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Enterobius Vermicularis Infection: Prevalence and Risk Factors Among Primary School Children in Al-mudhafar Directorate, Taiz, Republic of Yemen

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Abstract: Enterobius vermicularis (pinworm) is a common parasitic infection, especially in children; it causes gastrointestinal disease called enterobiasis. The present study was aimed to explore the prevalence, and the associated risk factors of this infection, among the students of the primary schools in Al-Mudhfar directorate, Taiz, Republic of Yemen. A cross-sectional study conducted on 370 of the primary school children (4-12 years). The perianal cellophane tape method was used to investigate pinwom infection. Parents were asked to complete questionnaires to collect information about children and families personal and hygienic characteristics. The overall prevalence rate of *Enterobius vermicularis* infection was 68%. It is found that there is no association between the prevalence and the gender or the age of the participants. Parent's educational level ($P < 0.05$), Family income levels ($P = 0.074$) and hosing levels ($P = 0.037$), all were found to be risk factors for pinworm infection. Personal hygiene factors that had found to affect the prevalence of infection of this worm were, hand washing after using toilet ($P = 0.001$), scratching around the anus ($P = 0.001$), Finger's sucking or nail's biting ($P = 0.07$), and exposing bedspreads to sunlight ($P = 0.01$). The rate of pinworm (*Enterobius vermicularis*) infection among the primary school children in Taiz; Republic of Yemen is high, and, therefore, represent an important parasitic disease. Waste disposal and good sanitation, in addition to mass screening for preschool and school children in Taiz governorate, and if possible in the whole country should be admitted**.** Pinworm infection among school children in Taiz is high, good sanitation and insurance of unpolluted food and water supplies, in addition to mass screening and treatment of infected persons should be admitted for the population of Taiz City to decrease the rate of pinworm infection.

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Key words: *Enterobius Vermicularis*, Parasitic, Prevalence, School Children, Risk Factor, Personal Hygiene.

1. Introduction

Enterobius vermicularis (*E. vermicularis*, pinworms or threadworms) is one the most common parasitic helminthes that affect human, and it is estimated that; about 200 million people worldwide are supposedly infected, with children 5-10 years accounting for over 30% of cases [1]. This infection has a larger geographical distribution than other helminthes [2]. It seems that, compared to other intestinal helminthic infestations, the prevalence of Enterobius vermicularis infection is underestimated due to the nature of worm migration during the night, and the relative difficulty of egg detection in the routine stool examination [3]

Regardless person's race, culture or socio-economic level; Enterobius vermicularis infection may be facilitated by certain factors such as personal or group hygiene and conditions of overcrowdings in schools, and family groupings [4]. Poor hygiene and overcrowdings facilitates pinworm's eggs to be transmitted from person to another, either directly via the anus to mouth, and, finger contamination or indirectly via contaminated objects such as pens, classroom's tablets, chairs or even grounds [4,5]. Since hygiene (group and personal), and exposure, represents the two most important transmission factors, children of the primary schools who live in a relatively poor, overcrowded and un-sanitary environments such as Taiz City are the most common group susceptible to Enterobius vermicularis infection [5,6]. The embryonated eggs of the pinworm measure 30-60 µm and could be found in clothing, house's dust and other surfaces. Infestation occur via ingestion and/or inhalation of the infective eggs, or via retrograde lava migration from the anal canal to the rectum then to the intestines, larva then become mature into adult worm. Migration of graved adult female occurs by night to the perianal area where they deposit up to 11,000~15000 eggs. Eggs became infective within 6 hours of deposition [19].

Several worldwide epidemiological surveys showed that; pinworm infection rate among school children in some countries in Asia, was as a follows; about 55% in China, 8.8% in Thailand, 47.2% in Myanmar and 4.4% in South Korea [7,8,9,10]; While the infection rate in Africa was; 26.3 in Tanzania, 1.7% in Angola, and 11.7% in Nigeria [11,12,13]; and in South America e.g., about 35% in Chile, 19% in Argentina [14,15]; and in Europe, e.g., 17.4% in Germany, and 19.3% in Kyrgyzstan [16,17]. Low prevalence rate were reported in studies that depends on stools analysis compared to those depends on perianal swab examination due to the fact that the worm's eggs are sticky and adherent to the perianal skin and cloths. The two methods of pinworm detection were compared in a survey made in mountainous Owa-Owa state, South Africa, among hospitalized children; the results suggested that fecal examination under-estimate the true prevalence as there were only few (0.4%) of the infected persons were positive in fecal analysis, where the percent was rises to 45.3% on examination of the same persons using Scotch tape method [18].

The status of pinworm infection among school children in the Republic of Yemen is supposed to be high; however the exact prevalence has unfortunately remained unknown. Previous studies have stated different intestinal parasitic infection among schoolchildren was found in Sanaa, and Taiz, Yemen, but these studies were depends on stool examination, so the real pinworm infection rate is unclear [19,20]. The present investigation attempted to determine the prevalence of pinworm infestation among the primary school children and to detect the associated risk factors using cellophane stick tape for specimen collection and a questionnaire interviews to analyze risk factors.

2. Methods

2.1. Area of the study and sample size calculation

This study was conducted from Mars to Septemper 2021 in Al-Mudhafar directorate, Taiz city, which is a Yemini city, located about 256 kilometers to the south of the capital, Sanaa. Primary school children, from 4 to 12 years of age, who agreed to participate in this study and whose parents or legal guardians gave consent were included. The number of the study population totaled 27521 persons. Finite single population proportion was used for sample size calculation, as follows, considering the rate of the prevalence (p) of 39.0%, as mentioned in the previous studies [21], with a 95% confidence interval (95% CI) (z = 1.96) and a 5% margin of error (d = 0.05). The final sample size was 370 participants, with inclusion of 2.4 non response rate.

$$n = \frac{Np(1-p)Z^2_{1-a/2}}{d^2(N-1)+p(1-p)Z^2_{1-a/2}} \quad \textbf{Eq1}$$

2.2. Survey for risk factors

Through the assistance of students of the final year of medical laboratory department of the faculty of medical and health science at AL-Saeed University, school children's parents was interviewed with structural questioner concerning demographic data (gender, age, residence, number of siblings, parent's educational and financial levels and occupation) and student's personal hygiene, (washing hands after using toilets, finger sucking, or keeping fingernails short, household cleaning, and living conditions) [5].

2.3. Sample collection for pinworm screening

Parents and children were informed about the timing of the experiment in advance. Samples were taken from every child; with the help of children's mothers, using perianal adhesive tape swab technique, in the morning before the defecation and bathing of children [2,22]. Participants were randomly selected from the studied community by taking one child from every five housing units. Samples were collected by passing the sticky side of the adhesive tape on the perianal region of the children and then sticking the tape on the labeled glass slide then putting it in a sterile envelope. The collected samples were then transported to the Microbiology Laboratory, Faculty of Medical and Health Sciences, Al-Saeed University, and examined under a light microscope.

2.4. Data analysis

After undergoing to cleaning, data then entered into computer, and analyzed using STATA version 13 (STATA Corp., TX, USA). The demographic characteristics of the participants were described using frequencies, percentages, and 95% CI for categorical data; means, and standard deviations (SD) were used for continuous data. For investigation of factors that affected *E. vermicularis* infections, the prevalence rate, 95% CI, and odds ratios (ORs) were estimated using simple and multiple logistic regressions and a generalized estimating equation (GEE). A P value of less than 0.05 was considered statistically significant (23).

3. Results

From a total of 370 primary school children, aged from 4-12 years, enrolled in this study, 204 (55%) were male and 166 (45%) were female. The total positivity rate of *E. vermicularis* among the primary school children in Al-Mudhafar directorate, Taiz, was 68.1%, and the number of positive samples were 252 out of 370 child examined (**Figure 1**).

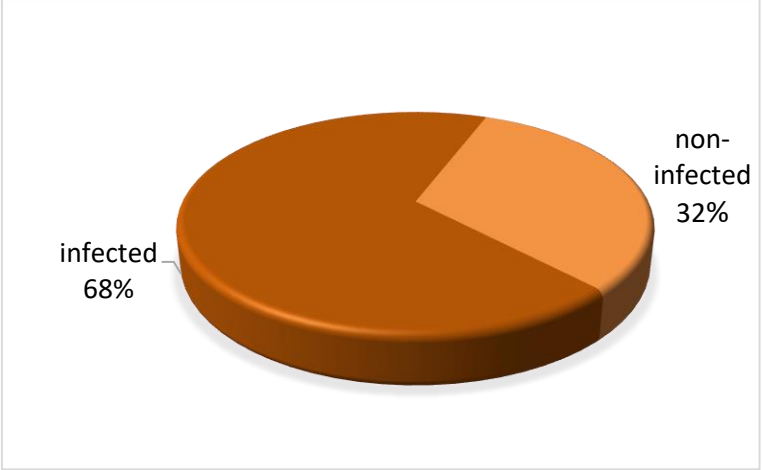

Figure 1: *Enterobius vermicularis* infection rate

The results showed that, there is no significant differences in the rate of infection between male 67.6% (138/204) and female 68.8 (114/166) individuals, or between different age groups (**Table 1**).

Table 1: Infection rate in different genders and different age groups

Characteristics		Examined samples	Infected	Uninfected	Infection%	*P value*
Gender	Male	204	138	66	67.6%	0.413
	Female	166	141	25	68.8%	
Age group	4-6	140	98	42	70%	0.775
	7-9	138	90	48	65.2%	
	10-12	92	64	28	69.6%	

The result of this study is also showed that, there is statistically significant correlation between the rate of pinworm infection and the educational levels of the parents ($p < 0.05$), and the rate of infection decease with the increase of the educational level of fathers and/or mothers (**Table 2**), ten children's fathers and five mothers don't give their educational levels.

Table 2: Effect of parents' educational level on the prevalence of pinworm infection

Parents	Educational level	Total	Infected	Uninfected	Infection %	*P value*
Father	Uneducated	16	13	3	81%	0.024
	Primary	52	40	12	77%	
	Preparatory	68	46	22	68%	
	Secondary	103	71	32	69%	
	University	121	77	44	64%	
Mother	Uneducated	25	20	5	80%	0.042
	Primary	47	34	13	72%	
	Preparatory	85	59	26	69%	
	Secondary	140	94	46	67%	

University	68	42	26	62%

There is a clear (but statically insignificant, P= 0.074) effect of the family income level on the prevalence of *Enterobius vermicularis* infection, as the prevalence decrease with the increase of the income table 3. The result also showed statistically significant correlation between the prevalence the housing levels **Table 3**.

Table 3: Effect of family income and housing level on pinworm infection

Characteristics		Total	Infected	Infection %	*P value*
Family income level	Poor	29	22	76%	0.074
	Weak	85	60	71%	
	Middle	212	144	68%	
	High	42	24	57%	
Housing level	Privately owned	112	65	58%	0.037
	Good rented	45	28	62%	
	Average rented	195	144	74%	
	Bad rented	14	12	86%	

Among selected personal hygiene factors, statistically insignificant correlation (P = 0.072) were found between sucking fingers or biting nails and the prevalence of pinworm infection. There was no correlation between keeping fingernails short and the rate of infection. Children who wash their hands after using toilet had lower egg positive rates for *E. vermicularis* than those who did not ($p < 0.01$). Statically significant increase in the prevalence of infection was found in children with the habit of scratching around the anus than whom not ($P < 0.01$). Periodic exposing of bedspreads to sunlight was also found to be significantly associated with lower egg positive rates for E. vermicularis (**Table 4**).

Table 4: Personal hygiene factors affecting the prevalence of pinworm infection

Characteristics		Total	infected	Non infected	Infection %	P value
Hand washing after using toilet	Not determined	16	12	4	75%	0.001
	Yes	94	36	58	38%	
	No	260	204	56	78%	
Scratching around the anus	Not determined	3	1	2	33%	0.001
	Yes	267	280	13	78%	
	No	100	43		43%	
Finger's sucking or nail's biting	Yes	213	153	57	72%	0.072
	No	157	99	58	63%	
Keeping fingernails short	Not determined	2	1	1	50%	0.585
	Yes	248	169	79	68%	
	No	120	82	38	68%	
Exposing bedspreads to sunlight	Yes	213	125	88	59%	0.011
	No	157	127	30	81%	

4. Discussion

Enterobius vermecularis is a worldwide public health problem; it is one of the common infections in many countries, irrespective of the socioeconomic level. This parasitic infection appeared to be more common in certain communities; such as children's care centers, schools, and over-crowded households. Generally, infection caused by these pinworms is relatively unobtrusive. Nevertheless; the deposition of eggs may cause irritation in perineal, perianal or even vaginal areas, and in their tries to relieve irritation of the continuous itching; persons possibly suffer from sleep disturbance, impaired concentration, emotional instability, or enuresis [5].

The present study shows that; the total percent of *E. vermicularis* infection among the primary school children in Al-mudhafr directorate, Taiz; Yemen, was 68%. The high prevalence of *E. vermicularis* in the determined study area could be attributed to exposure of children to the predisposing factors of infection; such as poor sewage disposal system, unsafe water sources, poor housing and lack of heath awareness on the majority of parents and children. Other important factor that may contribute for increase the rate of the prevalence in this study is the state of the war nowadays in Taiz, that lead to increase pollution in water and food supplies, and worsen sanitary disposal system. Other Yemeni studies made in Sanaa, Ibb, and Al-mahweet, indicated several pathogenic parasites, including pinworm, indicated that the pinworm infection rate is quite low (0.4% - 13%) [20,24,25]. Nevertheless, this is not the real situation as all of these studies were relayed on stool's findings because several studies have indicated that eggs are only found in the stool of 5% of infected persons [1]; thus the tape test can serve as a quick and sensitive way to clinch a diagnosis.

In studies made in Iraq which suffer from 'relatively same' economic and social complication of the war; higher infection rate (83.9 %) was reported in Najaf Province in 2015 [26], and a lower infection rate (27.13%) was reported in Erbil Province in 2020 [27]. Compared with other Asian countries, the prevalence of pinworm in school children detected in the present study (68%) was considerably higher than that reported in China (> 50%) [7]; and that conducted in Palestine (22.1%) [28], Thailand (7.8%) [29] And in Taiwan (0.21) [21].

In this study, the risk factor is not associated with the gender or the age of the participants; this disagree with results of some other studies, that showed that; the prevalence of pinworm infection was significantly higher in children aged > 5 years than in younger children aged ≤5 years [5,30] these studies were attributed the difference in the prevalence of infection in genders and in age groups to the difference in play, physical and social activity programs for children. The similarity in pinworm infection in different children's gender and age in the present study may be explained by the eating habits in Yemen, in which all members of the family used hands for eating at the same time from the same dish. The prevalence of pinworm infection in this study found to be inversely propionate to the parent's educational level; this could be explained by increase in the sanitary awareness and attitudes with the increase of the level of education.

The infection rate in this study is also decrease with the increase of the family income (but this result is statistically insignificant, P 0.074), Significant negative correlation is also found between the rate of infection and the housing level. Personal hygienic factors such as hand washing after using toilet and exposing bedspreads to sunlight were also significantly decrease the rate of pinworm infection (p 0.01). This findings are agreed with other studies reported from Iran in 2017 [6] and in China in 2015 [7]. Finger's sucking or nail's biting and keeping fingernails short are not significantly associated risk factors, this disagree with other studies reported from Taiwan [31] and Korea [32] that indicated these inadequate personal hygiene might increase the risk of pinworm infection among children.

5. Conclusion

The rate of infection *E. vermicularis* among school children is high, and, therefore, represent an important parasitic disease in Taiz; Republic of Yemen. Mass screening for preschool and school children in Taiz governorate, and if possible in the whole country should be admitted, and infected children and their family members should be treated, at the same time, together with improvement of sanitary systems and assuring good water supply.

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