	1.7 (0.3, 9.4)	0.637*
Poor school performance	0	0	NA	-	20 (25.0)	1 (1.7)	10.3 (1.5, 51.7)	< 0.001
Transmission								
Know at least one way of transmission	24 (38.7)	20 (36.4)	1.1 (0.7, 1.6)	0.794	39 (48.8)	24 (40.0)	1.2 (0.8, 1.8)	0.303
Eating contaminated food	7 (11.3)	7 (12.7)	0.9 (0.5, 1.6)	0.811	16 (19.8)	7 (11.9)	1.5 (0.8, 2.8)	0.214
Dirty hands	11 (17.7)	3 (5.5)	2.3 (0.8, 6.5)	0.041	28 (33.8)	5 (8.5)	3.2 (1.4, 7.3)	< 0.001
Walking barefooted	8 (12.9)	3 (5.5)	1.8 (0.7, 4.8)	0.168	38 (46.9)	3 (5.1)	7.7 (2.6, 23.5)	< 0.001
Drinking untreated water	6 (9.7)	2 (3.6)	1.9 (0.6, 5.6)	0.196*	25 (30.9)	4 (6.7)	3.6 (1.4, 9.1)	< 0.001
Playing with soil	2 (3.2)	5 (9.1)	0.6 (0.4, 1.1)	0.251*	18 (22.5)	8 (13.3)	1.5 (0.8, 2.7)	0.168
Not cutting nails regularly	5 (7.9)	2 (3.6)	1.6 (0.5, 4.5)	0.447*	28 (34.6)	5 (8.5)	3.3 (1.5, 7.6)	< 0.001
Flies	0	0	NA	-	18 (22.5)	0 (0.0)	NA	< 0.001
Prevention								
Know at least one way for prevention	24 (38.7)	28 (50.9)	0.8 (0.5, 1.1)	0.185	52 (64.2)	27 (45.8)	1.5 (1.0, 2.3)	0.030
Taking de-worming drugs	10 (16.1)	17 (30.9)	0.7 (0.5, 0.9)	0.058	24 (30.0)	21 (35.6)	0.9 (0.6, 1.3)	0.486
Washing hands before eating	10 (16.1)	9 (16.4)	1.0 (0.6, 1.7)	0.973	45 (55.6)	13 (22.0)	2.5 (1.5, 4.1)	< 0.001
Wearing shoes when outside	5 (8.1)	2 (3.6)	1.7 (0.5, 5.5)	0.445*	31 (38.8)	6 (10.0)	3.2 (1.5, 6.9)	< 0.001
Boiling drinking water	4 (6.5)	4 (7.4)	0.9 (0.4, 1.9)	0.840*	19 (23.8)	9 (15.0)	1.4 (0.8, 2.5)	0.286
Washing vegetables before consumption	0	0	NA	-	25 (30.9)	0 (0.0)	NA	< 0.001
Cutting fingernails regularly	2 (3.2)	1 (1.8)	1.5 (0.4, 3.9)	0.762*	18 (22.5)	3 (5.1)	2.3 (1.4, 4.3)	0.004

OR, Odds ratio. CI, Confidence interval. NA, Not applicable due to small numbers.

* Fisher's Exact test

Significant association ($P < 0.05$)

Interestingly, the practices of Orang Asli respondents in relation to STH infections have significantly improved among the intervention group compared to the control group (Table 4.12). A great improvement was noted in the percentages of those washing their hands before eating, wearing shoes when going outside the house (APPENDIX I), washing hands after defecation, and washing vegetables before consumption. A significant reduction in the percentage of those practicing open defecation was also reported among the intervention group compared to unchanged percentage in the control group (P = 0.04). Among the intervention group, it was observed and was informed that people who have toilets facilities at their houses were using them while many others started practicing defecation on tree leaves and bury it (APPENDIX I). Although there were improvements in the percentages of those who practiced washing fruits before eating and boiling drinking water, but the differences were not statistically significant.

TABLE 4.12: Attitude and perceived practices towards intestinal helminths among Orang Asli people in both groups

Variable	Baseline assessment				3 months assessment			
	HELP n (%)	Control n (%)	OR (95% CI)	*P*	HELP n (%)	Control n (%)	OR (95% CI)	*P*
Effects of intestinal helminths								
Harmful to peoples' health	36 (40.4%	26 (34.2)	1.2 (0.8, 1.9)	0.348	76 (85.4)	32 (42.1)	2.6 (1.9, 3.6)	< 0.001
Do not know	53 (59.6)	50 (65.8)	-	-	13 (14.6)	44 (57.9)	-	-
Faeces as source of infections								
Yes	24 (27.0)	28 (36.8)	0.7 (0.3, 1.7)	0.276	45 (50.6)	34 (44.7)	1.2 (0.7, 2.3)	0.620
No	1 (1.1)	2 (2.6)	-	-	1 (1.1)	2 (2.6)	-	-
Do not know	64 (71.9)	46 (60.5)	-	-	43 (48.3)	40 (52.6)	-	-
Practices								
Washing hands before eating	34 (38.2)	33 (43.4)	0.8 (0.4, 1.5)	0.469	80 (89.9)	38 (50.0)	3.5 (1.9, 6.4)	< 0.001
Washing hands after defecation	49 (55.1)	41 (53.9)	1.0 (0.6, 1.9)	0.887	73 (82.0)	43 (56.6)	3.5 (1.7, 7.1)	< 0.001
Washing hands with soap	16 (18.0)	18 (23.7)	0.7 (0.3, 1.5)	0.366	60 (67.4)	18 (23.7)	6.5 (3.2, 13.1)	< 0.001
Wearing shoes when outside	50 (56.2)	37 (48.7)	1.4 (0.7, 2.8)	0.336	81 (91.0)	41 (53.9)	8.6 (3.6, 20.3)	< 0.001
Cutting fingernails regularly	36 (40.4)	35 (46.1)	0.7 (0.5, 1.1)	0.469	68 (76.4)	46 (60.5)	2.1 (1.1, 4.1)	0.028
Washing vegetables before eating	33 (37.1)	31 (41.3)	0.8 (0.4, 1.6)	0.578	64 (71.9)	35 (46.7)	2.9 (1.5, 5.6)	0.001
Washing of fruits before eating	29 (32.6)	30 (39.5)	0.7 (0.4, 1.4)	0.357	53 (59.6)	34 (44.7)	1.8 (0.9, 3.3)	0.057
Boiling drinking water	21 (23.9)	17 (22.7)	1.0 (0.4, 2.6)	0.857	32 (36.4)	17 (22.7)	1.9 (0.9,3.9)	0.062
Indiscriminate defecation	58 (65.2)	51 (67.1)	0.9 (0.7, 1.4)	0.793	41 (46.1)	47 (61.8)	0.7 (0.5, 0.9)	0.043
Seeking treatment from clinic	88 (98.9)	71 (94.7)	1.2 (0.6, 2.7)	0.180	88 (100)	70 (93.3)	1.0 (0.5, 2.8)	0.094

OR, Odds ratio. CI, Confidence interval. NA, Not applicable due to small numbers.
Significant association ($P < 0.05$)

As a part of the knowledge assessment, drawing activities were organized at both schools at baseline and after 3 months. At baseline, not all children were able to draw a clear or meaningful figure relating to intestinal worms. Subsequently, children from the intervention school showed a significant improvement with more than 75% of them being able to translate their understanding on intestinal worm morphology, modes of transmission and preventive measures in clear figures. On the other hand, children from the control school continued drawing unclear figures. Figure (4.9) shows examples of pupils' drawing activity selected randomly from both schools; in Kuala Koyan School, at start of the project (Drawing -A1-), and after 3 months ((Drawing -A2-), while for Betau school, the activity done before starting HELP Package (Drawing -B1-) and after 3 months from HELP Package (Drawing -B2-).

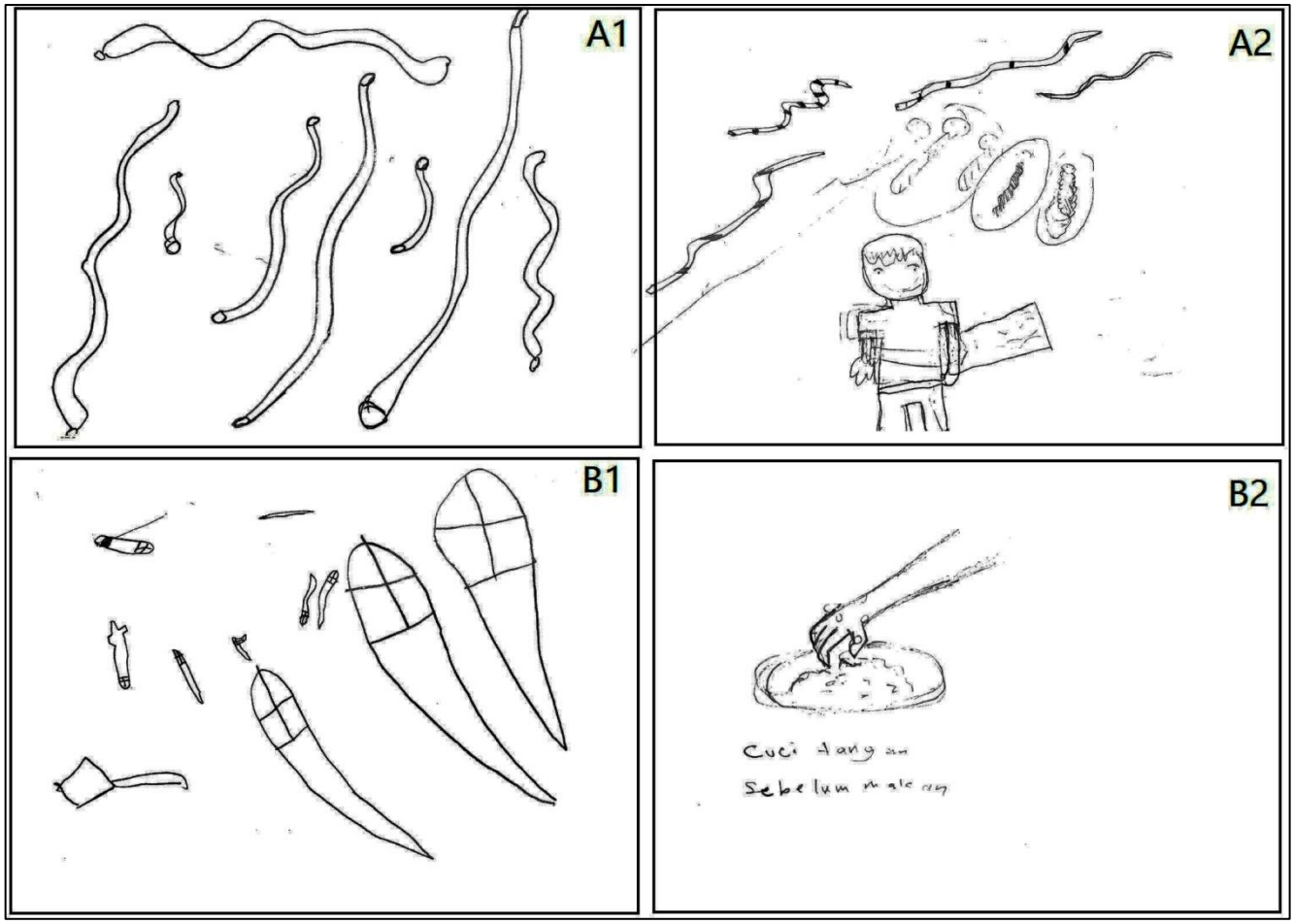

FIGURE 4.9: Examples of drawing assessments for children at baseline and after 3 months.

A: Control school B: Intervention school 1: Baseline 2: After 3 months

4.8.5 Impact of HELP on the knowledge of teachers about STH infections

The knowledge of teachers about intestinal helminth infections was assessed at baseline and after 3 months among 44 teachers from both schools (Table 4.13). There were 45 and 17 teachers in SKPB and SKKK respectively. However, there were only 29 teachers from SKPB and 15 from SKKK during the assessment sessions. At baseline, the results showed that the majority of the teachers from both schools had heard about intestinal worms, with there was no significant difference in their knowledge about signs,

symptoms, transmission and prevention of intestinal helminth infections. About half of the teachers in both schools mentioned abdominal pain as a symptom of infection, not washing hands before eating as a mode of transmission, and taking deworming drugs as a preventive measure.

The follow-up assessment after 3 months showed a significant improvement in the knowledge of the teachers from the HELP school, at which time all of them (100%) mentioned at least one helminth type, one symptom, one way of transmission, and one preventive measure for tackling intestinal helminthic infections. On the other hand, the knowledge of teachers in the control school remained unchanged. Interestingly, 93.1%, 79.3% and 37.9% of the teacher in the HELP group mentioned roundworm, hookworm and whipworm, respectively, and these were significantly higher when compared with their counterparts from the control school. The results also showed that 41.4% and 37.9% of the teachers from the HELP school had mentioned poor school performance as a symptom for infections, as well as flies as a way of transmission respectively and that these were significantly higher when compared to displays of such knowledge from the control group.

TABLE 4.13: Knowledge about intestinal helminths, symptoms, transmission and prevention among teachers in both schools involved in the study

Variable	Baseline assessment				3 months assessment			
	HELP n (%)	**Control n (%)**	**OR (95% CI)**	***P***	**HELP n (%)**	**Control n (%)**	**OR (95% CI)**	***P***
Heard about intestinal worms	25 (86.2)	13 (86.7)	0.9 (0.2, 5.9)	0.966*	29 (100)	14 (93.3)		0.341*
Source of information								
Clinic/hospitals	4 (16.0)	2 (15.4)	0.9 (0.2, 6.0)	0.961*	5 (17.2)	3 (21.4)	0.8 (0.3, 2.3)	0.741*
Internet	3 (12.0)	2 (15.4)	0.8 (0.3, 2.7)	0.770*	3 (10.3)	3 (21.4)	0.6 (0.2, 1.5)	0.373*
Mass media	4 (16.0)	2 (15.4)	1.2 (0.4, 4.3)	0.961*	3 (10.3)	2 (14.3)	0.8 (0.3, 2.5)	0.706*
School	0	0	NA	-	23 (79.3)	4 (28.6)	2.6 (1.0, 7.1)	< 0.001
Type of worms								
Roundworm	8 (32.0)	5 (38.5)	0.8 (0.3, 2.0)	0.690	27 (93.1)	5 (35.7)	5.2 (2.2, 12.2)	< 0.001
Pinworm	6 (24.0)	4 (30.8)	0.8 (0.3, 2.1)	0.709*	9 (31.0)	7 (50.0)	0.6 (0.3, 1.4)	0.228
Hookworm	9 (36.0)	6 (46.2)	0.7 (0.3, 1.8)	0.544	23 (79.3)	6 (42.9)	2.7 (1.2, 6.4)	0.035*
Whipworm	0	0	NA	-	11 (37.9)	0 (0.0)	NA	0.008*
Signs and symptoms								
Know at least one symptom	20 (80.0)	9 (69.2)	1.4 (0.6, 3.5)	0.459	28 (96.6)	9 (64.3)	3.4 (1.8, 6.7)	0.010*
Abdominal pain	14 (56.0)	7 (53.8)	1.1 (0.4, 2.5)	0.899	29 (100)	7 (50.0)	NA	< 0.001
Diarrhoea	10 (40.0)	7 (53.8)	0.7 (0.3, 1.7)	0.415	18 (62.1)	8 (57.1)	1.1 (0.5, 2.7)	0.757
Vomiting	6 (24.0)	3 (23.1)	1.0 (0.4, 2.9)	0.949*	6 (20.7)	4 (28.6)	0.8 (0.3, 1.9)	0.704
Loss of appetite	6 (24.0)	5 (38.5)	0.7 (0.3, 1.6)	0.457	6 (20.7)	4 (28.6)	0.8 (0.3, 1.9)	0.704*
Body weakness	7 (28.0)	2 (15.4)	1.7 (0.5, 6.3)	0.456*	7 (24.1)	4 (28.6)	0.9 (0.4, 2.2)	0.755

Blood in stool	4 (16.0)	2 (15.4)	1.0 (0.3, 3.5)	0.961*	1 (3.4)	1 (7.1)	0.6 (0.2, 2.7)	0.590*
Poor school performance	0	0	NA	-	12 (41.4)	1 (7.1)	5.6 (1.0, 38.7)	0.033*
Transmission								
Know at least one way of transmission	16 (64.0)	10 (76.9)	0.7 (0.2, 1.9)	0.486	29 (100)	11 (78.6)	NA	0.029*
Eating contaminated food	10 (40.0)	5 (38.5)	1.0 (0.4, 2.6)	0.927	17 (58.6)	8 (57.1)	1.0 (0.4, 2.5)	0.927
Dirty hands	13 (52.0)	8 (61.5)	0.8 (0.3, 1.9)	0.575	20 (69.0)	9 (64.3)	1.2 (0.5, 2.8)	0.795
Walking barefooted	7 (28.0)	4 (30.8)	0.9 (0.4, 2.4)	0.859	17 (58.6)	5 (35.7)	1.9 (0.8, 4.7)	0.159
Drinking untreated water	8 (32.0)	4 (30.8)	1.0 (0.4, 2.7)	0.938	5 (17.2)	5 (35.7)	0.5 (0.2, 1.3)	0.252
Playing with soil	2 (8.0)	1 (7.7)	1.0 (0.2, 4.5)	0.973*	20 (69.0)	4 (28.6)	3.1 (1.2, 8.5)	0.012
Not cutting nails regularly	5 (20.0)	4 (30.8)	0.7 (0.3, 1.7)	0.689*	10 (34.5)	6 (42.9)	0.8 (0.3, 1.8)	0.594
Flies	0	0	NA	-	11 (37.9)	1 (7.1)	5.0 (1.0, 34.3)	0.035*
Prevention								
Know at least one way for prevention	20 (80.0)	8 (61.5)	1.7 (0.7,4.1)	0.263*	29 (100)	10 (71.4)	NA	0.008*
Taking de-worming drugs	11 (44.0)	8 (61.5)	0.6 (0.2, 1.6)	0.305	17 (58.6)	7 (50.0)	1.3 (0.5, 2.9)	0.594
Washing hands before eating	8 (32.0)	5 (38.5)	0.8 (0.3, 2.0)	0.730*	29 (100)	9 (64.3)	NA	0.002*
Wearing shoes when outside	7 (28.0)	4 (30.8)	0.9 (0.4, 2.4)	0.858*	15 (51.7)	6 (42.9)	1.3 (0.5, 3.0)	0.586
Boiling drinking water	3 (12.0)	4 (30.8)	0.5 (0.2, 1.2)	0.203*	6 (20.7)	4 (28.6)	0.8 (0.3, 1.9)	0.704*
Washing vegetables before consumption	5 (20.0)	6 (46.2)	0.4 (0.2, 1.1)	0.135*	9 (31.0)	5 (35.7)	0.9 (0.4, 2.1)	0.759*

OR, Odds ratio. CI, Confidence interval. NA, Not applicable due to small numbers.
* Fisher's Exact test
Significant association ($P < 0.05$)