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Prevalence of intestinal parasitic infections and its relationship with socio-demographics and hygienic habits among male primary schoolchildren in Al-Ahsa, Saudi Arabia

Hamdan Ibrahim Al-Mohammed[1], Tarek Tawfik Amin[2*], Elsayed Aboulmagd[1], Hatem Refaat Hablus[3], Burhan Omar Zaza[4]

[1]*Department of Medical Microbiology and Parasitology, College of Medicine, King Faisal University, Saudi Arabia*
[2]*Department of Community Medicine, Faculty of Medicine, Cairo University, Egypt*
[3]*Department of Paediatrics, College of Medicine, King Faisal University, Saudi Arabia*
[4]*Technical Director, School Health Preventive Services, Ministry of Education, Al-Hofuf Directorate, Saudi Arabia*

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ABSTRACT

Objective: To investigate the prevalence of different intestinal parasitic infections among male primary schoolchildren in Al-Ahsa, Saudi Arabia, and to explore the possible relative socio-economic, environmental and behavioural sanitary correlates. **Methods:** A cross-sectional descriptive study was performed. A total of 1 289 male students aged from 7 to 12 years were selected randomly from 20 urban and 12 rural primary schools by multistage sampling method. Data collection was carried out by self administered questionnaire form to the parents/guardians of students and included inquires about socio-demographics, environmental conditions, and behavioural sanitary habits. Stool analysis was carried out to examine the presence of intestinal parasitic infections. **Results:** Overall prevalence of parasitic infections was 27.2%, more among rural students. Frequently encountered infections included *Entamoeba histolytica/dispar* (8.2%), *Giardia lamblia* (6.5%), *Entamoeba coli* (4.0%) and *Enterobius vermicularis* (1.6%). Logistic regression revealed that lower maternal educational level and occupational status, low family income, big family size, poor personal hygienic practices and positive history of previous intestinal infections among family members increased the likelihood of infections. **Conclusions:** Although of low magnitude, intestinal parasitic infections still represent a public health concern among male schoolchildren in Al-Ahsa region. Socio-demographic and poor personal hygienic habits are the main predictors for these infections.

1. Introduction

Intestinal parasitic infections are globally endemic illness especially in tropical and subtropical countries. It is estimated that more than two billion people are infected with intestinal parasites. The majority are children and nearly 300 million infected patients are severely ill[1]. Parasitic infections are regarded as a serious public health problem, as they cause iron deficiency anaemia, growth retardation and other physical and mental health problems[2]. School children are the prime victims of intestinal parasitism that affect their physical development, school attendance and ability to learn[3]. Epidemiological researches in different countries have shown that the socio-economic, sanitary and environmental conditions are important underlying causes in the endemicity of parasitic infections[4,5].

Studies delineating the pattern of parasitic infections among school children in Saudi Arabia are scarce and dedicated to define prevalence of specific parasites[6,7]. *Entamoeba histolytica/dispar* is estimated to infect 10% of the world population, the prevalence of which varies according to localities and may reach up to 50% in under-developed areas[8]. In Saudi Arabia, the prevalence ranged from 2.2% among children with diarrheal diseases[7], to 32% in Riyadh region[9]. Data regarding the prevalence of other intestinal parasites and the underlying possible correlates of infections especially socio-economic, environmental and

*Corresponding author: Tarek Tawfik Amin, MD, Community Medicine Department, Faculty of Medicine, Cairo University, Cairo, Egypt. PO Box: 109 El Malek El Saleh, Cairo. Zip code: 11559.
Tel: 0020144793563
Fax: 0020223687673
E-mail: amin55@myway.com

sanitary are deficient. Subsequently, the objective of this study is to investigate the prevalence of different intestinal parasitic infections among primary school children in Al-Ahsa, Saudi Arabia and to explore the socio-economic, environmental and behavioural sanitary habits which favour these infections.

2. Materials and methods

2.1. Ethical considerations

Permissions were obtained from the local Directorate of Education as well as our institution after approval of the study protocol and data collection form. The data confidentiality was preserved according to Helsinki Declaration of Bioethics, and for the sake of the proper information management system. Those with intestinal parasitic infections were referred to School Health Centres (two centres were dedicated) in Al-Ahsa for proper treatment of cases and delivery of health education students and parents.

2.2. Subjects

A cross-sectional descriptive study was carried out in Al-Ahsa Governorate located in the Eastern Province of Saudi Arabia (450 km from Riyadh) with 996 000 Saudis.

An updated list of public primary schools in 2009 was used as the sampling frame. Two schools from each urban or rural area were randomly selected out of the proposed frame with a total of 20 urban and 12 rural primary schools. Then a proportionate sampling method was applied in rural/urban distribution. By an appropriate sampling fraction, the total number of sampled population was estimated in each school. A total of 1 289 students aged 7-12 years were the target of the study. Finally a systematic random method was employed to select the participantsby by students' roll number.

2.3. Data collection

The consent forms were given to parents or legal guardians of selected students to explain the objectives and procedures of the study. In addition, a questionnaire form "self administered" was also delivered to student's parents (guardians). It contained socio-demographic data, environmental factors, behavioural sanitary habits, previous history of intestinal parasitic infections.

School health workers were responsible for guidance of students on how parents should fulfil the form in case of illiteracy of both parents.

2.4. Collection of stool samples and intestinal parasites examination

The pilot testing was performed to 76 male students. Mothers or guardians were asked to collect stool specimen for analysis. Material for examination was collected early in the morning before bathing or defecation. Field workers were responsible for collection of stool specimens together with the questionnaire format. Stool specimens were collected from each participant and preserved in a labelled plastic container, transported to the laboratory within four hours after collection without any preservatives. Iceboxes were used to keep the stool samples during transportation. These specimens were examined by direct wet mount, Lugol's iodine, and modified formalin ethyl acetate sedimentation techniques for the presence of intestinal parasites. All specimens were scanned by single investigator to avoid inter-observer error.

2.5. Data processing and analysis

Collected data were revised according to certain pre-determined criteria "data collection forms with non-response or missing of more than two elements were eliminated (n=79, 23 urban and 56 rural)". Response rate among urban primary schools was 88.6% (753/850), and 94.6% (615/650) for rural. Those refused to participate showed no significant difference in relation to socio-demographic characteristics.

A pre-designed SPSS version 16.0 (SPSS Inc, Chicago, IL) file was used for data entry. Categorical data were expressed in proportions and percentage. *Chi* square and Z test for proportion were applied for comparison, univariate analysis with odds ratio and 95% confidence intervals calculated. Continuous data were expressed in median and standard deviation. T-test was employed for comparison. Spearman's correlation was used as appropriate. Logistic regression model was generated by inclusion of significant independent predictors (socio-demographics, hygienic habits, and others) at the univariate level against the dependent variable (intestinal parasitic infections). P value of < 0.05 was considered significant.

3. Results

3.1. Socio-demographic characteristics

A total of 1 289 schoolchildren aged from 7 to 12 years [(9.12±1.41) years] were included in this study and the age of infected children was (8.96±1.42) years old. The urban schoolchildren constituted 56.6% of the total sample. Saudis schoolchildren accounted for 94.7% of the total participants. Family number was significantly larger in rural compared to urban families (5.88±1.60 in urban *vs* 6.61±2.23 in rural, $P< 0.01$). Child order was also higher among rural students.1st child constituted 18.9% in urban *vs* 12.9% rural, 2nd and 3rd child in 31.3% urban and 31.5% rural while 4th and above child order was found in 49.7% in urban vs. 55.6% in rural schools.

Parental educational status showed that illiteracy was higher in rural compared to urban schools. Illiteracy rate among father was 12.5% (91/730) vs. 25.8% (144/559) in rural for father while for maternal it was 17.7% (129/730) vs. 28.8% (161/559) for rural mothers). Only 13.2% of the included mothers were working, more in urban compared to rural;

jobs included chiefly teaching, technician and governmental employees. Family income in Saudi Riyals was also significantly higher among family of urban students. Those with income of < 3 000 Saudi Riyals represented 21.9% vs. 34.4% in rural families (P<0.01).

3.2. Prevalence of intestinal parasitic infections

The prevalence of intestinal parasitic infections was demonstrated in Table 1. The overall prevalence was 27.2% (Confidence intervals, *CI*=24.9-29.7) slightly more among rural students but without statistical significance. The most frequently encountered parasites included *Entamoeba histolytica/dispar* (8.2%), followed by *Giardia lamblia* (6.5%), *Entamoeba coli* (4.0%) and *Enterobius vermicularis* (1.6%), while the least frequently encountered parasites were *Ascaris lumbricoides*, *Hymenolepis nana* and *Blastocystis hominis* (0.9% each). Those with multiple infections constituted 4.3%.

3.3. Correlates of intestinal parasitic infections

Univariate analysis results of socio-demographics and housing characteristics were depicted in Table 2. Those infected were significantly of younger age and 32.1% were in the age group of 7 to 9 years (Odds ratio, *OR*=1.45). Non-Saudis were more than three folds at risk of infections (*OR*=3.67). Those with illiterate mothers and working mothers were at significantly higher risk (*OR*=1.83 and 1.55, respectively). Low family income imposed increased risk but without statistical significance, while family number of ⩾ 5 significantly increased the risk (*OR*=1.38). Infections among 1st and 2nd order children were less than those of higher birth order, from 21.5% in the 1st order to more than 30.4% from 3rd child onwards (Spearman correlation coefficient: -0.122, P= 0.011). Current housing condition showed that apartment owners had lower risk of infections while those living at rented residency and villas were at higher risk but without statistical significance. The presence of maids, bathroom type, drinking water sources, garden and pets in the house and type of sewerage system had all variable association with intestinal parasitic infections but without statistical significance.

Table 3 showed the results of univariate analysis of personal hygienic habits and previous infections among students or their siblings. Infrequent hand washing before meals and following defecation and the methods used were significantly associated with increased risk to infections. History of previous parasitic infections of the same children, their siblings or previous history of treatment were all positive predictors for the occurrence of intestinal parasitic infections.

The analysis of logistic regression showed that several variables were positively associated with intestinal parasitic infection including: socio-demographic (β coefficient=0.224, odds ratio=0.82, *CI*=0.59-1.10, P=0.138); non-Saudi nationality(β coefficient=0.494, odds ratio=2.97, *CI*=1.61-5.48, P=0.030), lower maternal educational status(β coefficient=0.279, odds ratio=1.76, *CI*=1.12-2.75, P=0.009) and current maternal working condition(β coefficient=-0.513, odds ratio=0.11, *CI*=0.02-0.58, P=0.008). Previous history of parasitic infections(β coefficient=0.660, odds ratio=4.31, *CI*=1.78-10.39, P=0.01) imposed a greater risk for infection, infrequent hand washing (β coefficient=0.418, odds ratio=1.52, *CI*=0.72-3.22, P=0.168) especially following defecation (β coefficient=0.493, odds ratio=1.92, *CI*=1.09-3.37, P=0.038)and nail trimming through nibbling (β coefficient=0.567, odds ratio=1.76, *CI*=1.03-3.02, P=0.039)were also associated with significant risk of infection.

4. Discussion

In the present study, the prevalence of intestinal parasitic infections and their relationship with socio-demographic, environmental housing conditions and personal hygienic habits of male primary schoolchildren in Al-Ahsa, eastern region of Saudi Arabia, was studied. Several previous studies had tackled intestinal parasitism in different regions of Saudi Arabia like Riyadh[9,10], Jeddah[11,12] and Makkah[13,14]. However, this is the first study to investigate the problem in Al-Ahsa region.

The current study shows that 27.2% of primary schoolchildren, aged 7-12 years, were infected by one or more intestinal parasites. These findings are consistent with reports of Al-shammari *et al* and Al-Braiken *et al*[9,12]. Compared to our finding, the prevalence of intestinal parasitic infections among primary schoolchildren in Jeddah (western region of Saudi Arabia) was significantly

Table 1
Prevalence of intestinal parasitic infections among male primary schoolchildren in relation to the type of schools.

Parasitic infections	Schools [*n*(%)]		*Z* test	95% *CI*	Total [*n*(%)]
	Rural (*n*=559)	Urban (*n*=730)			
Entamoeba histolytica/dispar	57(7.8)	49(8.8)	0.52	6.8-9.9	106(8.2)
Entamoeba coli	30(4.1)	21(3.8)	0.18	3.0-5.2	51(4.0)
Giardia lamblia	43(5.9)	41(7.3)	0.93	5.3-8.0	84(6.5)
Blastocystis hominis	6(0.8)	5(0.9)	-0.17	0.5-1.5	11(0.9)
Enterobius vermicularis	11(1.5)	9(1.6)	-0.08	1.0-2.4	20(1.6)
Hymenolepis nana	6(0.8)	6(1.1)	0.17	0.5-1.6	12(0.9)
Ascaris lumbricoides	5(0.7)	6(1.1)	0.45	0.5-1.5	11(0.9)
Multiple infections	29(4.0)	27(4.8)	0.61	4.3-5.6	56(4.3)
Total	187(25.6)	164(29.3)	1.42	24.9-29.7	351(27.2)

Table 2
Socio-demographics of the male schoolchildren infected with intestinal parasitic infections.

Variables		Schoolchildren[*n*(%)]		Odds ratio (95% *CI*)
		Total (*n*=1 289)	Infected (*n*=351)	
Age groups	7- <9	455(35.3)	146(32.1)	1.45(1.12-1.88)**
	9-<11	613(47.6)	156(25.4)	0.84(0.65-1.09)
	⩾ 11	221(17.1)	49(22.2)	-
Nationality	Arabs non-Saudis	68(5.3)	38(55.9)	3.67(2.18-6.21)**
	Saudis	1 221(94.7)	313(25.6)	-
Father education	Illiterate/read and write	235(18.2)	56(23.8)	0.80(0.57-1.13)
	< Secondary education	580(45.0)	170(29.3)	1.21(0.94-1.56)
	Secondary or higher	474(36.8)	125(26.4)	-
Mother education	Illiterate/read and write	290(22.5)	124(42.8)	1.83(1.39-2.40)**
	< Secondary education	596(46.2)	132(22.1)	0.76(0.59-0.99)*
	Secondary or higher	403(31.3)	95(23.6)	-
Family number	⩾5	825(64.0)	243(29.5)	1.38(1.05-1.80)*
	< 5	464(36.0)	108(23.3)	-
Maternal work	Housewife	1 119(86.8)	291(26.0)	1.55(1.09-2.21)*
	Employed	170(13.2)	60(35.3)	-
Family income in Saudi Riyals/month	< 3 000	352(27.3)	106(30.1)	1.23(0.93-1.63)
	3000-< 6000	362(28.1)	91(25.1)	0.87(0.66-1.16)
	⩾ 6 000	575(44.6)	154(26.8)	-
Current housing	Rented house or apartments	303(23.5)	89(29.4)	1.15(0.86-1.54)
	Apartment (owner)	467(36.2)	104(22.3)	0.67(0.51-0.88)*
	House and villa	210(16.3)	63(30.0)	1.18(0.84-1.65)
	Living with the family	309(24.0)	95(30.7)	-
Maid in the house	Yes	440(34.1)	118(26.8)	0.97(0.74-1.27)
	None	849(65.9)	233(27.4)	-
Bathroom types	Traditional	503(39.1)	136(27.0)	0.98(0.76-1.28)
	Western	150(11.6)	38(25.3)	0.90(0.59-1.34)
	Both	636(49.3)	177(27.8)	-
Drinking water sources	Well	1 022(79.3)	283(27.7)	1.12(0.82-1.54)
	Tank	149(11.6)	42(28.3)	1.06(0.71-1.57)
	Bottled	118(9.2)	26(22.0)	-
Garden in the house	Yes	270(20.9)	74(27.4)	1.01(0.74-1.38)
	No	1 019(79.1)	277(27.2)	-
Sewer type	Septic tank	485(37.6)	129(26.6)	0.95(0.73-1.32)
	Municipal	804(62.4)	222(27.6)	-

CI=Confidence Intervals, * P <0.05, ** P< 0.001.

much lower (9.5%) which may reflect either the outstanding and hygienic care in the visited school in Jeddah or the fault pertained in sample selection[11]. Saudi Arabia has witnessed a rapid advancement in socio-economic status in the last three decades. It reflected on the provision of well integrated health system which is free of charge and cover all age groups aided with advanced technology and high quality services[15]. School health services are provided to all students with improvement of environmental school sanitary conditions, and increase in the socioeconomic and nutritional status. One of the consequences of this socio-economic advancement that entailed better lifestyle pattern with adequate nutrition, proper environmental sanitation and improvement of health system led to subsequent decline in infections including the parasitic[15].

Our results are comparable to those reported from other countries at epidemiological transition[16,17]. The encountered prevalence rate in this study is far less with low socio-economic profile: 66% in Albania[18], 58% in Cuba[19], 57% in Mexico[20] and 51% in China[21].

The rate of polyparasitism in this study (4.3%) was much lower than the rate of monoparasitism (22.9%). Such low prevalence of mixed infection has been consistently reported by Okyay *et al*[16]. On contrast, Kitvatanachai *et al*[22] showed that, the rate of mixed infections (56.8%) was much higher than that of single infections (17.3%) in Thailand.

Our findings revealed that there was no significant difference between intestinal parasitic infections and residence of school (P= 0.154). The relationship between the prevalence of intestinal parasitic infections and the urban/rural localities with higher prevalence is not always positive either in Saudi Arabia or other developing countries.

For instance, Al-Shammari *et al*[9] and Wördemann *et al*[19] showed that, the rate of parasitic infections in urban schools was higher than that found in rural schools in Riyadh and the western region of Cuba, respectively. Nevertheless,

Table 3
Intestinal parasitic infections in relation to personal hygienic habits and previous history of infection.

Personal hygienic habits		Schoolchildren[*n*(%)]		Odds ratio (95% *CI*)
		Infected (*n*=351)	Total (*n*=1 289)	
Hand washing before meals	Always	770(59.7)	182(23.6)	0.72(0.56-0.93)*
	Sometimes	461(35.8)	147(31.9)	1.36(1.05-1.77)*
	Rarely	58(4.5)	22(37.9)	-
Method of hand washing	With water only	633(49.1)	170(26.9)	0.96(0.75-1.24)
	With soap and water	656(50.9)	181(27.6)	-
Hand washing after defecation	Always	693(53.7)	141(20.3)	0.47(0.36-0.61)**
	Sometimes	458(35.5)	156(34.1)	1.68(1.30-2.18)**
	Rarely	138(10.7)	54(39.1)	-
Method of hand washing after efecation	Water	612(47.5)	189(30.9)	1.42(1.10-1.83)*
	Soap and water	677(52.5)	162(23.9)	-
By whom	Himself	1 228(95.3)	331(27.0)	0.76(0.42-1.36)
	Parents	61(4.7)	20(32.8)	-
Nail cutting frequency	Once/month	218(16.9)	28(12.8)	0.34(0.22-0.53)**
	Twice or more /month	292(22.6)	63(23.6)	0.71(0.52-0.99)*
	Nibbling of nails	454(35.2)	134(29.5)	1.19(0.92-1.55)
	Rarely	325(25.2)	126(38.8)	-
Previous history of infections	Yes	417(32.4)	232(55.6)	7.94(5.98-10.50)**
	No	872(67.6)	119(13.6)	-
Previous infections among other iblings	Yes	447(34.7)	214(64.0)	5.03(3.84-6.58)**
	No	842(65.3)	137(7.7)	-
Previous treatment of the child or his siblings	Yes	88(6.8)	46(52.3)	3.22(2.03-5.10)**
	No	1 201(93.2)	305(25.4)	-

CI= Confidence Intervals, * $P < 0.05$, ** $P < 0.001$.

the situation in Abha in Saudi Arabia[12] and Aydin in Turkey[16], was the other way where the prevalence of parasitic infections in the rural schools was higher.

In Al-Ahsa Governorate, Saudi Arabia, urban and rural regions are geographically intermingled with more or less similar living conditions and lifestyle, for instance Saudis working in agriculture represent only 6.7% and labourer force are mainly dependent on expatriate workers[23]. The previous notions may provide some explanations for the slight difference between the reported rates of intestinal infections while considering urban/rural differential.

In this study, the intestinal parasites namely Giardia lamblia, *Entamoeba histolytica/dispar, Entamoeba coli, Ascaris lumbricoides, Enterobius vermicularis, Hymenolepis nana and Blastocystis hominis* were identified from the tested stool samples. *Giardia lamblia* and *Entamoeba histolytica/dispar* were the most common intestinal parasites identified. These two protozoa represent the most common cause of intestinal parasitism not only in *Saudi Arabia*[9-12] but also in many areas of the world[17,19,22]. For instance, *Giardia lamblia* is the most common parasitic infection in the United States[24], while *Entamoeba histolytica/dispar* infects about 480 millions of persons worldwide[25]. These two protozoa are transmitted by the faecal-oral route and both are environmental contaminants of the water supply[22]. On the other hand, the low incidence of *Enterobius vermicularis* detected may be due to lacking of application of cellophane tape method.

No cases of *Taenia solium* or *Taenia saginata* were detected in the screened samples. This finding is in consistent with many reports from different regions in Saudi Arabia[9,11,12]. *Taenia solium* cases may be completely absent from Saudi Arabia because consumption of pork products are forbidden for Muslims who represent almost 100% of the population. On the other hand, absence of *Taenia saginata* cases may be due to absence of the practice or habit of eating uncooked or undercooked meat in Saudi Arabia.

According to the mode of transmission, most of the detected parasites in the present study are transmitted by faecal-oral route. These parasites may be an important indicator of socio-economic level. The effects of many socio-demographic factors on the prevalence of parasitic infection were evaluated in this study. Such factors may exert variable effect on the susceptibility of intestinal parasitic infections among the included students. For instance, no significant relation was found between the diagnosed intestinal parasitic infection and the presence of maid, garden or pets in the house and type of bathroom.

On the contrary, the rate of infections was significantly higher among 6-9 years-old schoolchildren (youngest category). It may be attributed to fault hygienic practice following the defecation practice where 95% of infected children carry out the cleaning procedures by themselves and 54% of them only with parental supervision.

In addition, this study revealed no significant association between the occurrence of intestinal parasitic infections and

sources of drinking water or the type of sewage disposal. The previous findings are in conflict with other studies carried out in Saudi Arabia, like Riyadh[9] and Asir region[12] where the source of water and the method of sewage disposal were significant predictor for the development of intestinal parasitic infections. The results of the previous studies reported factors underlying intestinal parasitic infections among Saudi Schoolchildren were more 10 years old, and the usual pattern has changed in response to rapid improvements in the infrastructure including the sewerage system and strict supervision of drinking water source. These associations are still existing in other developing societies, such as Brazil[26,27], Iran[28], Turkey[17] and Cuba[29].

This study reported a rate of intestinal parasitic infections in non-Saudis schoolchildren twice of the rate among Saudis. This result endorses the previous report from other region of Saudi Arabia. It showed the rate was higher in Riyadh compared to the included Saudi population[9].

In the current study, higher maternal education was associated with lower prevalence of intestinal parasitic infection from 42.8 % (for illiterate) to 23.3% (schoolchildren of high educated mother) while paternal education level had no significant role in relation to parasitic diseases. These observations were in agreement with findings reported from other countries as Turkey[17], Mexico[20], Nepal[30] and Iran[28].

In addition, significant association between the prevalence of intestinal parasitic infections and the occupational status of the mothers was also found. The higher prevalence was noticed among those with working mothers. This may be explained by the amount of time spent in child caring and supervision in relation to personal hygienic habits which is limited in case of working mothers[20]. The same finding was also reported in other study carried out in Turkey[17].

Östen *et al*[17] and Maia *et al*[27] reported that increased number of household members and overcrowded conditions are associated with higher frequency of parasitic infections. Similar finding was concluded from the present study. Presence of five members or more in the family increased the risk of infection which may be attributed to the close contact within the crowded houses and lead to increasing risk of intra-family transmission. On the other hand, Quihui *et al*[20] reported that family size had no significant effect on the rate of parasitic infection.

Regarding the relationship between the family income and the prevalence of parasitic infections, it was reported that higher family income was associates with lower prevalence of intestinal parasitism[20, 28]. However, our results showed that, family income has slight effect on the rate of parasitic infections. This statistically insignificant effect may be due to the availability of the governmental health care for all schoolchildren in Saudi Arabia regardless the income of the families.

The relation between the prevalence of parasitic infection and the personal hygiene is well established and extensively studied[31-33]. In the present study, many personal hygienic habits were evaluated and most of these factors were found to have significant effect on the rate of intestinal parasitic infections. Hand washing before meals and after defecation, the method employed in hand washing after defecation were found to be significantly linked to the prevalence of infections, these results are in agreement with previously published reports[16,28,31,33].

However, the current study has certain limitations. The inclusion of only male gender was attributed to the conservative nature of the Saudi society. It is inaccessible to female schools due to lack of permissions at the time of study conduction and non availability of female technicians and/or investigators.

Secondly, only one stool sample was examined instead of the ideal three consecutive samples due to the level of cooperation and response of the parents and guardians. What's more, the prevalence of *Enterobius vermicularis* could not be estimated precisely as the refusal rate for the application of the cellophane tape was high. The results of this study cannot be generalized to all Saudi schoolchildren as the variations of the included variables are expected in relation to different geographic and socio-economic differentials.

In conclusion, intestinal parasitic infections are an important public health problem in Al-Ahsa region among male primary Schoolchildren. Socio-demographic, as age, nationality, maternal education and occupational status of the mother in addition to poor personal hygienic habits are the main correlates affecting the prevalence of these infections. Different preventative programs are required including health education and promotion, awareness about personnel hygiene and environmental sanitation. In addition, different plans should be done to reduce the percentage of uneducated parents specially the mothers.

Conflict of interest statement

We declare that we have no conflict of interest.

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