

# Epidemiology and Risk Factors of Intestinal Parasites in Hospital Patients

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## Abstract

Pathogenic parasites of intestine have been a major public health problem in tropical and sub-tropical areas. To gain deeper insight into the magnitude of problem in Pakistan, present study was conducted to assess the prevalence of intestinal parasites and associated risk factors in hospital patients in district Mardan, Khyber Pakhtunkhwa (KP), Pakistan. Main purpose of study was to find UpToDate epidemiology of intestinal parasitic infections (IPIs) in hospital environment and analysis of risk factors that have leading role in spread of parasites. Collected stool samples were processed for microscopic and macroscopic analysis of intestinal parasites and blood samples were processed for complete blood count (CBC). Questionnaire was used for collection of history related to potential risk factors of IPIs. Data from questionnaire was used for statistical analysis of risk factors through Fisher's exact test. Overall, 45.90% (101/220 in number) cases were positive: species-wise distribution revealed 74.25% (*A. lumbricoides*), 24.75% (*T. trichiura*), and 0.9% (*G. lamblia*) cases. High prevalence was observed in males (27.27%) than females (18/63%), age groups 8-13 (40.59%) and 14-19 (29.70%) and associated with more meat consumption and poor personal hygiene. Among potential risk factors assessed, source of drinking water ( $P = 0.0002$ ), handwash before meal ( $P = 0.0006$ ), handwash after defecation ( $P < 0.0001$ ), footwear ( $P < 0.0001$ ) and skin care ( $P < 0.0001$ ) were found to be the most important predictors of high risk of parasitic infections in human. Present study revealed high prevalence of intestinal parasitic infections (IPIs) in patients of age between 8-19, which demands improved health education among school/college students on handwashing before meal and after defecation, avoid walking barefooted and importance of skin and nails cleanliness.

**Key words:** Helminths; Parasites; Prevalence; Protozoans

## INTRODUCTION

Intestinal parasitic infections (IPIs) are remained a major public health problem worldwide, making millions of people sick every year. IPIs are more common in developing countries and responsible for considerable morbidity and mortality rates especially in children<sup>[1]</sup>. Over-crowding, unsafe water supply, low altitude and tropical climate are the common risk factors of IPIs<sup>[2]</sup>. Although parasites affect people of all ages, but they cause repeated infections in low-class families which are usually malnourished, have poor personal/environmental hygiene and low socio-economic status. This contributes majorly in economic instability and social demotion<sup>[3]</sup>. Parasites get their food and shelter from host organisms. Human parasites are restricted to digestive system specifically to intestine. They can be either unicellular protozoans like *Cryptosporidium*, *Giardia*, and *Entamoeba* species or multicellular helminths such as flatworms (Trematodes), tapeworms (Cestodes), and roundworms (Nematodes)<sup>[4]</sup>. Intestinal parasites are associated with many symptoms, disorders, deficiencies, and abnormal conditions. For example, iron-deficiency anemia, seizures, weight loss, chronic diarrhea and hypertension and in particular, in children, growth retardation, malnutrition, low birth weight, mental disturbances and abnormal physical development<sup>[5]</sup>. Globally, previous studies found high prevalence rate of IPIs in different countries: 30.1% in Kathmandu, Nepal (*Entamoeba histolytica* (38.5%), 16.3% in western Rajasthan, India (*E. histolytica* (37.57%), 25.6% in Nairobi, Kenya (*E. histolytica* (36.7%) and 35.8 % in Hawassa, Ethiopia (*Cryptosporidium* (13.2 %) <sup>[6-9]</sup>. In Pakistan, three studies conducted in different regions revealed gradual increase in prevalence of intestinal parasites among local population. These studies found 35% prevalence of intestinal parasites in Sukkur, Sindh (2005-2007)<sup>[10]</sup>, 65.95% (2006-2008) in district Swat Khyber Pakhtunkhwa (Khan *et al.*, 2012) and 83.1% (2011-2013)<sup>[11]</sup> also in district Swat. Most of the people with IPIs goes asymptomatic, few becomes ill and even fewer die. In Pakistan, high morbidity rates in children and persistence of poor hygiene infrastructure increases the burden of IPIs, which cannot be neglected at all<sup>[1]</sup>. Therefore, epidemiological studies determining time to time prevalence of different parasites contributes significantly to control the IPIs in local population. This study will determine the prevalence of intestinal parasites in hospitalized patients in district Mardan, KP, Pakistan. The study will also determine statistical significance between different risk factors of IPIs and blood cells count and percentage of single/multiple parasitic infections in patients.

## EXPERIMENTAL SECTION

The study was conducted in Medical Complex and Headquarters hospital of district Mardan, Pakistan. From January-December 2019, 220 stool and blood samples were collected from patients hospitalized for intestinal disturbances. Written consent was taken from all patients and those either showed unwillingness to participate in a study or on anti-parasitic treatment were excluded. Stool samples were processed for parasitological analysis and blood samples for complete blood

count (CBC). Different risk factors were analyzed through questionnaire and general information regarding age, gender, food habit, personal hygiene and meat consumption was collected through verbal communication with patients.

Previously identified method [12] was used for CBC test using the Cell-DYN-Ruby machine (Abbott, USA): a multi-parameter automated hematology analyzer appropriate for routine use in laboratories. The stool samples were undergone macroscopic and microscopic examination involving determination of physical appearance and microscopy of the stool [13]. For macroscopic analysis, the stool samples were checked for presence of adult worms/larvae/segments of worms, blood/mucus, consistency (formed/soft/loose/watery), color and odor.

The microscopic examination was done using direct smear or wet mount tests (iodine and saline wet mount tests) and concentration technique (sodium chloride flotation method). The saline wet mount test and iodine wet mount test (using Lugol’s iodine) were used for identification of protozoan trophozoites/cysts [14] and helminth eggs/larvae [15]. The sodium chloride flotation method was used for screening of ova of helminths in the stool [13].

**Statistical analysis**

For statistical analysis, data collected through questionnaires and parasitological tests was compiled and evaluated using the Fishers exact test.

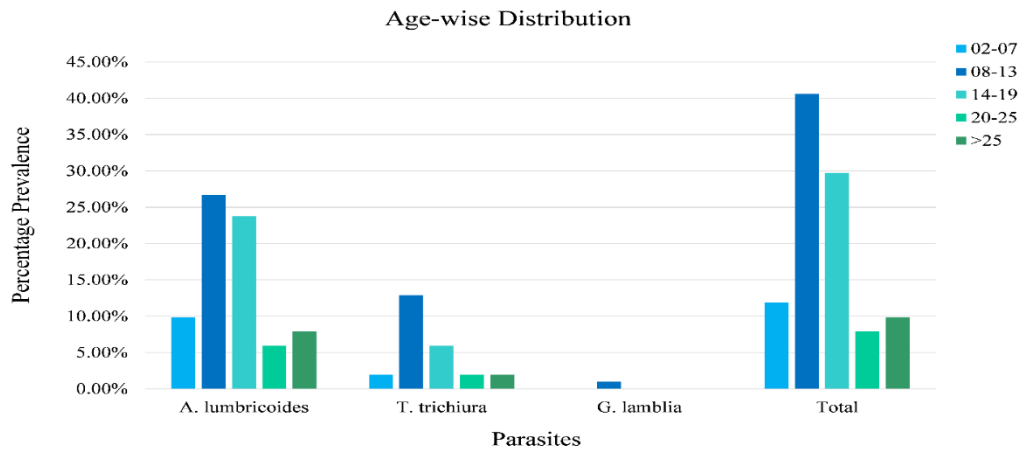
**RESULTS**

Present research performed analysis of parasites in blood and stool samples of hospitalized patients. Total 220 stool samples were process and 101 (45.90%) were positive, majority being helminths: 34.09% (75 in number) *Ascaris (A.) lumbricoides* and 11.36% (25 in number) *Trichuris (T.) trichiura*. Only one sample (0.45%) was positive for protozoan parasite *Giardia (G.) lamblia*. Higher prevalence (27.27%) of IPIs was found in male gender including one positive case for *G. lamblia* (Table 1).

**Table 1:** Gender-wise distribution of intestinal parasites in hospitalized patients.

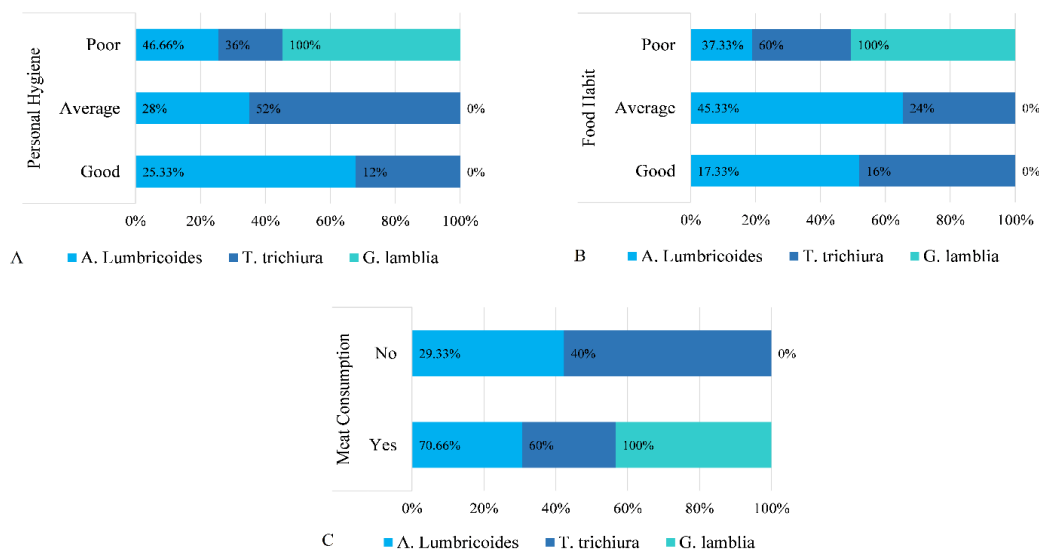
Gender	Positive cases (%)			Overall prevalence (%)
	<i>A. lumbricoides</i>	<i>T. trichiura</i>	<i>G. lamblia</i>	
Male	46 (20.90%)	13 (5.90%)	01 (0.45%)	60 (27.27%)
Female	29 (13.18%)	12 (5.45%)	00 (0%)	41 (18.63%)
Total Cases	75 (34.09%)	25 (11.36%)	01 (0.45%)	101 (45.90%)

Two age groups: children and teenagers were found more prone to IPIs. Age-wise distribution revealed that children (Age: 8-13, Prevalence: 40.59%; 41 in number) and teenagers (Age: 14-19, Prevalence: 29.70%; 30 in number) are more affected by IPIs than patients with age above 25 years. Least percentage of prevalence of IPIs was observed in age group 20-25 and >25 that was 7.92% (8 in number) and 9.90% (10 in number) respectively.



**Figure 1:** Age-wise distribution of intestinal parasites in hospitalized patients.

Also, *A. lumbricoides* was the most prevalent intestinal parasite in age groups 8-13 (26.73%, 27 in number) and 14-19 (23.76%, 24 in number) (Figure 1), *T. trichiura* was more prevalent (12.87%, 13 in number) in age group 8-13 and single case is reported of *G. lamblia* in the present study which accounted for about 0.99% (1 in number) of the total positive cases. Further, 77% single worm infection was noticed compared to multiple worm infection, only 23%. Important to note is that multiple worm infections were noticed as co-infections of *A. lumbricoides* and *T. trichiura*.



**Figure 2:** Association of parasitic infections with (A) personal hygiene, (B) food habits (B) and (C) meat consumption.

The association of parasitic infections with personal hygiene, food habit and amount of meat consumption was also analyzed (Figure 2). The *A. lumbricoides* and *G. lamblia* infections were strongly associated with poor personal hygiene, average-to-poor food habit and high meat consumption. Whereas percentage of *T. trichiura* infection was found associated with average hygiene, average food habit and more meat consumption. The statistical analysis was done of potential risk factors that might increase chances of parasitic infections in human (Table 2). The

results of all risk factors were statistically highly significant except for Habits of nail biting which were insignificant. Uncleanliness of nails and clothes produced least significant results.

**Table 2:** Statistical analysis of risk factors.

Factors	Parameters	Positive (%)	Negative (%)	P value ( $P < 0.05$ )
Source of drinking water <sup>***</sup>	Tap water	85 (84.15%)	72 (60.5%)	$P = 0.0002$
	Well water	16 (15.84%)	47 (39.49%)	
Hand wash before meal <sup>***</sup>	Yes	17 (16.83%)	45 (37.81%)	$P = 0.0006$
	No	84 (83.16%)	74 (62.18%)	
Hand wash after defecation <sup>****</sup>	Water	90 (89.10%)	27 (22.68%)	$P < 0.0001$
	Soap	11 (10.89%)	92 (77.31%)	
Footwear <sup>****</sup>	Yes	13 (12.87%)	90 (75.63%)	$P < 0.0001$
	No	88 (87.12%)	29 (24.36%)	
Skin <sup>****</sup>	Clean	13 (12.87%)	75 (63%)	$P < 0.0001$
	Not clean	88 (87.12%)	44 (36.97%)	
Nails <sup>*</sup>	Clean	45 (44.55%)	70 (58.82%)	$P = 0.0423$
	Not clean	56 (55.44%)	49 (41.17%)	
Habits of nail biting <sup>ns</sup>	Yes	07 (6.93%)	10 (8.4%)	$P = 0.8021$
	No	94 (93%)	109 (91.59%)	
Clothes <sup>*</sup>	Clean	33 (32.67%)	57 (47.89%)	$P = 0.0276$
	Not clean	68 (67.32%)	62 (52.10%)	

Note: \* represents level of significance: More stars = high significance and vice versa. ns represents no significance.

In blood cells count, it was observed that patients with IPIs have very low RBCs count ranged from 3.0-5.0 million cells/mm<sup>3</sup>: touching the lower levels of normal RBCs count for men (4.7-6.1 million cells/mm<sup>3</sup>) and women (4.2-5.4 million cells/mm<sup>3</sup>). WBCs count of patients was lied in average range of 6000-12000 cells/mm<sup>3</sup> compared to normal which is 4300-10800 cells/mm<sup>3</sup>. Similarly, platelets (PLTs) count of patients with IPIs was also within the normal PLT range (150,000 – 450,000 cells/mm<sup>3</sup>). Eosinophils are considered central feature of host immune response against parasitic worms and helminths. Therefore, eosinophils count usually increase in the present of parasitic infections. In present research most of the patients with IPIs were with high eosinophils count (5-10%) in comparison to normal range (1-5%).

The blood hemoglobin count of patients revealed that patients with IPIs have low hemoglobin count range between 7-13 g/dL which is although normal for women and child but low for men and this study found high prevalence of IPIs in males.

## DISCUSSION

IPIs are a major public health problem in developing countries. High worm loads and repeated infections with intestinal parasites can cause severe anemia and chronic diarrhea, resulting in

negative impact on growth, fitness and learning ability<sup>[16]</sup>. The prevalence of intestinal infections observed by<sup>[17]</sup> among expatriate workers in Al-Khobar, Saudi Arabia was 14%. A similar study was conducted and observed 78.87% prevalence of IPIs in district Upper Dir<sup>[18]</sup>. In present research, prevalence of intestinal worm's infestation was observed in local hospitals of district Mardan. The findings showed that 101, out of 220 samples, were positive (45.90%) for parasitic and protozoan infections: Species wise percentage among the total positive cases was 74.25% (*A. lumbricoides*), 24.75% (*T. trichiura*), and 0.9% (*G. lamblia*). Similar results were obtained by<sup>[19]</sup> who found 90% and 15% prevalence of *A. lumbricoides* and *T. trichiura*.

Gender- and age-wise distribution revealed that IPIs are more common in males (27.27%) than females (18.63%) and two age groups 8-13 (40.59%) and 14-19 (29.70%) were most affected by IPIs. (Ademola Omotola and Ofoezie, 2019) reported that 48.6% of males and 40.4% of females were infected with IPIs but the difference was statistically insignificant. Previous study found highest prevalence of IPIs in age group 11-20 (0.89%, 4/449 in number) which showed concurrent results with the present study. According to<sup>[20]</sup>, *Trichuris* species cause more chronic infections than the *Ascaris* species. Other studies also reported peak intensity of *Trichuris* infections in study participants. These results coincide with the results of present research in which overall 76% of individuals were reported with chronic infections of *T. trichiura*. The association of IPIs with age in present study concluded that children of age 2-14 are more vulnerable to IPIs possibly due to uncleanliness and habits of playing in soil.

The association of different risk factors with IPIs was also checked and statistically analyzed using Fishers exact test. Except for the Habits of nail biting<sup>ns</sup> ( $P = 0.8021$ ), peak values of statistical significance were obtained for all other risk factors: source of drinking water<sup>\*\*\*</sup> ( $P = 0.0002$ ), handwash before meal<sup>\*\*\*</sup> ( $P = 0.0006$ ), handwash after defecation<sup>\*\*\*</sup> ( $P < 0.0001$ ), footwear<sup>\*\*\*\*</sup> ( $P < 0.0001$ ), skin care<sup>\*\*\*\*</sup> ( $P < 0.0001$ ), nails<sup>\*</sup> ( $P = 0.0423$ ) and clothes<sup>\*</sup> ( $P = 0.0276$ ). Further, age, personal hygiene and food habits also influence rate of IPIs. For example, in our study, high percentage of IPIs was reported in age groups 8-13 and 14-19, poor food habits, and poor personal hygiene. Prevalence of IPIs and their risk factors in school children of north-west Ethiopia and got results equivalent to present study. He found that habits of open field defecation, consistency of wearing shoes, habits of eating unwashed and raw vegetables, age, uncleanliness of fingernails, and trimming habits are the common risk factors of high rate of IPIs among school children<sup>[21]</sup>.

Overall, normal pattern of blood cells count was found of patients with IPIs in the present study. Difference than normal was found only in RBCs count, Eosinophils count, and hemoglobin range. RBCs count of individuals with IPIs was below (3.0-5.0 million cells/mm<sup>3</sup>) the normal range of RBCs/mm<sup>3</sup>, hemoglobin range was also below (7-13 g/dL; also normal for women and children but low for men) normal and eosinophils count was above (5-10%) the normal percentage. Another study conducted on prevalence of intestinal parasites in anemic patients in Iraq<sup>[2]</sup> found significantly decreased number of RBCs and hemoglobin in blood samples. This indicates that IPIs significantly affect RBCs count and ultimately decrease patient's blood hemoglobin level and the host immune system responds IPIs by increasing eosinophils count in the blood.

## CONCLUSION

Intestinal helminthiasis and protozoan infections are common parasitic infections observed in hospital patients in district Mardan; implying that IPIs continue to be a major public health problem in developing countries like Pakistan. A relatively high prevalence of IPIs was revealed in age groups 8-19 years and consisted of children and teenagers. Species-wise prevalence determined 74.25% *A. lumbricoides*, 24.75% *T. trichiura*, and 0.9% *G. lamblia* infections. In short, it was revealed that poor hygiene practices in hospitals led to high rates of IPIs. Further, low RBCs count, low blood hemoglobin and high eosinophils count was recorded from blood samples of studied patients.

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