IJPHCS
Open Access: e-Journal

International Journal of Public Health and Clinical Sciences
e-ISSN: 2289-7577. Vol. 4:No. 1
January/February 2017

A Cross-sectional Study on the Determinants of Personal Hygiene Practices Related to Soil-transmitted Helminthiases among School Children in Bandar Baru Bangi, Malaysia

Auwal S.G.[1, 2], Hejar A.R.[1*], Minhat H.S.[1]

[1]Department of Community Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia.
[2]Hajiya Gambo Sawaba General Hospital, Zaria LGA, Kaduna State, Nigeria.

Corresponding author: Associate Prof (Dr) Hejar Abdul Rahman, hejar@upm.edu.my

ABSTRACT

Background: Soil-transmitted helminthiases (STHs) are important causes of morbidity among school age children in the tropics and the promotion of good personal hygiene practice that protects against infection remains a vital component of the control and elimination strategies. This study aimed to identify the determinants of personal hygiene practice among urban school children to assist in health education and hygiene promotion.

Materials and Methods: Using a cross-sectional study design and a proportionate stratified random sampling, 380 standard five Malay students were drawn from five Malay-medium national primary schools in the town of Bandar Baru Bangi, Malaysia. Self-administered questionnaires were used to collect information regarding their socio-demographic characteristics, knowledge, attitude and personal hygiene practices related to soil-transmitted helminthiases. Using SPSS version 22.0, multiple logistic regression analysis was used to obtain the adjusted determinants of good personal hygiene practice. In making statistical decisions, p-values < 0.05 were considered significant.

Result: A total of 352 students returned eligible questionnaires within a period of one week, giving the study an overall response rate of 92.6%. Out of these, 267 (75.9%) heard of STHs, 329 (93.5%) considered them harmful to health, and majority of the students reported good hygiene practices including always washing fruits before eating (92.0%), always washing hands before eating (88.6%) and always wearing shoes when going outside (88.1%). Determinants of good personal hygiene practice included disease awareness (AOR=2.13; 95%CI=1.04 to 4.36) and knowing poor academic performance as a possible complication of STHs (AOR=2.27; 95%CI=1.30 to 4.00).

Conclusion: Knowledge, attitude and personal hygiene practices related to soil-transmitted helminthiases were generally good among standard five Malay students in the area. The observed associations between some knowledge items and self-reported personal hygiene practice present an important opportunity for improving the students' hygiene practices through health education.

Keywords: soil-transmitted helminthiasis, knowledge, attitude, personal hygiene practices, school-age children

International Journal of Public Health and Clinical Sciences
e-ISSN: 2289-7577. Vol. 4:No. 1
January/February 2017

1.0 Introduction

Since the passage of the World Health Assembly Resolution WHA54.19 in 2001, soil-transmitted helminthiases (STHs) – a group of human intestinal parasites that typically comprises of hookworms (*Ancylostoma duodenale* and *Necator americanus*), roundworm (*Ascaris lumbricoides*) and whipworm (*Trichuris trichiura*), have been gaining more attention (World Health Organization, 2012). In the past, their ability to trigger chronic asymptomatic disease with relatively low mortalities even among people living in poor and impoverished communities allowed them to successfully evade global attention even as they constitute some of the most prevalent Neglected Tropical Diseases (NTDs).

It is now known that apart from a host of hypersensitivity reactions which the human body may develop against the larval forms of these parasites and the acute surgical complications the adult forms may trigger (Bethony et al., 2006; Utzinger et al., 2012), even seemingly chronic asymptomatic infestations of moderate intensity could lead to iron deficiency anaemia, vitamin A deficiency and chronic malnutrition, factors which among school age children are associated with impaired cognitive and physical growths, frequent illness, absenteeism from school, diminished academic performance and poor future economic productivity (Ahmed et al., 2011; Hotez et al., 2008).

In 2010, an estimated 1.45 billion people were believed to be living with at least one of the three common parasites, majority of them were pre-school and school age children in tropical regions (Pullan, Smith, Jasrasaria, & Brooker, 2014). Studies in the past have shown that soil-transmitted helminthiases were once endemic to many parts of Malaysia, until 1978, when rapid but disproportionate socio-economic development nearly wiped the disease away from the urban towns (Jamaiah & Rohela, 2005; Lim, Romano, Colin, Chow, & Smith, 2009), while the poor indigenous populations in the remote villages continue to harbour an alarmingly high numbers of the disease (Anuar, Salleh, & Moktar, 2014; Lee, Ngui, Tan, Muhammad Aidil, & Lim, 2014).

Public health efforts to control STHs have traditionally focused on mass drug administration (MDA) with anti-helminths, provision of sanitation and health education to create more awareness and bring about lasting behaviour modification (Asaolu & Ofoezie, 2003; Keenan et al., 2013). The latter strategy was most favourable as it is considered less costly to implement and that it significantly increases the effectiveness of other strategies when undertaken together (Mascie-Taylor et al., 2003). However, using health education to promote personal hygiene practices requires an understanding of the basic factors that influence hygiene practice among the individuals at risk (Ansari & Warbhe, 2014). In most instances, this task begins with exploring the state of knowledge and attitudes of such individuals within the target population.

This study, therefore, aimed to describe the socio-demographic characteristics of Malay school age children in an urban location, determine their level of knowledge and attitudes towards soil-transmitted helminthiases and also ascertain if any of those factors significantly predicts personal hygiene practice among the students. It also aimed to assist school authorities in creating health education interventions and enlighten the local health authorities in assessing the magnitude of health risks posed by STHs among urban school children.

International Journal of Public Health and Clinical Sciences
e-ISSN: 2289-7577. Vol. 4:No. 1
January/February 2017

2.0 Materials and Methods

2.1 Study site

This study was conducted in Bandar Baru Bangi, an urban town in the district of Hulu Langat, the second most populous district in the state of Selangor. The town, which is divided into 16 sections, covers an area of 2,925 hectares and is situated about 25km south of Malaysia's capital city, Kuala Lumpur. A total of six public primary schools were in the area; five of them Malay medium national primary schools (*Sekolah Kebangsaan*), and the remaining one a religious type school that used Arabic language as medium of teaching (Mohd Dlan & Kasim, 2012).

2.2 Study design

This was a cross-sectional study, designed to collect information from primary school students using a close-ended, self-administered, pre-tested and bilingual questionnaire that was adapted from two previous studies (Al-Delaimy et al., 2014; Nasr, Al-Mekhlafi, Ahmed, Roslan, & Bulgiba, 2013). The independent variables were socio-demographic characteristics, knowledge on soil-transmitted helminthiases and attitudes towards them. The dependent variable was self-reported personal hygiene practice, which in this study was arbitrarily categorized into "good" and "poor" practice. Good practice was defined as having a correct response to all the nine questions making up the personal hygiene section, while any set of responses short of this ideal score, occasioned by a sometimes or a never answer to even one personal hygiene question was classified as poor practice.

2.3 Sampling method

The sampling population consisted of standard five Malay students who attended any of the five Malay-medium national primary schools in Bandar Baru Bangi. Other students who attended privately-owned schools or the religious type school, where the medium of teaching was not Malay, were excluded to avoid language barrier. In addition, standard six students in all the schools were excluded to avoid interference with their academic schedules, in compliance with the Malaysian Ministry of Education's regulations. Standards one to four were also excluded as they would not be able to satisfactorily read, understand and respond to the questionnaire.

Available records from the Education Department showed that 9,547 students were enrolled in the five selected primary schools, about 1,592 of which were estimated to be in standard five (panel A, Figure 1). Thus, by way of SPSS select random cases command, a stratified proportionate simple random sampling was used to select a total of 380 standard five students. However, this sample size exceeded the minimum number of 350 students required to give the study an 80% power of detecting a 10% difference in the proportions of good personal hygiene practices with 95% confidence, given a finite population size of 1,592 standard five students.

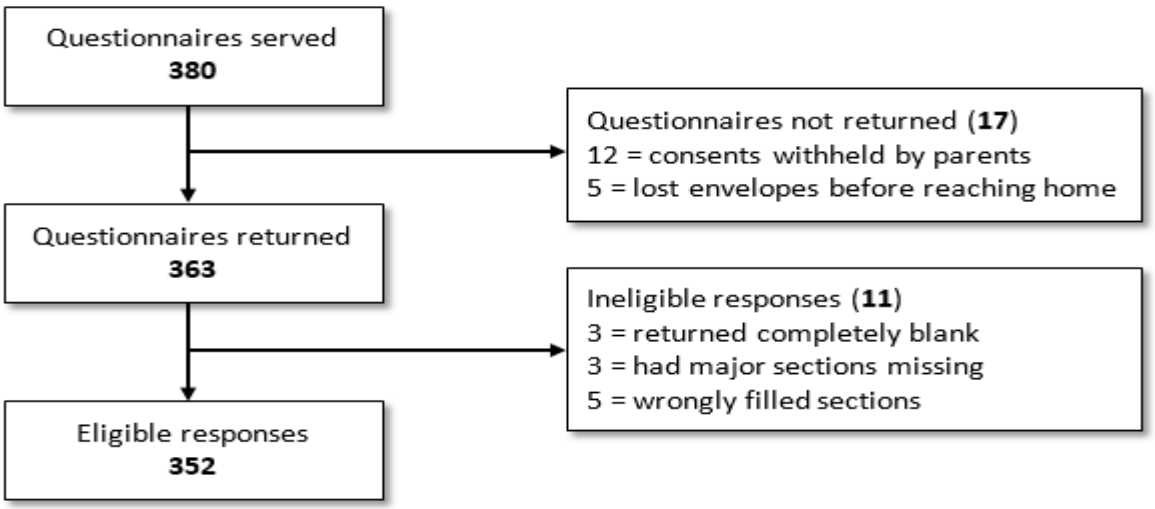
Selected students in all schools were instructed on how to respond to the various sections of the questionnaire before they were served take-home envelopes, each containing copies of the

International Journal of Public Health and Clinical Sciences
e-ISSN: 2289-7577. Vol. 4:No. 1
January/February 2017

questionnaire and a consent form for their parents. In each school, a focal person responsible for gathering the returned envelopes was assigned and introduced to the students. All returned envelopes were collected by the researcher exactly seven days after distribution.

School	Section 2	Section 3	Section 4	Section 6	Section 7	Total
[1]**Number of Students**	1466	1793	2255	1482	2551	**9547**
[2]**Estimated Number of Students in Standard 5**	245	299	376	247	425	**1592**
Number of Standard 5 Students Selected	**60**	**70**	**90**	**60**	**100**	**380**

A



B

Figure 1: Proportionate stratified sampling of students and the response rate
[1] Figures obtained from Ministry of Education
[2] Estimates obtained by dividing the population of each school by 6

2.4 Ethical considerations

Ethical approval to conduct this study was obtained from the University Ethics Committee on Research involving Human Subjects, the Malaysian Ministry of Education and the Selangor State Department of Education. Participation in the study was entirely voluntary and only

International Journal of Public Health and Clinical Sciences
e-ISSN: 2289-7577. Vol. 4:No. 1
January/February 2017

students whose parents or guardians willingly provided an informed consent were included. Both anonymity and confidentiality were maintained throughout the study with only questionnaire codes used to identify individual respondents.

2.5 Statistical analysis

Analysis was done using IBM SPSS version 22.0. A simple logistic regression analysis was first used to explore the associations between items making up the independent variables and the state of personal hygiene practice before using a multiple logistic regression analysis to determine the predictors of good personal hygiene practice among the students, adjusting for the influence of related variables. In performing the multivariate analysis, Forward-LR method was used to select predictor variables into the model, with the exception of age and gender that were purposely included. In making statistical decisions, p-values < 0.05 were considered significant.

3.0 Result

3.1 Characteristics of respondents

At the end of one week period, of the 380 envelopes distributed to selected students, a total of 363 were returned back. Those who failed to do so indicated either failure to obtain consent from their parents or they had lost their envelopes before they could reach home. Further examination of the returned envelopes showed an additional three were returned blank, another three had major sections missing, while five others were wrongly filled. Altogether, a total of 352 questionnaires were eligible for final analysis, giving the study an overall response rate of 92.6% (panel B, Figure 1).

Table 1 describes the socio-demographic characteristics of the students. All were Malay between the ages of 10 and 11 years and girls constituted 54.8% of the study participants, just as students from section 7 accounted for nearly a quarter of all respondents. All the students indicated their parents had received some formal education, ranging from primary school certificates (UPSR) to doctorate degrees. Only 2.8% of fathers and 21.6% of mothers were reported to be out of job at the time of data collection. About 267 students (75.9%) had awareness on STHs prior to the study, having heard of the disease from either their parents (59.2%), school teachers (35.2%), or from TV sources (36.3%). Many, however, heard of soil-transmitted helminthiases from multiple sources.

Table 1: Socio-demographic characteristics of the students (N = 352)

Characteristics	n	%
Primary schools:		
Section 2	52	14.8
Section 3	65	18.5
Section 4	86	24.4
Section 6	57	16.2
Section 7	92	26.1
Gender:		
Male	159	45.2
Female	193	54.8
Age (years):		
Ten	16	4.5
Eleven	336	95.5
Father is employed:		
Yes	341	96.9
No	10	2.8
Do not know	1	0.3
Mother is employed:		
Yes	274	77.8
No	76	21.6
Do not know	2	0.6
Heard of STHs:		
Yes	267	75.9
No	85	24.1

3.2 Personal hygiene practices

Table 2 shows the distribution of students according to their personal hygiene practices. Majority of them engaged in recommended hygiene practices including always washing fruits before consumption (92.0%), always washing hands before eating (88.6%) and always wearing shoes when going outside (88.1%). Moreover, a significant number of the students abstained completely from unhygienic practices such as never practiced open defecation (95.5%) and never drank untreated water (90.1%). Some students, however, reported occasionally playing with the soil (53.7%), not washing hands with soap and water after visiting toilet (36.9%) and having uncut fingernails (20.2%). In all, a total of 70 students (19.9%) qualified as having good personal hygiene practice.

Table 2: Personal hygiene practices of the students (N = 352)

Hygiene Practice	Always		Sometimes		Never	
	n	(%)	n	(%)	n	(%)
Wash hands before eating	312	(88.6)	40	(11.4)	0	(0.0)
Wash hands after touching animals	251	(71.5)	91	(25.9)	9	(2.6)
Wash fruits before eating	324	(92.0)	25	(7.1)	3	(0.9)
Wear shoes when going out	310	(88.1)	39	(11.1)	3	(0.9)
Cut fingernails	281	(79.8)	71	(20.2)	0	(0.0)
Wash hands with soap after toilet use	215	(61.1)	130	(36.9)	7	(2.0)
Drink untreated water	2	(0.6)	33	(9.4)	317	(90.1)
Pass stools outside house	3	(0.9)	13	(3.7)	336	(95.5)
Play with soil	13	(3.7)	189	(53.7)	150	(42.6)

3.3 Attitude

The students' attitudes towards soil-transmitted helminthiases are shown in Table 3. About 93.5% believed worms are harmful to health and 85.5% agreed that delay in seeking treatment is also harmful. Although the students were divided on whether previous treatment with antihelminthic medication protects against future infestations, a significant proportion (62.5%) agreed that living in a town area does not offer any protection. In addition, many of the students believed there were things they could do to protect themselves against STHs, and as high as 95.4% agreed they needed to learn more on how to achieve self-protection.

Table 3: Attitudes of the students towards soil-transmitted helminthiases (N = 352)

Attitude	Agree		Undecided		Disagree	
	n	%	n	%	n	%
Worms are harmful to health	329	(93.5)	19	(5.4)	4	(1.1)
Delay in treatment is harmful	301	(85.5)	39	(11.1)	12	(3.4)
I will not be infected since I have taken deworming drugs	141	(40.2)	117	(33.3)	93	(26.5)
I can prevent myself from worm infection	219	(62.2)	82	(23.3)	51	(14.5)
Children should be taught on intestinal worms	318	(90.3)	28	(8.0)	6	(1.7)
I am safe from worms since I live in town area	20	(5.7)	112	(31.8)	220	(62.5)
Treatment of worms is not necessary as it is self-limiting	19	(5.4)	108	(30.7)	225	(63.9)
I need to know more about worms for my own protection	335	(95.4)	13	(3.7)	3	(0.9)

International Journal of Public Health and Clinical Sciences
e-ISSN: 2289-7577. Vol. 4:No. 1
January/February 2017

3.4 Knowledge

The students' knowledge on soil-transmitted helminthiases are presented in Table 4. Majority of the students identified transmission through egg-contaminated foods (72.7%) as against infection through skin penetration, which was identified by only 38.0%. A sizeable proportion of them knew that mosquitos, coughing individuals and houseflies do not transmit the disease (67.9%, 63.4% and 35.9% respectively). In addition, up to 57.7% knew that touching infected persons does not transmit STHs, while another 48.6% knew that eating food with an infected person does not constitute a risk.

Table 4: Knowledge on transmission, symptoms, complications, misconceptions and preventive practices (N = 352)

Knowledge	**Correct**		**Wrong**		**Do not know**	
	N	**(%)**	**n**	**(%)**	**n**	**(%)**
Transmission						
Worm eggs in food	256	(72.7)	31	(8.8)	65	(18.5)
Mosquito bite	239	(67.9)	25	(7.1)	88	(25.0)
Skin penetration	133	(38.0)	117	(33.4)	100	(28.6)
Touching infected persons	203	(57.7)	40	(11.3)	109	(31.0)
Houseflies	126	(35.9)	124	(35.3)	101	(28.8)
Through coughing	223	(63.4)	38	(10.8)	91	(25.9)
Eating food with infected persons	171	(48.6)	88	(25.0)	93	(26.4)
Symptoms						
Abdominal pain	313	(88.9)	7	(2.0)	32	(9.1)
Abdominal distension	238	(67.8)	56	(16.0)	57	(16.2)
Paleness	202	(57.4)	62	(17.6)	88	(25.0)
Fever	98	(27.8)	164	(46.6)	90	(25.6)
Dysentery	268	(76.1)	26	(7.4)	58	(16.5)
Vomiting	241	(68.5)	48	(13.6)	63	(17.9)
Complications						
Frequent illness	271	(77.0)	28	(8.0)	53	(15.0)
Absenteeism from school	223	(63.5)	74	(21.1)	54	(15.4)
Poor growth	207	(58.8)	45	(12.8)	100	(28.4)
Poor academic performance	170	(48.3)	88	(25.0)	94	(26.7)
Poor future career	92	(26.1)	140	(39.8)	120	(34.1)
Misconceptions						
Infected children must look ill	199	(56.5)	60	(17.0)	93	(26.5)
Infected children can get better without treatment	31	(8.8)	247	(70.2)	74	(21.0)
Children treated for worms in the past will not get infected again	38	(10.8)	214	(60.8)	100	(28.4)
Prevention						
Wash hands before eating	336	(95.5)	6	(1.7)	10	(2.8)
Bathing regularly	57	(16.2)	252	(71.8)	42	(12.0)
Wash fruits before eating	335	(95.7)	4	(1.1)	11	(3.2)
Eating food regularly	186	(53.0)	119	(33.9)	46	(13.1)
Cutting nails regularly	306	(87.2)	24	(6.8)	21	(6.0)
Wash hands after toilet	327	(93.2)	11	(3.1)	13	(3.7)
Wearing shoes regularly	307	(87.5)	18	(5.1)	26	(7.4)
Brushing teeth regularly	118	(33.5)	189	(53.7)	45	(12.8)
Using mosquito net	267	(75.9)	24	(6.8)	61	(17.3)

The commonly identified symptoms were abdominal pain (88.9%), dysentery (76.1%), abdominal distension (67.8%), vomiting (68.5%) and paleness (57.4%). Fever, although an uncommon symptom of chronic infestation, was indicated by 46.6% of the students. Concerning the long-term complications associated with STH infestation, most of the students recognized frequent illness (77.0%), school absenteeism (63.5%) and poor growth (48.3%). Up to 48.3% could not link STH infestation to poor academic performance and only 26.1% associated the disease with poor future career.

Interestingly, when asked about common misconceptions associated with STHs, more than half of the students (56.5%) believed infected children must show symptoms. About 10.8% believed re-infection is not possible while an additional 28.4% expressed uncertainty about this. However, a significant proportion (70.2%) understood deworming as a necessary precondition for complete cure from disease. In terms of preventive practices, majority of the students knew of washing fruits before consumption (95.7%), hand washing before eating food (95.5%), hand washing after visiting toilet (93.2%), wearing shoes when going outside (87.5%) and regular nail cutting (87.2%). Although about 75.9% of the students knew that sleeping inside mosquito net does not protect against infestation, other common hygiene practices such as regular bathing and regular teeth brushing were wrongly identified as preventive practices by more than half of the students.

3.5 Determinants of good personal hygiene practices

The result of multiple logistic regression analysis is presented in Table 5. Good personal hygiene practice was neither influenced by older age (eleven years) nor by female gender, as their respective odds ratios when compared to younger age (ten years) and male gender were not significantly different from unity. On the other hand, students who heard of STHs before the study were more likely to report good personal hygiene practice compared to those who never heard of the disease, irrespective of age and gender (AOR=2.13; 95%CI=1.04 to 4.36). Similarly, those who realized poor academic performance was a possible complication of STHs were significantly more likely to report good personal hygiene practice compared to those who did not know about the complication (AOR=2.27; 95%CI=1.30 to 4.00).

Table 5: Multivariate analysis of factors associated with good personal hygiene practice

Variable	Wald	AOR	95% CI
Eleven years	2.113	0.44	0.15, 1.33
Female gender	0.125	1.10	0.64, 1.90
Heard of STHs	4.301	2.13*	1.04, 4.36
Poor academic performance is a complication	8.202	2.27*	1.30, 4.00

AOR, Adjusted odds ratio. CI, Confidence interval. * Significant association ($P < 0.05$).

4.0 Discussion

This study, which explored the knowledge, attitude and personal hygiene practices related to STHs focused on school children residing in urban areas. Findings from the study show several key departures from similar ones conducted among Malaysian rural indigenous (Orang Asli) school children, among whom STHs are known to be highly endemic (Al-Delaimy et al., 2014; Anuar et al., 2014).

Regarding personal hygiene practices, we found that apart from adhering to other personal hygiene practices to varying degrees, 92.0% of our students reported always washing fruits before consumption, 88.6% reported always washing their hands before eating food, 79.8% reported regular cutting of their fingernails, while some 95.5% never practiced open defecation. In contrast, an interventional study carried out on indigenous school children in Lipis District of Pahang, Malaysia, found that at baseline, only 41.3% of children in the control school washed fruits before consumption. Hand-washing before eating was practiced by only 43.4% and a slightly higher percentage (46.1%) were reported to practice regular cutting of fingernails. In addition, the unhealthy habit of indiscriminate defecation was said to be common among the students (Al-delaimy et al., 2014). Thus, students in our study had shown greater tendency to report good personal hygiene practices compared to other students of comparable age from rural indigenous populations.

In terms of attitudes towards the disease, our study found that STHs were considered harmful by an overwhelming majority of the students (93.5%). Again this finding, contrasts sharply with the modest 34.2% observed in Lipis District (Al-delaimy et al., 2014). Interestingly, this study found no association between attitude and self-reported personal hygiene practices of the students. In the well to-do Arraial suburb of Rio de Janeiro, where up to 94.4% of the respondents agreed that intestinal worms are bad for people, an exceedingly low prevalence of STHs (1.9%) was recorded (Moraes Neto et al., 2010). Thus it would appear that better socioeconomic status is associated with good attitude towards STHs, which in turn lowers the risk of infection. Indeed, a study conducted among school children in Hunan province of China found a significant negative correlation between an individual's attitude score and risk of infection with any STH (Bieri et al., 2013). However, it is important to note that this relationship between attitude and risk of STH is not always present and even children already infected could report good attitude. Indeed a study which focused on the KAP patterns of highly endemic rural indigenous populations in Malaysia found no association between attitude and risk of infection with any of the three main parasites (Nasr et al., 2013). In any case, the uncertainty surrounding this relationship makes any association between attitude and self-reported personal hygiene practices particularly more challenging to establish, especially giving the fact that both attitude and self-reported personal hygiene practice are highly susceptible to social desirability bias.

In terms of knowledge, the level of disease awareness among our students is comparable to that of school children in rural indigenous populations (75.9% versus 72.4%) (Al-delaimy et al., 2014). However, despite this similarity, important differences also exist in that 72.7% of our students knew about oral transmission, 95.5% knew hand-washing before eating food is a preventive practice, 88.9% knew abdominal pain is a symptom and 77.0% knew frequent illness is a complication of STHs. Among children in one school in Lipis District, only 36.4%

could mention at least one route of transmission, 45.5% could mention at least one symptom, and only 50.9% could mention at least one preventive practice (Al-delaimy et al., 2014). Although a true difference in knowledge may account for the observations noted above, it is important to bear in mind that such a difference could have been exaggerated, given the fact that a close-ended questionnaire was used in our study, which might have encouraged guessing on options.

Based on our arbitrary criteria, 19.9% of all students qualified as having good personal hygiene practice. Age and gender were not determinants of this status. On the contrary, disease awareness and knowing that poor academic performance is a complication are two factors that significantly predict good personal hygiene practice. This underscores the importance of awareness programmes and health education as means of promoting personal hygiene practices and bringing a lasting solution to the problem of STH among school age children.

Our study, given all its potential merits, is not without limitations. As noted above, the use of a close-ended questionnaire means all possible options to any given item were provided to the respondents to choose from, and this might have encouraged guessing. Although self-reported personal hygiene practice is positively correlated with observed personal hygiene practice (Bieri et al., 2013), arguably, the use of the latter is more preferred since it is considered more accurate and less susceptible to social desirability bias. We also excluded private and non-Malay medium schools in our study to avoid a potential language barrier. This decision, although necessary at the time, might have placed an additional restriction on the study's external validity even within the study area, given the fact that a typical Malaysian community comprises of both Malay, Chinese and Indian ethnicities.

5.0 Conclusion and recommendation

Soil-transmitted helminthiases are increasingly being recognized as important causes of morbidity especially among school age children in the tropics and as they are being targeted for control and elimination, the implementation of sustainable and cost-effective strategies that specifically focus on behaviour modification of individuals at risk will continue to remain a priority. Thus, even as we conclude that knowledge, attitude and personal hygiene practices were generally good among the students in our study, the important predictive associations observed provide yet another opportunity for changing students' attitude and improving their personal hygiene practices through health education using carefully selected key messages.

Acknowledgement

The authors acknowledge the Universiti Putra Malaysia Ethics Committee on Research involving Human Subjects (JKEUPM), the Malaysian Ministry of Education (JKM) and the Selangor State Department of Education for their approvals and permissions to conduct the study. Our appreciation also goes to the parents, staff and students of Malay medium national

primary schools in Bandar Baru Bangi and in Seri Kembangan (where the questionnaire was pretested), for agreeing to participate in our study.

Declaration

All authors have no competing interest(s) to declare.

Authors' contributions

Author 1: Designed the study, performed field work, analyse data and write the manuscript.
Author 2: Additional input on data analysis, editing and proof-reading of manuscript.
Author 3: Additional input on study design, data collection, analysis and editing of final draft.

References

Ahmed, A., Al-Mekhlafi, H. M., Choy, S., Ithoi, I., Al-Adhroey, A. H., Abdulsalam, A. M., & Surin, J. (2011). The burden of moderate-to-heavy soil-transmitted helminth infections among rural malaysian aborigines: an urgent need for an integrated control programme. *Parasites & Vectors*, *4*(1), 242.

Al-delaimy, A. K., Al-mekhlafi, H. M., Lim, Y. A. L., Nasr, N. A., Sady, H., Atroosh, W. M., & Mahmud, R. (2014). Developing and evaluating health education learning package (HELP) to control soil-transmitted helminth infections among Orang Asli children in Malaysia. *Parasites & Vectors*, *7*(1), 416.

Al-Delaimy, A. K., Al-Mekhlafi, H. M., Nasr, N. a., Sady, H., Atroosh, W. M., Nashiry, M., Mahmud, R. (2014). Epidemiology of Intestinal Polyparasitism among Orang Asli School Children in Rural Malaysia. *PLoS Neglected Tropical Diseases*, *8*(8), e3074.

Ansari, S. Y., & Warbhe, P. A. (2014). Assessment of the Knowledge and Practice Regarding Personal Hygiene among School Children. *International Journal of Current Medical and Applied Sciences*, *4*(1), 1–12.

Anuar, T. S., Salleh, F. M., & Moktar, N. (2014). Soil-transmitted helminth infections and associated risk factors in three Orang Asli tribes in Malaysia. *Scientific Reports*, *4*, 4101.

Asaolu, S. ., & Ofoezie, I. . (2003). The role of health education and sanitation in the control of helminth infections. *Acta Tropica*, *86*(2003), 283–294.

Bethony, J., Brooker, S., Albonico, M., Geiger, S. M., Loukas, A., Diemert, D., & Hotez, P. J. (2006). Soil-transmitted helminth infections: ascariasis, trichuriasis, and hookworm.

Lancet, *367*(9521), 1521–1532.

Bieri, F. A., Gray, D. J., Williams, G. M., Raso, G., Li, Y. S., Yuan, L., McManus, D. P. (2013). Health-Education Package to Prevent Worm Infections in Chinese Schoolchildren. *New England Journal of Medicine*, *368*(17), 1603–1612.

Hotez, P. J., Brindley, P. J., Bethony, J. M., King, C. H., Pearce, E. J., & Jacobson, J. (2008). Helminth infections: the great neglected tropical diseases. *The Journal of Clinical Investigation*, *118*(4), 1311–1321.

Jamaiah, I., & Rohela, M. (2005). Prevalence of intestinal parasites among members of the public in Kuala Lumpur, Malaysia. *The Southeast Asian Journal of Tropical Medicine and Public Health*, *36*(1), 68–71.

Keenan, J. D., Hotez, P. J., Amza, A., Stoller, N. E., Gaynor, B. D., Porco, T. C., & Lietman, T. M. (2013). Elimination and Eradication of Neglected Tropical Diseases with Mass Drug Administrations: A Survey of Experts. *PLoS Neglected Tropical Diseases*, *7*(12), 1–8.

Lee, S. C., Ngui, R., Tan, T. K., Muhammad Aidil, R., & Lim, Y. A. L. (2014). Neglected Tropical Diseases among Two Indigenous Subtribes in Peninsular Malaysia: Highlighting Differences and Co-Infection of Helminthiasis and Sarcocystosis. *PLoS ONE*, *9*(9a), e107980.

Lim, Y. a L., Romano, N., Colin, N., Chow, S. C., & Smith, H. V. (2009). Intestinal parasitic infections amongst orang asli (indigenous) in malaysia: Has socioeconomic development alleviated the problem? *Tropical Biomedicine*, *26*(2), 110–122.

Mascie-Taylor, C. G., Karim, R., Karim, E., Akhtar, S., Ahmed, T., & Montanari, R. (2003). The cost-effectiveness of health education in improving knowledge and awareness about intestinal parasites in rural Bangladesh. *Economics & Human Biology*, *1*(3), 321–330.

Mohd Dlan, N., & Kasim, R. (2012). Exploratory Study for the Neighbourhood Facilities Provision in Bandar Baru Bangi, Malaysia. *Proceedings International Conference of Technology Management, Business and Entrepreneurship 2012*, 174–210.

Moraes Neto, A. H. A., Pereira, A. P. M. F., Alencar, M. F. L., Souza-Júnior, P. R. B., Dias, R. C., Fonseca, J. G., Almeida, J. C. A. (2010). Prevalence of intestinal parasites versus knowledge, attitudes, and practices of inhabitants of low-income communities of Campos dos Goytacazes, Rio de Janeiro State, Brazil. *Parasitology Research*, *107*(2), 295–307.

Nasr, N. A, Al-Mekhlafi, H. M., Ahmed, A., & Bulgiba, A. (2013). Towards an effective control programme of soil-transmitted helminth infections among Orang Asli in rural Malaysia. Part 1: prevalence and associated key factors. *Parasites & Vectors*, *6*(1), 28.

Pullan, R. L., Smith, J. L., Jasrasaria, R., & Brooker, S. J. (2014). Global numbers of infection and disease burden of soil transmitted helminth infections in 2010. *Parasites & Vectors*, *7*(1), 37.

Utzinger, J., Becker, S. L., Knopp, S., Blum, J., Neumayr, A. L., Keiser, J., & Hatz, C. F. (2012). Neglected tropical diseases: Diagnosis, clinical management, treatment and control. *Swiss Medical Weekly*, *142*(November), 19–22.

World Health Organization. (2012). *Soil-Transmitted Helminthiases: Eliminating Soil-Transmitted Helmnthiases as a Public Health Problem in Children*. *Progress Report*.