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Prevalence and risk factors associated with intestinal parasitic infections among schoolchildren in Punjab, Pakistan

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Abstract. Intestinal parasitic infections (IPIs) are a major cause of morbidity worldwide and have been described as an important public health concern. The present study aimed to determine the prevalence and identification of risk factors associated with IPIs among 3-15 years old school age children residing in Mandi Bahauddin, Pakistan from 2011- 2013. A cross sectional school-based study was conducted using a structured pre-tested questionnaire. Anthropometric tools and stool tests were used to obtain epidemiological and disease data. The direct wet mount preperation in saline/iodine/haematoxylin stain and Kato-Katz methods were used for stool examination. Data were analysed using appropriate descriptive, univariate and multivariable logistic regression methods. Of the 1,434 children studied (mean age of 8.6±3.6 years) the overall prevalence rate for intestinal parasitic infections was found to be 33.3%. Children infected with single parasite accounted for 27.6% and 5.7% were detected with poly-parasitism. The study showed that helminths (21.4%) were more prevalent than protozoans (17.9%). *Ascaris lumbricoides* (17.5%), *Giardia lamblia* (9.8%), *Entamoeba histolytica* (8.2%), *Hymenolepis nana* (2.0%), *Trichuris trichiura* (1.3%) and *Taenia saginata* (0.7%) were identified in children living in irrigated areas. The multiple logistic regression model indicated that age of the child, gender, family size, source of drinking water, type of milk used, house condition, feeding habit, personal hygiene and socioeconomic status were significantly ($p<0.05$) associated with the IPIs. Intestinal parasites were prevalent in varying magnitude among the schoolchildren located in irrigated areas. We conclude that there is a need for mass scale campaigns to create awareness regarding health and hygiene in children, and the need for development of effective poverty control programmes because deworming alone is not adequate to control parasitic infections.

INTRODUCTION

Parasitic infections represent major public health concerns in the developing world, and are a leading cause of disease and illness in children (Steketee *et al.*, 2003). The risk factors associated with intestinal parasitic infections (IPIs) are low socio-economic conditions, improper personal hygiene, limited access to health services, poor sanitization practices and contaminated drinking water (Montresor *et al.*, 1998). Poor nutrition and repeated parasitic infection are leading causes of anemia and diarrhoea in children. In addition, they also impair appetite, growth and physical fitness of children, educational achievement, cognitive performance and economic development (Drake *et al.*, 2000). Intestinal parasitic infections are prevalent throughout the world and found in people of all age groups and both sexes (Steketee *et al.*, 2003).

The most common parasitic infections include amoebiasis, ascariasis, trichiuriasis and hookworm infections (WHO, 1987). Intestinal parasitic infection was found in 30.0% of the world population, especially people living in developing countries. *Ascaris lumbricoides* is the largest and most common human intestinal roundworm and is responsible for infecting 807–1221 million people in the world (CDC, 2016a). The whipworm *Trichuris trichiura* causes infection in 800 million people (CDC, 2016b). *Giardia lamblia*, affects about 280 million people worldwide (Esch & Petersen, 2013). The other most common parasitic protozoan is *Entamoeba histolytica*, which is estimated to infect about 50 million people worldwide (Bercu *et al.*, 2007). *Hymenolepis nana*, the dwarf tapeworm, is a cosmopolitan parasitic cestode, often seen in children with inadequate sanitation and hygiene (Pillai & Kain, 2003). *Taenia saginata*, a zoonotic tapeworm found anywhere where beef is eaten, estimated to cause 40 and 60 million human infections globally (Eckert, 2005).

Intestinal parasitic infections in general affect more than two-thirds of the human population and an estimated 300 million people experience sever morbidity, of which 50% are school going children (Uneke *et al.*, 2007; Anonymous, 2006). Intestinal parasitic infections rarely cause mortality, but illness and disabilities are frequently attributed to IPIs and represent a substantial economic burden (Stephenson *et al.*, 2000).

Studies on the prevalence of parasites in Pakistan have mainly been restricted to big cities within a confined population. Individuals living in rural irrigated areas are at great risk of infection, and these areas provide an ideal environment for the transmission of intestinal parasites (Dejenie & Petros, 2009). However, little information is available on the magnitude of the intestinal parasite problem in these areas of Pakistan. Thus, the objective of the current study was to provide baseline data on the prevalence of morbidity of human IPIs and its covariates among school age children residing in Mandi Bahauddin district, Pakistan.

MATERIALS AND METHODS

Study Area

A cross-sectional study was conducted in Mandi Bahauddin district Punjab, Pakistan. It is located at 32°34’60N and 73°30’0E and is bordered on the northwest by the Jhelum River and on the southeast by the Chenab River. This district covers 2,673 km^2, has 1,160,552 inhabitants (1998 census) of which 14.93% live in urban environments. The climate is moderate, hot in summer (maximum 45°C) and cold in winter (below 2°C), with an average rainfall of 50 mm.

Study Population, Sample Size

A simple random sampling technique was applied on the study population of schoolchildren from age groups of 3 to 15 years. From the prepared school list, 40 primary and secondary schools from Mandi Bahauddin were selected. The students in these schools belonged to families with different economic backgrounds. The sample size (n=1434) was determined by using the formula- p (1-p) z^2 / d^2 (Daniel, 1995). To choose the children, they were stratified according to their educational level (primary to secondary). A quota was assigned for each level comparative to the number of students in each grade. The questionnaire was administered by trained observers to parents or guardians of each child. All the questionnaires were checked for accuracy and completeness.

Stool Sample Collection and Laboratory Testing

After proper instruction, the children were given labelled collection cups and applicator sticks. From each subject, about 2g of fresh stool was collected. Each of the specimens was checked for labelling, quantity and procedure of collection. Direct stool examinations were done using saline/ Kato-Katz techniques within 30 minutes of stool sample collection. Stool samples were also preserved in 10% formalin solution for iodine/haematoxylin stain and formalin-ether concentration technique to increase the chance of detecting parasites. The experiment was repeated three times for each faecal sample and examined microscopically by using 10× and 40× objectives. The study was approved by the local Ethics Committee and all participants gave consent to provide stool samples.

Data management and statistical analysis

The data obtained after parasitological examination were entered using EPI-INFO 6 statistical programme (CDC, 2001) and analysed by using the Statistical Package for the Social Sciences (SPSS version 17). The anthropometric indices, i.e. stunting (height for age), wasting (weight for height) and underweight (weight for age) were calculated by using WHO Anthro (WHO, 2010) software. Crude association between infection and associated risk factors were primarily calculated by chi-square test. The univariate logistic regression analysis was applied to find the relative risk among associated variables. The data was subjected to multivariate logistic regression analysis for risk factors which were found significant in univariate analysis. Odd ratios (ORs) were computed at 95% CIs. The level of significance was set at $p<0.05$.

RESULTS

Prevalence of Intestinal Parasitic Infections

The overall prevalence of intestinal parasitic infections was 33.3% (95% CI: 30.9; 35.8), i.e. 478 positive out of 1434. About 27.6% of samples contained mono-parasitism and 5.7% were detected with poly-parasitism (Table 1). The study showed helminth infections were most frequent (21.4%) then protozoan (17.9%). The most common intestinal parasite was *A. lumbricoides* (17.5%) followed by *G. lamblia* (9.8%), *E. histolytica* (8.2%), *H. nana* (2.0%), *T. trichiura* (1.3%), and *T. saginata* (0.7%).

Characteristics of study population

The studied population consisted mean age group of 8.6 years (with satd. deviation ±3.6), and there was almost equal distribution of males (49%) and females (51%). The literacy rate above primary was 68.8% for fathers and 44.3% for mothers of participants. The proportion of children categorized as wasted, stunted and underweight was 47.6%, 26.7% and 25.7%, respectively. A few factors related

Table 1. Proportion of mono-parasitism and poly-parasitism of intestinal parasitic infection among schoolchildren, residing in Mandi Bahauddin district Punjab, Pakistan

Type of infection	No. of species	Species associated	Case (%)
Mono-parasitism	1 species (n=396)	*E. histolytica*	72 (5.0)
		G. lamblia	100 (7.0)
		A. lumbricoides	186 (13.0)
		T. trichiura	8 (0.5)
		H. nana	24 (1.7)
		T. saginata	6 (0.4)
Total mono-parasitism			**396 (27.6)**
Poly-parasitism	2 species (n=76)	*E. histolytica + T. saginata*	4(0.3)
		G. lamblia + A. lumbricoides	32(2.2)
		A. lumbricoides + E. histolytica	28(2.0)
		T. trichiura + E. histolytica	5(0.3)
		G. lamblia + E. histolytica	4(0.3)
		H. nana + G. lamblia	3(0.2)
	3 species (n=6)	*A. lumbricoides + E. histolytica + T. trichiura*	5(0.3)
		A. lumbricoides + H. nana + G. lamblia	1(0.1)
Total poly-parasitism			**82 (5.7)**

with the environment such as type of latrine (flush to piped sewer systems, flush to septic tanks and flush to pit latrines), type of household construction and geophagia did not show variation; therefore, were not analysed further. The proportion of children having anemia was 13.6%.

Crude associations of possible risk factors with intestinal parasitic infections

The demographics and risk factors of the study subjects are shown in Table 2. In the univariate analyses, significantly higher prevalence in males (40.2%) was observed then females (p<0.01, OR=0.5; 95% CI: 0.4; 0.7). There was a significant association between age and parasitic infection (p<0.01, χ^2=13.9), the children with age group below 6 years (38.2%) had a high proportion of parasitic infection compared to other age groups. A significant decrease was observed in IPIs with age group 10-13 years (p<0.01, OR=0.7; 95% CI: 0.5; 0.9) and age group $\geq$ 14 years (p<0.01, OR=0.5; 95% CI: 0.4; 0.8). The low education level (primary and below) of father and mother represented a higher risk of infection for children (p<0.01, OR=1.9; 95% CI: 1.5; 2.4 and p<0.01, OR=2.1; 95% CI: 1.7; 2.7 respectively). A significant association between family size and parasitic infection (p<0.01, χ^2=34.9) was observed, the children with family size 11–15 (43.7%) had a significant increase in parasitic infection (p<0.01, OR=2.5; 95% CI: 1.7; 3.7) compared to other groups. Further analyses of the data showed that IPIs were independent of locality, season and medication (p> 0.05).

The result showed that children using untreated water had significantly higher parasitic infections (p<0.01, OR=2.0; 95% CI: 1.5; 2.5). However, children consuming meat showed non-significant (p>0.05, OR=1.9; 95% CI: 0.9; 3.9) difference with parasitic infection. High risk of infection was found in children that preferred semi cooked food (p<0.0001, OR=1.8; 95% CI: 1.4; 2.3) compared to that of children that ate properly cooked food. With regard to taeniasis and contamination of milk with soil borne parasites, unboiled milk consumption showed significant (p<0.001, OR= 4.4; 95% CI: 3.3; 5.8) association with parasitic infections.

Children from poor socio-economic conditions were more likely to have IPIs (p<0.0001, χ^2=51.3) as compared with those from higher socio-economic conditions. A significant association was found in children who have pet animals with IPIs (p<0.01, OR= 0.56; 95% CI: 0.45; 0.71), and children having close association with water bodies were also at great risk of infection (p<0.01, OR= 0.5; 95% CI: 0.4; 0.7) as compared to those who do not have contact with water bodies. Three hundred and eighteen (22.2%) of the children reported good hygiene with the practice of hand washing with soap and water before meals and after defecation. Higher IPIs were found in children with poor hygiene who do not practice hand washing before eating (p<0.01, OR= 2.5; 95% CI: 1.9; 3.2) than those who practice it. House condition also contributed significantly (p<0.001, χ^2=102.4) to IPIs, children living in earthen floor houses were more likely to be infected (57.7%, OR=2.9; 95% CI: 2.1; 4.0) as compared to the children living in marble floor houses (OR=1.5; 95% CI: 1.2; 1.9).

Multivariable Analysis

The final model indicated that age of the child, gender, family size, source of drinking water, milk used, house condition, feeding habit, personal hygiene and socioeconomic status were significantly associated with the IPIs (Table 3). With each year increase in age group, there was a decrease in IPIs (OR=0.9; p<0.001; 95% CI: 0.89; 0.96). Infection was higher in male children (OR=2.3; p<0.001; 95% CI: 1.70; 3.1). Large family size resulted in greater risk of infection to children (OR=1.1; p<0.01; 95% CI: 1.0; 1.27). Drinking treated water decreased the risk of IPIs (OR=0.6; p<0.05; 95% CI: 0.4; 0.9), similarly use of boiled milk also decreased the risk of IPIs in children (OR=0.2; p<0.001; 95% CI: 0.1; 0.3). Children of families living in earthen and concrete floor houses were more likely to be infected with IPIs as compared to children of families living in marble floor houses (OR=1.9; p=0.002; 95% CI: 1.3; 3.0 and OR = 0.9; p<0.001; 95% CI: 0.6;1.6 respectively).

Table 2. Univariate analysis of factors associated with intestinal parasitic infection among school going children, residing in Mandi Bahauddin district Punjab, Pakistan who provided a stool sample for this study

Characteristics	Investigated children	Positive n(%)	OR	95% CI		p value
				Lower	Upper	
Locality						0.0947^NS
Rural¶	584	180(30.82)				
Urban	850	298(35.06)	1.21	0.97	1.51	
Season						0.2626^NS
Summer¶	726	252(34.71)				
Winter	708	226(31.92)	0.88	0.71	1.10	
Gender						0.0001*
Male¶	706	284(40.23)				
Female	728	194(26.65)	0.54	0.43	0.67	
Age groups						
<6¶	356	136(38.20)				
6–9	506	182(35.97)	0.91	0.69	1.20	0.5034^NS
10–13	402	118(29.35)	0.67	0.50	0.91	0.0102**
≥14	170	42(24.71)	0.53	0.35	0.80	0.0024**
Father education						0.0001**
Above Primary¶	988	284(28.74)				
Primary and below	446	194(43.50)	1.91	1.51	2.41	
Mother education						0.0001**
Above Primary¶	636	154(24.21)				
Primary and below	798	324(40.60)	2.14	1.6999	2.69	
Family size						
3–6¶	494	116(23.48)				
7–10	798	300(37.59)	1.96	1.52	2.5271	0.0001**
11–15	142	62(43.66)	2.53	1.71	3.74	0.0001**
Wasting (weight for height)						0.0001**
Wasted¶	300	282(94.00)				
Normal	1134	196(17.28)	0.01	0.01	0.02	
Stunting (height for age)						0.0001**
Stunted¶	168	158(94.05)				
Normal	1266	320(25.28)	0.02	0.01	0.04	
Underweight (weight for age)						0.0001**
Underweight¶	162	152(93.83)				
Normal	1272	326(25.63)	0.02	0.01	0.04	
Anemic						0.0001**
Anemia¶	196	182(92.86)				
No Anemia	1238	296(23.91)	0.02	0.01	0.04	
Personal hygiene						
Casual¶	554	148(26.71)				
Good	318	64(20.13)	0.69	0.50	0.96	0.0295*
Poor	562	266(47.33)	2.47	1.92	3.17	0.0001**
Feeding habit						
Vegetables¶	800	302(37.75)				
Mix	604	160(26.49)	0.59	0.47	0.75	0.0001**
Meat	30	16(53.33)	1.88	0.91	3.91	0.0895^NS
Source of drinking water						0.0001**
Treated water¶	440	104(23.64)				
Untreated water	994	374(37.63)	1.95	1.51	2.51	
Cooking methods						0.0001**
Properly cooked¶	406	100(24.63)				
Semi cooked	1028	378(36.77)	1.78	1.37	2.31	

Milk used						0.0001**
Boiled¶	1172	316(26.96)				
Unboiled	262	162(61.83)	4.39	3.31	5.81	
Medication						0.6609NS
Treated¶	1124	380(33.81)				
Untreated	310	98(31.61)	0.94	0.72	1.23	
Contact with water bodies						0.0001**
Yes¶	918	350(38.13)				
No	516	128(24.81)	0.54	0.42	0.68	
Pet animals						0.0001**
Yes¶	772	302(39.12)				
No	662	176(26.59)	0.56	0.45	0.71	
Scio-economic condition						
Normal¶	828	224(27.05)				
Good	328	114(34.76)	1.44	1.09	1.89	0.0096**
Poor	278	140(50.36)	2.74	2.07	3.62	0.0001**
House condition (floor)						
Brick¶	370	118(31.89)				
Concrete	494	144(29.15)	0.88	0.66	1.1770	0.3857NS
Earthen	274	158(57.66)	2.91	2.10	4.02	0.0001**
Marble	296	58(19.59)	0.52	0.36	0.7466	0.0004**

¶ Reference group in univariate analysis
NS Non-Significant ($p \geq 0.05$)
*Significant ($p \leq 0.05$)
**Highly Significant ($p \leq 0.01$)

Table 3. Logistic regression models of risk factors (by odds ratio and 95% CI) for intestinal parasitic infections in schoolchildren (3-15 years) from Mandi Bahauddin district, Pakistan

Predictors	*Coefficient (standard error)	p-value	Odd Ratio	95% CI	
				Lower	Upper
Age	-0.077(0.020)	0.000	0.93	0.89	0.96
Gender	0.82(0.15)	0.000	2.28	1.70	3.06
Family size	0.09(0.03)	0.005	1.09	1.03	1.17
Source of drinkable water	-0.47(0.20)	0.020	0.62	0.42	0.93
Type of milk used	-1.58(0.20)	0.000	0.20	0.14	0.31
Concrete floor	0.66(0.20)	0.001	1.94	1.30	2.89
Earthen floor	0.66(0.21)	0.002	1.94	1.27	2.96
Habit of eating mix food	-0.35(0.16)	0.032	0.70	0.51	0.97
Poor socioeconomic condition	0.75(0.20)	0.000	2.12	1.41	3.19
Poor personal hygiene	0.36(0.18)	0.045	1.44	1.01	2.05

*Only significant regression coefficients (β) are shown.

Children with the habit of eating mixed food were less likely to be infected with IPIs (OR=0.7; p=0.032; 95% CI: 0.5; 1.0). Children with poor personal hygiene were also likely to be at great risk of IPIs as comparable with those had good personal hygiene (OR=1.4; p=0.045; 95% CI: 1.0; 2.1). Socioeconomic status also was associated with great risk of IPIs in children living in poverty (OR= 2.1; p<0.001; 95% CI: 1.4; 3.2). Five other variables, contact with water bodies, cooking methods, pet animals, mother education and father education, were not significantly associated with IPIs but were kept in the final model because of their confounding effect. The Hosmer-Lemeshow goodness-of-fit test for the final model showed reasonable fit (χ^2= 17.2, p = 0.028).

DISCUSSION

The current investigation reported data on prevalence of intestinal parasites and their associated risk factors. The results showed that age of the child, gender, family size, source of drinking water, milk consumed, house condition, feeding habits, personal hygiene and socioeconomic status were significantly associated with IPIs. The present findings were consistent with other reported studies (Sejdini *et al.*, 2011; Tappe *et al.*, 2008). However the prevalence of IPIs (33.3%) recorded in the present study were not in agreement with other studies conducted on children living in slums, rural areas and those with gastrointestinal problems in Pakistan (Mehraj *et al.*, 2008; Mumtaz *et al.*, 2009). The parasitic infestation among the male was found significantly higher (40.2%) than female (26.7%), which may be due to increased mobility of males than females. However, other studies recorded low parasitic infestation in male than female (Sah *et al.*, 2013; Amer *et al.*, 2016) because females have more contact with soil during planting of vegetables and eating raw vegetables than males.

The parasitic species identified from stool samples in this study were similar to those recorded in other studies namely: *A. lumbricoides*, *G. lamblia*, *E. histolytica*, *H. nana*, *T. trichiura* and *T. saginata*. This may be due to environmental conditions that may be more conducive to development and transmission of helminths than protozoan infections. Another plausible reason of higher prevalence of helminths may be associated with re-infection rates, predisposition, or difference in the efficacy of medication. Several earlier studies have shown the reinfection rates increase following mass drug administration. The prevalence of *A. lumbricoides* and *T. trichiura* usually returned to levels close to the initial pretreatment in most endemic areas, although such predisposing effects were not as clear-cut for *T. trichiura* (Jia *et al.*, 2012).

High prevalence of *A. lumbricoides*, *G. lamblia* and *E. histolytica* was found in this study and a significant association was found between *A. lumbricoides* and *G. lamblia*, *A. lumbricoides* and *E. histolytica* was observed. These three parasites were found more frequently and co-infections may result due to common risk factors that include environmental/climatic conditions, host density levels, host behaviours, or host physiological conditions (Ezenwa & Jolles, 2011; Lello *et al.*, 2013). Hookworms were not reported in this study which is consistent with other studies (Mehraj *et al.*, 2008; Ahmed *et al.*, 2003) conducted in urban localities but not in rural areas (Siddiqui *et al.*, 2002; Ensink *et al.*, 2005). Drinking untreated water, eating contaminated and semi cooked food were most frequently mentioned causes of ascariasis (Nyantekyi *et al.*, 2014). The low prevalence of *T. trichiura* found in current study was in agreement with other studies recorded that *A. lumbricoides* were more common than *T. trichiura* (Kang *et al.*, 1998). However, high prevalence of *Ascaris* may be associated with its robust transmission, given enormous daily egg output and environmental resistant of these eggs.

The prevalence of the cestode *H. nana* was found to be much higher than *T. saginata* in this study, and similar results were reported in other studies conducted in Pakistan (Khan *et al.*, 2004; Malik & Baig, 2006). *T. saginata* was not very prevalent in this study because of the proper cooking of food. However, the habit of eating uncooked food (Kabab, Tikka) and consumption of unboiled milk contaminated with *Taenia* species can be transmitted to human (McFadden *et al.*, 2011; Qureshi *et al.*, 1992). Unboiled milk contaminated with soil may also lead to the presence of soil-borne helminths in milk (e.g., *Ascaris lumbricoides*, *Trichuris trichiura*). Hence sanitary conditions, milk pasteurization and proper hygienic should be maintained to avoid such contaminations (Dhanashekar *et al.*, 2012).

Among the covariates locality, season and medication were not associated with parasitic infections. Children under the age of 6 had higher prevalence than older children. Lower prevalence in old children may be due to the awareness of improved hygiene (Gelaw *et al.*, 2013). Among the family parameters, education of the father and mother and family size significantly influenced the prevalence of IPIs. The results indicated that educated parents and small family size contributed to lower prevalence of IPIs with improved sanitation practices, cleanliness and personal hygiene of their children (Mane *et al.*, 2014).

Epidemiologic studies have shown that food preferences among school going children has significant risk of acquiring IPIs. Seventy percent of the children in this study used untreated water which posed a significant health risk. Purifying drinking water is essential to help avert IPIs (Quihui *et al.*, 2006). The results of this study also indicated that methods of cooking and use of unboiled milk contributed significantly to transmission of IPIs. Also, raw uncooked vegetables were a major source of infection for various parasitic diseases (Qureshi *et al.*, 1992; Shahrul Anuar *et al.*, 2012; Pham Duc *et al.*, 2011).

Personal hygiene including hand washing habits among children posed a significant risk of IPIs. In developing countries poor hand washing practices before eating and after defecation is a leading cause for faecal-oral transmission of parasitic infection (Mane *et al.*, 2014; Shahrul Anuar *et al.*, 2012; Pham Duc *et al.*, 2011). This study also reported a significant association between contact with water bodies and IPIs as many of the protozoan infections are acquired through ingestion of contaminated water by bathing in swimming pools, irrigated canals, ponds and drinking recreational water (Shahrul Anuar *et al.*, 2012). This study reported significant association between domestic animals and IPIs among schoolchildren. Most of the children had household pets that were allowed to wander freely in and out of the houses and contact with them may lead to transmission of IPIs (Shahrul Anuar *et al.*, 2012). Lower socioeconomic status and house condition are also risk factors for IPIs (Mehraj *et al.*, 2008) which may favour environmental faecal contamination and interpersonal transmission of direct-cycle parasites (Mane *et al.*, 2014; Gamboa *et al.*, 2011).

CONCLUSION

Intestinal parasitism posed public health problems in the study area, inspite of the anthelmintics used. These parasites are a potential cause of anemia, malabsorption and other complications. This study indicated that age of the child, gender, family size, source of drinking water, milk used, house condition, feeding habit, personal hygiene and socioeconomic status were significantly associated with IPIs. There is a need to promote intervention strategies on health education to create awareness about health and hygiene, because IPIs will be difficult to control by drugs alone.

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REFERENCES

Ahmed, A.K., Malik, B., Shaheen, B., Yasmeen, G. & Dar, J.B. (2003) Frequency of intestinal parasitic infestation in children of 5–12 years of age in Abbottabad. *Journal of Ayub Medical College Abbottabad* **15**: 28-30.

Albonico, M., Stoltzfus, R.J., Savioli, L., Chwaya, H.M., d'Harcourt, E. & Tielsch, J.M. (1999) A controlled evaluation of two school-based antihelminthic regimes on intensity of intestinal helminths infections. *International Journal of Epidemiology* **28**(3): 591-596.

Anonymous. (2006). Schistosomiasis and soil-transmitted helminth infections – preliminary estimates of the number of children treated with albendazole or mebendazole. *Weekly Epidemiological Record* **81**: 145-163.

Amer, O.H., Ashankyty, I.M. & Haouas, N.A.S. (2016). Prevalence of intestinal parasite infections among patients in local public hospitals of Hail, Northwestern Saudi Arabia. *Asian Pacific Journal of Tropical Medicine* **9**(1): 44-48.

Bercu, T.E., Petri, W.A. & Behm, J.W. (2007). Amebic colitis: new insights into pathogenesis and treatment. *Current Gastroenterology Reports* **9**: 429.

CDC. Parasites – Ascariasis. Global Health – Division of Parasitic Diseases: Center for Disease Control & Prevention, May 24, 2016a.

CDC. DPDx: Laboratory Identification of Parasites of Public Health Concern. Atlanta: Center for Disease Control & Prevention, USA; May 3, 2016b.

CDC. Epidemiological Information. Epi info. 6.04d ed. Atlanta: Center for Disease Control and Prevention, USA, 2001.

Daniel, W.W. (1995). *Biostatistics a foundation for analysis in the health science*. John Willey & Sons Inc, New York.

Dejenie, T. & Petros, B. (2009). Irrigation practices and intestinal helminth infections in Southern and Central Zones of Tigray. *Ethiopian Journal of Health Development* **23**(1): 48-56.

Dhanashekar, R., Akkinepalli, S. & Nellutla, A. (2012). Milk-borne infections. An analysis of their potential effect on the milk industry. *Germs* **2**(3): 101-109.

Drake, L.J., Jukes, M.C.H., Sternberg, R.J. & Bunday, D.A.P. (2000). Geohelminth infections (ascariasis, trichiuriasis, and hookworm): cognitive and development impacts. *Seminars in Pediatric Infectious Diseases* **11**: 245-251.

Eckert, J. (2005). "Helminths". In Kayser, F.H., Bienz, K.A., Eckert, J., Zinkernagel, R.M. Medical Microbiology. Stuttgart: Thieme. 560-562.

Ensink, J.H., Van der Hoek, W., Mukhtar, M., Tahir, Z. & Amerasinghe, F. P. (2005). High risk of hookworm infection among wastewater farmers in Pakistan. *Transactions of the Royal Society of Tropical Medicine and Hygiene* **99**: 809-818.

Esch, K.J. & Petersen, C.A. (2013). Transmission and epidemiology of zoonotic protozoal diseases of companion animals. *Clinical Microbiology Reviews* **26**(1): 58-85.

Ezenwa, V.O. & Jolles, A.E. (2011). From host immunity to pathogen invasion: the effects of helminth coinfection on the dynamics of microparasites. *Integrative and Comparative Biology* **51**(4): 540-51.

Gamboa, M.I., Navone, G.T., Orden, A.B., Torres, M.F., Castro, L.E. & Oyhenart, E.E. (2011). Socio-environmental conditions, intestinal parasitic infections and nutritional status in children from a suburban neighnorhood of La Plata, Argentina. *Acta Tropica* **118**: 184-189.

Gelaw, A., Anagaw, B., Nigussie, B., Silesh, B., Yirga, A., Alem, M., Endris, M. & Gelaw, B. (2013). Prevalence of intestinal parasitic infections and risk factors among schoolchildren at the University of Gondar Community School, Northwest Ethiopia: a cross-sectional study. *BMC Public Health* **13**: 304.

Jia, T.-W., Melville, S., Utzinger, J., King, C.H., & Zhou, X.-N. (2012). Soil-Transmitted Helminth Reinfection after Drug Treatment: A Systematic Review and Meta-Analysis. *PLoS Neglected Tropical Diseases* **6**(5): e1621.

Kang, G., Mathew, M.S., Rajan, D.P., Daniel, J.D., Mathan, M.M., Mathan, V.I. & Muliyil, J.P. (1998). Prevalence of intestinal parasites in rural Southern Indians. *Tropical Medicine & International Health* **3**: 70-75.

Khan, A., Sultana, A., Dar, A.M.K., Rashid, H. & Najmi, S.A.A. (2004). A study of prevalence, distribution and risk factors of intestinal helminthic infestation in district Bagh (Azad Kashmir). *Pakistan Armed Forces Medical Journal* **54**: 243-248.

Lello, J., Knopp, S., Mohammed, K.A., Khamis, I.S., Utzinger, J. & Viney, M.E. (2013). The relative contribution of co-infection to focal infection risk in children. *Proceedings of the Royal Society B: Biological Sciences* **280**(1754): 2012-2813.

Malik, T.M. & Baig, Z.F. (2006). Frequency and pattern of intestinal parasitic infestation in upper Neelum valley. *Pakistan Armed Forces Medical Journal* **56**: 342-346.

Mane, M., Kadu, A., Mumbre, S., Deshpande, M. & Gangurde, N. (2014). Prevalence of intestinal parasitic infections and associated risk factors among pre-school children in tribal villages of North Maharashtra, India. *International Journal of Research in Health Sciences* **2**(1): 133-139.

Mehraj, V., Hatcher, J., Akhtar, S., Rafique, G. & Beg, M.A. (2008). Prevalence and Factors Associated with Intestinal Parasitic Infection among Children in an Urban Slum of Karachi. *PLoS ONE* **3**(11). DOI:10.1371/journal.pone.0003680.

McFadden, A.M., Heath, D.D., Morley, C.M. & Dorny, P. (2011). Investigation of an outbreak of *Taenia saginata* cysts (*cysticercus bovis*) in dairy cattle from two farms. *Veterinary Parasitology* **176**: 177-84.

Montresor, A., Crompton, D.W.T., Bundy, D.A.P., Hall, A. & Savioli, L. (1998). *Guidelines for the evaluation of soil transmitted helminthiasis and schistosomiasis at community level, A guide for the Managers of Control Programmes*. Switzerland: World Health Organization, Geneva.

Mumtaz, S., Siddiqui, H. & Ashfaq, T. (2009). Frequency and risk factors for intestinal parasitic infection in children under five years age at a tertiary care hospital Karachi. *Journal Pakistan Medical Association* **55**(4): 216-219.

Nyantekyi, L., Legesse, M., Medhin, G., Animut, A., Tadesse, K., Macias, C., & Erko, B. (2014). Community awareness of intestinal parasites and the prevalence of infection among community members of rural Abaye Deneba area, Ethiopia. *Asian Pacific Journal of Tropical Biomedicine* **4**: S152–S157.

Pham Duc, P., Nguyen-Viet, H., Hattendorf, J., Zinsstag, J. & Dan Cam, P. (2011). Risk factors for *Entamoeba histolytica* infection in an agricultural community in Hanam province, Vietnam. *Parasit and Vectors* **4**: 102.

Pillai, D.R. & Kain, K.C. (2003). Common Intestinal Parasites. *Current Treatment Options in Infectious Diseases* **5**: 207-217.

Quihui, L., Valencia, M. E., Crompton, D. W. T., Phillips, S., Hagan, P. & Morales, G. (2006) Role of the employment status and education of mothers in the prevalence of intestinal parasitic infections in Mexican rural school children. *BMC Public Health* **6**: 225-232.

Qureshi, A.H., Karamat, K.A., Qamer, R.H. & Malik, I.A. (1992). Intestinal parasitic infestation in Rawalpindi / Islamabad area: A study of 12640 stool samples. *Pakistan Journal of Pathology* **3**: 31- 39.

Sejdini, A., Mahmud, R., Lim, Y.A., Mahdy, M., Sejdini, F. & Gjoni, V. (2011). Intestinal parasitic infections among children in central Albania. *Annals of Tropical Medicine and Parasitology* **105**: 241-250.

Sah, R.B., Bhattarai, S., Yadav, S., Baral, R., Jha, N. & Pokharel, P.K. (2013). A study of prevalence of intestinal parasites and associated risk factors among the school children of Itahari, Eastern Region of Nepal. *Tropical Parasitology* **3**(2): 140-144.

Shahrul, Anuar, T., Al-Mekhlafi, H.M., Abdul G.M.K., Osman, E. & Yasin, M.A. (2012). Prevalence and risk factors associated with *Entamoeba histolytica/dispar/moshkovskii* infection among three Orang Asli Ethnic groups in Malaysia. *PLoS ONE* **7**(10). DOI:10.1371/journal.pone.0048165.

Siddiqui, M.I., Bilqees, F.M., Iliyas, M. & Perveen, S. (2002). Prevalence of parasitic infections in a rural area of Karachi, Pakistan. *Journal Pakistan Medical Association* **52**: 315-320.

Steketee, R.W. (2003). Pregnancy, nutrition and parasitic diseases. *Journal of Nutrition* **133**: 1661S–1667S.

Stephenson, L.S., Latham, M.C. & Ottesen, E.A. (2000). Malnutrition and parasitic helminth infections. *Parasitology* **121**: S23–38.

Tappe, K.H., Mohammadzadeh, H., Khashaveh, S., Rezapour, B. & Barazesh, A. (2011). Prevalence of intestinal parasitic infections among primary school attending students in Barandooz-Chay rural region of Urmia, West Azerbaijan province, Iran in 2008. *African Journal of Medical Research* **5**: 788-791.

Uneke, C.J., Eze, K.O., Oyibo, P.G., Azu, N.C. & Amlt, E.A. (2007). Soil Transmitted Helminth Infections in School Children in South East Nigeria: The Public Health Implication. *Internet Journal of Third World Medicine* **4**(1): ISSN: 1539-4646.

WHO. (1987). *Prevention and control of intestinal parasitic infections*. Technical Report Series **749**.

WHO. (2010). *Software for assessing growth and development of the world's children*. Geneva: (http://www.who.int/childgrowth/software/en/).