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Research Note

New insights of *Enterobius vermicularis* infection among preschool children in an urban area in MalaysiaT. S. ANUAR¹, L. JALILAH¹, M. NORHAYATI², M. Y. AZLIN², M. S. FATMAH², H. M. AL-MEKHLAFI³

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Summary

Enterobiasis is a common intestinal parasitic infection caused by the nematode, *Enterobius vermicularis*. To assess the prevalence and to identify the underlying risk factors associated with enterobiasis among preschool children aged 1 – 6 years in Malaysia, 136 children from four nurseries and four kindergartens residing in the urban area were examined for *Enterobius vermicularis*. The cellotape anal swab technique was used for the detection of pinworm eggs. The parents/guardians of the investigated children were asked to complete the questionnaire so as to ascertain the potential risk factors for enterobiasis. The overall egg positive rate for *Enterobius vermicularis* infection was 12.5 %. The prevalence of this infection showed an age-dependency relationship, with higher rates observed among older children, aged 5 – 6 years. Multivariate analysis confirmed that finger sucking and belonging to a large family were significant risk factors of enterobiasis in the population studied. Recent pre-medication with anthelmintics was also found to have a significant impact on decreasing the egg positive rate for pinworm. The establishment of such data will be beneficial for the public health authorities in the planning and implementation of specific prevention in order to better control the infection.

Keywords: *Enterobius vermicularis*; enterobiasis; children; urban; Malaysia

Introduction

Enterobiasis is a common intestinal parasitic infection caused by the nematode, *Enterobius vermicularis* (pinworm or threadworm). The disease is distributed worldwide and affecting almost one billion peoples from all socioeconomic classes (Burkhart & Burkhart, 2005). It is an infection which predominates in preschool and school children who are easily exposed to inadequate sanitation and overcrowded conditions and who have more active contact with each other than adults (Lohiya *et al.*, 2000). The transmission of infection is usually by oral and respiratory tracts (Brooker & Bundy, 2009). Due to its contagious nature, enterobiasis tends to occur more among large family members and institutions such as

nurseries and kindergartens, especially with crowded conditions (Gunawardena *et al.*, 2013).

Although highly prevalent, this infection is often overlooked as most infections remain asymptomatic or cause only mild disturbances such as perianal itching, which may be intense and induce the victim to scratch the affected area resulting in excoriations, haemorrhages and secondary infections (Burkhart & Burkhart, 2005). Other common symptoms of the disease include abdominal discomfort, weight loss, insomnia and restlessness, irritability and emotional instability (Tsibouris *et al.*, 2005). However, serious morbidity such as eosinophilic enterocolitis, appendicitis and pelvic inflammatory disease have been reported as consequences of enterobiasis (Sah & Bhadani, 2006).

It is difficult to detect *E. vermicularis* eggs in stool because they are detectable only in approximately 5 % of the cases (Chu *et al.*, 2012). Therefore, diagnosis of pinworm is mainly based on detection of the characteristic eggs in the perianal region using swabs or adhesive tape. Alternatively, eggs may be seen in stool samples or scrapings from under finger nails and adult worms may be detected in the perianal skin at night. Swabbing needs to be done at night to coincide with oviposition or first thing in the morning prior to washing or cleaning the perianal region (Brooker & Bundy, 2009).

In Malaysia, only a few reports have been published regarding the prevalence of pinworm among children (Noor Hayati & Rajeswari, 1991; Rahman, 1991). A relatively high egg positive rate (40.4 %) has been reported by Norhayati *et al.* (1994) among children aged 1 – 8 years living in a rural area in Labu and Dengkil. Up to this date, there are no comprehensive data describing the epidemiology of enterobiasis among preschool children living in an urban area. Within this context, a cross-sectional study was undertaken to assess the prevalence and to identify underlying risk factors associated with *E. vermicularis* infection among children aged 1 – 6 years.

Materials and Methods

Study area

This was a cross-sectional study conducted in Kota Damansara, Malaysia between April and May 2012. Kota Damansara is a township located under the Subang parliamentary constituency. It was spread across 4,000 acre (16 km²) of land with a metropolitan setting. The metropolitan areas are planned, less crowded with near

adequate infrastructure social amenities but with good sanitation. A great number of the residents in the metropolitan area are high income earners and include senior civil or public servants and chief executive officers from the organized private sector. It had a population of 516,666 in 2010. The numbers of children under 10 years old was 71,829 (13.9 %) (Population & Housing Census of Malaysia, 2010).

Subject recruitment and consents

The study protocol was approved by the Ethical Review Committee of Universiti Kebangsaan Malaysia Medical Centre (UKM 1.5.3/289/FF-301-2012) and informed consent was obtained from each subject before enrollment. For enrollment, the letter containing data about the nature, implication and objectives of the study, copies of a questionnaire, a guide for swab examination and a consent form were sent to directors of enrolled nurseries and kindergartens. One hundred and thirty six children from four nurseries and four kindergartens underwent a screening for enterobiasis via the cellotape anal swab technique. Parents were notified of the procedure beforehand and were asked not to shower their children or have them defecate in the morning of the examination, with letters of consent sent to be signed and returned before the laboratory examinations were undertaken. The researchers then collected the slides with the questionnaire, on the same day.

Collection of anal swabs

All samples were collected between 06:00 and 08:00, just after the children had woken up but before they had bathed. Each subject was sampled only once due to poor co-operation of the subject and/or their parents.

Table 1. General characteristics of preschool children that participated in this study

Characteristics	Preschool children	
	n	(%)
Age groups (years)		
1 – 4	56	(41.2)
5 – 6	80	(58.8)
Gender		
Boy	62	(45.6)
Girl	74	(54.4)
Socioeconomic status		
Father's education (>6 years)	136	(100.0)
Mother's education (>6 years)	134	(98.5)
High monthly household income (>RM900)	136	(100.0)
Working mothers	112	(82.4)
Working fathers	136	(100.0)
Large family members (>4)	25	(18.4)

n = Number examined

RM = Malaysian Ringgit (US\$100 = RM359.92) (1st May 2015)

Table 2. Prevalence of *Enterobius vermicularis* among preschool children according to age groups and gender in the present study

	No. examined	No. infected	Prevalence (%)
Age groups (years)			
1–4	56	3	5.4
5–6	80	14	17.5
Gender			
Boy	62	10	16.1
Girl	74	7	9.5
Total	136	17	12.5

Questionnaire survey

A pre-tested self-administered questionnaire completed by the parents were used to evaluate the risk factors and clinical manifestations associated with enterobiasis. The information collected included finger sucking, nail biting, frequency of bathing, hand washing behavior, the number of household members and recent pre-medication of anthelmintic. On return of the swabs and completed questionnaire, the parents were educated on transmission and prevention of enterobiasis through leaflets.

Detection of pinworm eggs

To each anal swab, two drops of xylene were added between the slide and the tape and spread over the entire length of the slide to dissolve the mucilage in the sample (Garcia, 2009). Each slide was then carefully examined by at least two medical technologist, under a light microscope at 10x and 40x for the characteristic of pinworm eggs.

Data analysis

For descriptive analysis, rate (percentage) was used to describe the characteristics of the studied subject, including the prevalence of *E. vermicularis*. A Chi-squares test (χ^2) was used to test the associations between the variables. All variables that were significantly associated with the prevalence of *E. vermicularis* in the univariate model were included in a logistic regression analysis to identify the risk factors for enterobiasis. For each statistically significant factor, an Odds Ratio (OR) and 95 % confidence interval (CI) were computed by the univariate and multivariate logistic regression analyses. The level of significance was set as $p < 0.05$. All data were analyzed by using the SPSS software program for Windows version 20 (SPSS, Chicago, IL, USA).

Results

Demographic and socioeconomic profile

In April and May 2012, a total of 164 children between 1 and 6

years old were recruited for the survey. Of these recruited, 136 complied with the given instructions and returned the swabs and completed questionnaire (rate of compliance 82.9 %). Among this cohort, 56 children were from nurseries and the remaining (80) were from kindergartens. Median age of the children was 5 years [interquartile range (IQR) 3 – 6], with 45.6 % boys and 55.4 % girls. General characteristics of the children, including their demographic and socioeconomic profiles are presented in Table 1.

Prevalence and distribution of *Enterobius vermicularis* infection

The prevalence and distribution of enterobiasis are shown in Table 2. The overall egg positive of *E. vermicularis* was 12.5 % (17/136). The prevalence of this infection was not statistically significant between boys and girls. However, *E. vermicularis* infection was significantly higher among older children, aged 5 – 6 years (OR = 3.75; 95 % CI = 1.02, 13.73; $p = 0.035$).

Risk factors for enterobiasis

Multiple logistic regression analysis further confirmed that being aged ≥ 5 years (OR = 3.45; 95 % CI = 1.08, 13.44; $p = 0.048$), finger sucking (OR = 3.41; 95 % CI = 1.08, 10.75; $p = 0.035$), being a member of a large family (OR = 3.16; 95 % CI = 1.03, 9.62; $p = 0.043$) and pre-medication of anthelmintics (OR = 3.43; 95 % CI = 1.17, 10.12; $p = 0.025$) as the real risk factors for enterobiasis in the population studied (Table 3).

Table 3. Multivariate analysis of risk factors associated with pinworm infection among preschool children

Variables	OR	95% CI	p-value
Age groups	3.45	1.08, 13.44	0.048
Finger sucking	3.41	1.08, 10.75	0.036
Large family members	3.16	1.03, 9.62	0.043
Pre-medication of anthelmintics	3.43	1.17, 10.12	0.025

Significant association ($p < 0.05$)

Discussion

E. vermicularis infection is generally considered to be a nuisance rather than a fatal disease. However, the level of morbidity is significant especially in preschool children. Although this infection can be readily cured by anthelmintic, the prevalence of enterobiasis has not diminished over the past decade. This could be attributed to the relative ease of transmission causing frequent re-infections and the failure to clear parasites due to incomplete medication. As shown by the results of the present study, the overall egg positive rate of *E. vermicularis* was 12.5 % among preschool children in urban area. These findings are consistent with a previous study by Song *et al.* (2003), which reported a prevalence rate of 9.5 % among preschool children in a metropolitan city in Korea. To the best of our knowledge, the only past study on enterobiasis in urban area was done over twenty years ago. It reported a prevalence rate

of 41.7 % among children aged 1 – 12 years living in a multi-storey flats in Malaysia (Noor Hayati & Rajeswari, 1991). Nowadays, the society particularly those who lived in urban area have been exposed to authentic information provided by the current media. This exposure has reinforced parental knowledge of public issues and has enable parents to produce more adequate care for their children. This explained why the infection rate of pinworm has tremendously declined as compared to previous local study. In such countries, a significant reduction in prevalence is obvious when comparing results of surveys done before and after year 2000. In Turkey, the overall rate of enterobiasis (45.9 %) observed in the period 1985 – 2000 decreased to 16 % in the period 2000 – 2008 (Degerli *et al.*, 2009).

Current results also showed that the infection rate was almost comparable and no statistically significant differences were found between boys and girls, which conformed with the previous finding (Muge *et al.*, 2008). It has been noted that the prevalence of enterobiasis is significantly higher among children aged 5 – 6 years in our study which is in parallel with Norhayati *et al.* (1994). The cause of this trend could be due to inadequate personal hygiene of the older children and playing with dirty toys. Furthermore, the play activity program for children of 5 – 6 years is slightly different from that of younger children, aged 1 – 4 years as they play outside of the kindergarten instead of taking a nap. Therefore, they have more opportunity to play with dirt and have more physical contact with their friends than their counterpart in nurseries. Another possible cause is also iterative self-infection if an earlier infection has remained untreated.

Another interesting finding of our study was the significant association observed between personal hygiene and *E. vermicularis* infection among preschool children. This study indicated that children with the habits of finger sucking evidenced significantly higher rates of enterobiasis than those who did not have this habit. It is well known that children who harbor this infection may scratch the contaminated perianal skin and unintentionally transfer the eggs on finger to the mouth. The present findings are consistent with a studies carried out by Sung *et al.* (2001) and Kim *et al.* (2010). However, other factors such as nail biting, frequency of bathing and failure to wash hands before meals were not found to be significantly associated with enterobiasis in the present study. The sanitary environment has been greatly improved by urbanization during the last decades and parents tend to pay more attention to their children than before, placing a higher priority on children's welfare. Therefore, personal hygiene had little effect on the prevalence of *E. vermicularis* infection in our study, although personal hygiene and exposure to infected subjects are still important (Cook, 1994).

Epidemiologic studies have shown that children from large family members (>4) has three fold higher risk of acquiring pinworm and this finding is consistent with a previous study from Turkey (Muge *et al.*, 2008). This could be attributed to the more frequent contact with other children. If children from the same family attend differ-

ent establishments from which they get infected, they could infect other members of the family. By contrast, Song *et al.* (2003) and Norhayati *et al.* (1994) did not found any significant association between large family members and the risk of enterobiasis.

It is interesting to note that pre-medication with anthelmintics was found to have a great impact on decreasing the egg positive rate of pinworm in our study. In Malaysia, a nationwide survey and the mass treatment of infected persons have been undertaken to control trichuriasis, ascariasis and hookworm infection over several decades. This has resulted in the successful control of STHs to a level of 57 % (trichuriasis), 23.8 % (ascariasis) and 7.4 % (hookworm infection) in 2011 (Anuar *et al.*, 2014). Even though the children's parents were not informed about the nature of our study prior to the anal swab sampling, the taking of anthelmintic proved to significantly reduce the egg positive rate of pinworm in their children. This finding was also supported by Song *et al.* (2003).

The findings of the present study may have been limited by several factors. Firstly, the unwillingness of some parents and children to participate in the study because of the invasion of their privacy. They were also discouraged as they believed that the results of the study might be easily traced since their demographic and socioeconomic data were recorded. These factors also impacted negatively on the sample size with a likelihood of underestimating the true prevalence of the infection in nurseries and kindergartens. Secondly, directors and teachers of nurseries and kindergartens included in the study hesitated to provide information regarding the characteristics of both places, such as the frequent of the toys were washed, the numbers of children in a class and how frequently that the classroom was cleaned. Hence, we were not able to assess the potential predictors associated with the environment of those places.

In conclusion, enterobiasis is still common among preschool children in an urban area in Malaysia. Due to its rapid rate of spread and high re-infection rate among children in the same class or among family members, a long term follow up of the infection rate should facilitate the establishment of an effective *E. vermicularis* program, especially when coupled with the vigilant and timely administration of appropriate medication. Furthermore, it is also necessary to identify environmental risk factors for enterobiasis in nurseries and kindergartens as the majority of pinworm infection might be transmitted in those places, in order to control the infection.

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References

- ANUAR, T.S., SALLEH, F.M., MOKTAR, N. (2014): Soil-transmitted helminth infections and associated risk factors in three Orang Asli tribes in Peninsular Malaysia. *Sci. Rep.*, 4. DOI: 10.1038/srep04101
- BROOKER, S., BUNDY, D.A.P. (2009): Enterobiasis. In: Cook GC, Zumla IA, eds. *Manson's Tropical Diseases*. 22nd ed. Saunders, pp. 1515 – 1517
- BURKHART, C.N., BURKHART, C.G. (2005): Assessment of frequency, transmission, and genitourinary complications of enterobiasis (pinworms). *Int. J. Dermatol.*, 44: 837 – 840. DOI: 10.1111/j.1365-4632.2004.02332.x
- CHU, T.B., LIAO, C.W., NARA, T., HUANG, Y.C., CHOU, C.M., LIU, Y.H., FAN, C. K. (2012): *Enterobius vermicularis* infection is well controlled among preschool children in nurseries of Taipei City, Taiwan. *Rev. Soc. Bras. Med. Trop.*, 45: 646 – 648. DOI: 10.1590/S0037-86822012000500020
- COOK, G. C. (1994): *Enterobius vermicularis* infection. *Gut.*, 35: 1159 – 1162
- DEGERLI, S., MALATYALI, E., OZCELIK, S., CELIKSOZ, A. (2009): Enterobiasis in Sivas, Turkey from past to present, effects on primary school children and potential risk factors. *Turkiye Parazitol. Derg.*, 33: 95 – 100
- GARCIA, L.S. (2009): *Practical Guide to diagnostic parasitology*. Washington DC: American Society for Microbiology, pp. 246 – 247.
- GUNAWARDENA, N.K., CHANDRASENA, T.N., DE SILVA, N.R. (2013): Prevalence of enterobiasis among primary school children in Ragama, Sri Langka. *Ceylon Med. J.*, 58: 106 – 110. DOI: 10.4038/cmj.v58i3.5039
- KIM, D.H., SON, H.M., KIM, J.Y., CHO, M.K., PARK, M.K., KANG, S.Y., KIM, B.Y., YU, H.S. (2010): Parents' knowledge about enterobiasis might be one of the most important risk factors for enterobiasis in children. *Korean J. Parasitol.*, 48: 121 – 126. DOI: 10.3347/kjp.2010.48.2.121
- LOHIYA, G.S., TAN-FIGUEROA, L., CRINELLA, F.M., LOHIYA, S. (2000): Epidemiology and control of enterobiasis in a developmental center. *West. J. Med.*, 172: 305 – 308
- MUGE, O.A., BAYKAN, Z., ARTAN, C. (2008): Enterobiasis among preschool children: a study from kayseri, Turkey. *Jpn. J. Infect. Dis.*, 61: 482 – 483
- NOOR HAYATI, M.I., RAJESWARI, B. (1991): Epidemiology and symptomatology of enterobiasis among young children attending a community clinic in Kuala Lumpur, Peninsular Malaysia. *Trop. Biomed.*, 8: 151 – 156
- NORHAYATI, M., NOOR HAYATI, M.I., OOTHUMAN, P., AZIZI, O., FATMAH, M. S., ISMAIL, G., MINUDIN, Y.M. (1994): *Enterobius vermicularis* infection among children aged 1 – 8 years in a rural area in Malaysia. *Southeast Asian J. Trop. Med. Public Health.*, 25: 494 – 497
- POPULATION AND HOUSING CENSUS OF MALAYSIA. (2010): Department of Statistics, Malaysia
- RAHMAN, W.A. (1991): Prevalence of *Enterobius vermicularis* in man in Malaysia. *Trans. R. Soc. Trop. Med. Hyg.*, 85: 249
- SAH, S.P., BHADANI, P.P. (2006): *Enterobius vermicularis* causing symptoms of appendicitis in Nepal. *Trop. Doct.*, 36: 160 – 162. DOI: 10.1258/004947506777978361
- SONG, H.J., CHO, C.H., KIM, J.S., CHOI, M.H., HONG, S.T. (2003): Prevalence and risk factors for enterobiasis among preschool children in a metropolitan city in Korea. *Parasitol. Res.*, 91: 46 – 50. DOI: 10.1007/s00436-003-0836-3
- SUNG, J.F., LIN, R.S., HUANG, K.C., WANG, S.Y., LU, Y.J. (2001): Pinworm control and risk factors of pinworm infection among primary school children in Taiwan. *Am. J. Trop. Med. Hyg.*, 65: 558 – 562
- TSIBOURIS, P., GALEAS, T., MOUSSIA, M., SOTIROPOULOU, M., MICHOPoulos, S., KRALIOS, N. (2005): Two cases of eosinophilic gastroenteritis and malabsorption due to *Enterobius vermicularis*. *Dig. Dis. Sci.*, 50: 2389 – 2392. DOI: 10.1007/s10620-005-3069-8