Original Article

Intestinal Parasitic Infections among Children and Young Adolescents Visiting Provincial Headquarter Hospital in Gilgit, Pakistan and their Associated Factors

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ABSTRACT

Objective: To detect the frequency and species distribution of intestinal parasites among children and young adolescents visiting a provincial Headquarter Hospital in Gilgit, Pakistan and determine their association with socio-demographic and environmental factors

Methodology: This descriptive, cross-sectional study was done among patients visiting the Provincial Headquarter Hospital in Gilgit-Baltistan, Pakistan after ethical approval. The study duration was 6 months from August 2024 to January 2025. After taking informed consent, 227 children and young adolescents with ages ranging from 1 to 18 years were included using non-probability convenience sampling technique. Data was collected using a structured questionnaire including demographic factors, hygiene practices, healthcare access, and other relevant factors. Specimen bottles labeled with participant names and identification numbers were provided to parents and they were guided for stool sample collection. The collected specimens were processed in the Pathology Department of a healthcare facility for stool routine analysis. The data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 25.

Results: Intestinal parasitic infections (IPIs) were present in 74(32.6%) children and young adolescents. *Ascaris lumbricoides* (46%) and *Giardia lamblia* (29.7%) were the most prevalent intestinal parasites. Access to clean drinking water and hygienic conditions had a significant relation with IPIs (p-value=0.001). No significant association was seen with other variables such as gender, age, education level, and family income.

Conclusion: Intestinal parasitic infections were prevalent in 32.6% children and young adolescents. *Ascaris lumbricoides* and *Giardia lamblia* were the most common parasites. There was a statistically significant influence of environmental factors, particularly access to clean drinking water and poor personal hygienic conditions, on the frequency of these infections.

Keywords: *Parasitic infections. Ascariasis. Giardiasis.*

INTRODUCTION

Intestinal parasitic infections pose a significant threat to global health, affecting 30% of the world population. Around 3.5 billion people have parasitic infestations across the world, out of which 450 million cases present with signs and symptoms. Approximately 200,000 deaths are attributed to these infections. The parasitic infections by hookworms cause 45000, *Ascaris* causes 4300, and *Entamoeba* histolytica causes 54000 annual deaths.[1,2] Intestinal parasitic infections are responsible for 1.9 million disability-adjusted life years. The healthcare systems face significant financial constraints to cope with the rising number of IPIs.[3]

The major burden of IPIs lies in the developing countries.[1] The major reasons behind the greater prevalence of IPIs in these countries are poverty, overcrowding, insufficient handwashing practices, use of unwashed vegetables, lack of education & awareness, poor hygiene, shortage of clean water supply, and inadequate healthcare facilities.[4] Parasitic infections are caused by protozoans and helminths (worms). The main transmission route is fecal-oral, but transmission can also occur by larval penetration of skin.[5] Children are prone to acquire IPIs owing to their weak immunity and poor hygienic practices. These infections cause abdominal pain, anemia, and malnutrition in children. They can also impair their physical and mental growth, leading to a great influence on productivity and quality of life. Children should be routinely screened for IPIs & their associated malnutrition and prescribed proper therapy, not only to reduce the morbidity & mortality attributed to IPIs but also to boost the physical and mental health of children.[6]

The prevalence of intestinal parasitic infections is very high in Pakistan, varying from 25% to 70%. Combating this high burden of IPIs is challenging owing to lack of awareness among the public, inadequate healthcare facilities, and a lack of a monitoring system for IPIs.[7]

The mountainous location of Gilgit-Baltistan with its harsh climate makes it a hard-to-reach area, leading to limited healthcare infrastructure in the region. The traditional practices of fetching water from far areas, lack of clean water availability, defecating in the open environment, and other unhygienic lifestyle conditions contribute to the favorable transmission

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of parasites. In spite of the considerable risks involved, there is an absence of thorough data regarding the frequency and determinants of intestinal parasitic infections in Gilgit-Baltistan. The current study aims to address this critical gap by assessing the frequency of IPIs and associated factors in children and young adolescents in Gilgit-Baltistan to provide evidence for improving public health interventions, aligning with Pakistan's broader commitment to the Sustainable Development Goals.

METHODOLOGY

This descriptive, cross-sectional study was done on children and young adolescents visiting the Provincial Headquarter Hospital in Gilgit, Pakistan. The study duration was 6 months from August 2024 to January 2025. After ethical approval (Letter No. 1150/PHG/2023, 29-07-2024), 227 participants were included using non-probability convenience sampling technique. The sample size was estimated based on the expected prevalence rate of 30% IPIs, confidence level of 95% and margin of error of 6%.[8] The inclusion criteria were children and young adolescents with an age range of 1 to 18 years, who were willing to participate and give stool samples. Children/adolescents on anti-parasitic/deworming medication and those with chronic gastrointestinal conditions unrelated to IPIs were excluded. Informed written consent was obtained from the parents or guardians before participation and they were explained the purpose of the study. Data was collected using a semi-structured questionnaire including demographic factors, education level of guardian, family income, access to clean drinking water, and physical hygiene conditions. Based on family income, those with monthly income <30,000 rupees were labeled as having low income, 30,000 to 70,000 rupees were middle income, and >70,000 rupees were high income. The physical hygienic conditions were categorized according to handwashing practices (before meals and after defecation), trimmed nails, regular wearing of shoes, in-home sanitation facility, eating raw fruits and vegetables, playing with soil, and swimming habit.[9] Wide-mouthed, leak-proof specimen bottles labeled with participant names and identification numbers were provided to parents or guardians and they were guided for stool sample collection. Each participant was instructed to provide three stool samples on alternate days to increase the diagnostic sensitivity. The collected specimens were processed in the Pathology Department of a nearby healthcare facility for stool routine analysis by a trained laboratory technologist. The fresh specimens received were physically examined and then two wet preparations were made using normal saline on one side and Lugol's iodine on the other side of the same glass slide. They were examined under 10X and 40X objective lens to identify ova, cysts or trophozoites of various parasites. In addition, wet preparations were also made by using the formalin-ether concentration technique. In this technique, 0.5 g of the stool sample was mixed with 10 ml of normal saline. The suspension was strained using a gauze, centrifuged, and the supernatant was discarded. Around 2.5 ml of 10% formaldehyde and 1 ml of ether were added to the sediment. The suspension was again centrifuged for 1-2 minutes at 3000 rpm. The supernatant was discarded and wet preparation was prepared from the sediment and examined under microscope.[9] To ensure accuracy, each sample was examined independently by two trained microbiologists. In case of disagreement, the slides were re-examined together and senior microbiologists were also consulted for final confirmation. Positive cases were referred to the physician for treatment.

STATISTICAL ANALYSIS

The data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 25. Categorical variables were presented as frequency & percentage, while numerical variables were summarized using mean and standard deviation. Association between categorical variables was determined using Pearson's Chi-square and Fisher's exact test. A p-value of <0.05 was considered statistically significant.

RESULTS

Out of 227 participants of our study, most (42.3%) were school-aged children (6-12 years), followed by young adolescents (33.5%), and children ≤5 years (24.2%). Most (55%) of the participants were males. A greater proportion of the participants (41.4%) had low income, 36.6% had middle income, and 22% had high income. Regarding the education status of guardians, 42.8% were illiterate, 34.8% were educated till secondary, and 22.4% had completed graduation. The majority (56.4%) of the population had no access to clean water and reported good physical hygienic conditions (62.1%).

Out of 227 participants, 74(32.6%) had parasitic infestations while 153(67.4%) showed no infestation. Access to clean drinking water and hygienic conditions were significantly associated with infestation rates (p-value=0.001). A higher

frequency of IPIs was observed among participants with no access to clean drinking water and poor physical hygienic conditions. No significant association was seen with other variables such as gender, age, education level, and family income (Table 1).

Regular swimming habits, playing with soil, and eating raw fruits & vegetables were significantly associated with the presence of parasitic infestations (p=0.001). More frequent IPIs were exhibited by those who did not trim nails, wear shoes or wash hands before meals, and after defecation regularly (p=0.001).

The most frequently reported parasite was *Ascaris lumbricoides* (46%), followed by *Giardia lamblia* (29.7%). Other parasites, such as *Hymenolepis nana*, *Taenia saginata*, *Trichuris trichiura*, and *Entamoeba histolytica*, had lower frequency rates (Figure 1).

Table 1: Association of Socio-Demographic and Environmental Factors with Parasitic Infestation

Socio-Demographic and Environmental Factors		Parasitic Infestation (Frequency & Percentage)			p-value
		Present (n=74)	Absent (n=153)	Total	
Gender	**Male**	38(16.7%)	87(38.3%)	125(55%)	0.43
	Female	36(15.9%)	66(29.1%)	102(45%)	
	Total	74(32.6%)	153(67.4%)	227(100%)	
Age Groups (Years)	**≤5**	23(10.1%)	32(14.1%)	55(24.2%)	0.18
	6 to 12	26(11.5%)	70(30.8%)	96(42.3%)	
	13 to 18	25(11%)	51(22.5%)	76(33.5%)	
	Total	74(32.6%)	153(67.4%)	227(100%)	
Education Level of Guardian	**Illiterate**	29(12.8%)	68(30%)	97(42.8%)	0.66
	Secondary	26(11.5%)	53(23.3%)	79(34.8%)	
	Graduation	19(8.3%)	32(14.1%)	51(22.4%)	
	Total	74(32.6%)	153(67.4%)	227(100%)	
Family Income	**Low**	29(12.8%)	65(28.6%)	94(41.4%)	0.89
	Middle	28(12.3%)	55(24.2%)	83(36.5%)	
	High	17(7.5%)	33(14.5%)	50(22%)	
	Total	74(32.6%)	153(67.4%)	227(100%)	
Access to Clean Drinking Water	**No**	65(28.6%)	63(27.8%)	128(56.4%)	0.001*
	Yes	9(4%)	90(39.6%)	99(43.6%)	
	Total	74(32.6%)	153(67.4%)	227(100%)	
Physical Hygienic Conditions	**Poor**	58(25.6%)	28(12.3%)	86(37.9%)	0.001*
	Good	16(7%)	125(55.1%)	141(62.1%)	
	Total	74(32.6%)	153(67.4%)	227(100%)	

**Significant p-value*

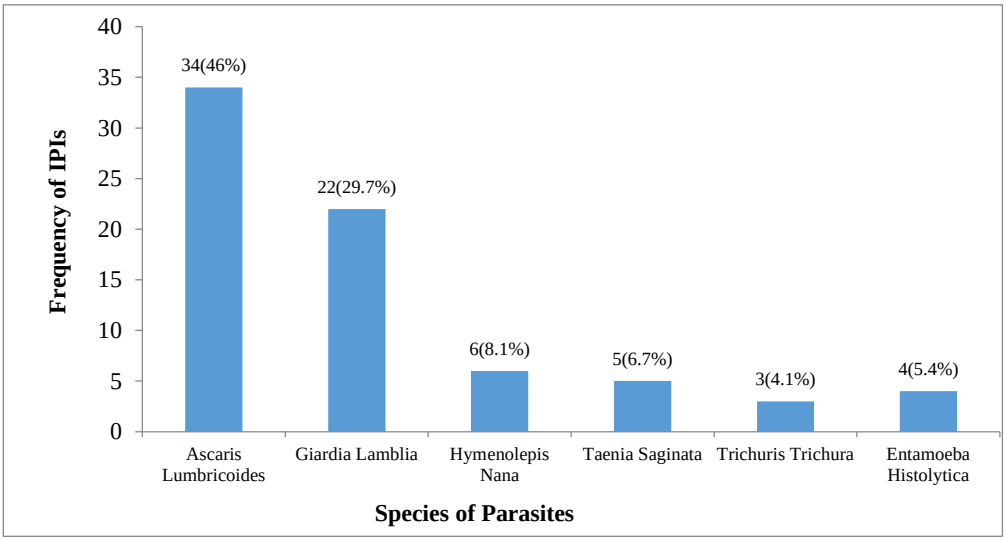

Figure 1: Species Distribution of Intestinal Parasitic Infections

DISCUSSION

Intestinal parasitic infections remain a critical public health challenge globally, especially in low-resource settings where factors such as inadequate sanitation, unsafe water, and poor hygiene practices are widespread. The prevalence of IPIs had also increased due to food globalization and frequent travel to various countries.[10,11] The findings of our study revealed a significant burden of IPIs (32.6%) among children and young adolescents in Gilgit-Baltistan, Pakistan. In two studies done in Ethiopia, IPIs were present in 24.4% of the children.[12,13] Other studies reported 28.27% and 29.4% prevalence of parasitic infestation among children in Ethiopia.[14,15] Sitotaw et al. reported a higher (62.40%) rate of parasitic infections among school children in Ethiopia.[16] This showed that the prevalence of IPIs can vary greatly from one area to another, even within the same country. In Argentina, 55.4% of the participants aged 1-15 years had IPIs.[17] In Somalia, IPIs were reported in 82.9% of the children.[18] A study from Lower Dir, Pakistan showed an 82% IPI rate among children. The high frequency of IPIs in children and young adolescents was attributed to their increased vulnerability due to unhygienic behaviors and greater interaction with contaminated environment.[19] On the other hand, a lower prevalence of IPIs had been found in Europe (5.9%).[20] In a study in India, the frequency of IPIs was 9.3%.[21]

The most common parasites in our study were *Ascaris lumbricoides* (46%) and *Giardia lamblia* (29.7%). Other parasites isolated were *Hymenolepis Nana* (8.1%), *Taenia saginata* (6.7%), *Trichuris trichiura* (4.1%), and *Entamoeba histolytica* (5.4%). In Lower Dir from Pakistan, *Ascaris* was the most common parasite isolated (57.7%), followed by hookworm (40.7%), *Taenia saginata* (20.9%), *Enterobius* (14.8%), *Trichuris* (14.5%), *Hymenolepis* (12.9%), and *Entamoeba* (9.25%).[19] Abebaw et al. and Scavuzzo et al. reported *Giardia lamblia* and *Hymenolepis nana* as the most common causes of parasitic infections.[12,17] In Ethiopia, parasitic infestations were mainly caused by *Entamoeba histolytica* (10.9%) and *Schistosoma mansoni* (7.4%).[13] According to a study by Duguma et al., *Ascaris* was the most common parasite (8%), followed by *Trichuris* (6.2%) and *Giardia* (4%).[15] In another study, the most common parasites were *Ascaris* (22.7%), Hookworms (20.6%), and *Entamoeba histolytica* (8.1%). Other parasites isolated were *Trichuris trichura* (7.6%), *Giardia* (6.5%), *Hymenolepis nana* (5.7%), and *Schistosoma mansoni* (4.4%).[16] In Somalia, the most common parasites were *Ascaris* (46.6%), *Giardia lamblia* (22.1%), and *Entamoeba histolytica* (17.6%).[18] In India, *Ascaris* (57%) and hookworm (42%) were the most common parasites.[21]

In our study, males comprised 55% of the population, and 45% were females. There was no statistically significant difference in parasitic infestation rates between males and females. Similarly, there were 53.2% males and 46.8% females in a study done by Yeshitila et al. Females were predominantly infected but with no statistical difference.[13] Similarly, another study revealed that IPIs affected males and females equally.[16] Our study showed that the frequency of IPIs was almost similar in various age groups and the age factor did not significantly affect infestation rates (p=0.18). Our results were in accordance with a study by Sitotaw et al., where no statistically significant difference in IPIs in different age groups was observed.[16] The IPIs affected a greater proportion of participants in the 10-14 years age groups (26.7%) in a study by Yeshitila et al.[13] In another study, there was a significant difference in the frequency of IPIs in different age groups, with <5 years most commonly affected, followed by 6-12 years.[17] Osman et al. from Somalia reported that IPIs were significantly prevalent in 13-36 months age group.[18] The results of the current study reported no significant association between the infestation rates and the education level of guardians (p=0.66). Similarly, family income did not significantly impact infestation rates (p=0.89). In contrast, a study revealed a significant association of IPIs with family income and education level. The rate of IPIs was significantly higher in the low income group and those with lower literacy.[16]

In our study, the factors significantly associated with IPIs were limited access to clean drinking water and poor physical hygienic conditions. Children without access to clean water (28.6%) had a significantly higher infection rate as compared to those with access to clean water (4%) (p=0.000). Poor hygienic conditions were significantly associated with higher infection rates (25.6%) as compared to only 7% rate among those with good hygienic practices. (p=0.000). Duguma et al. showed that access to clean drinking water, lack of handwashing, waste disposal methods, habit of wearing shoes, and poor hygiene were significantly associated with IPIs in Ethiopia.[15] In other studies, the most common risk factors associated with parasitic infections in children were untrimmed fingernails and lack of

handwashing.[12,14] The predisposing factors for parasitic infestation were lack of handwashing and swimming in contaminated water in a study.[13] Scavuzzo et al. reported that overcrowding and walking barefoot, were significantly associated with IPIs in Argentina.[17]

CONCLUSION

Intestinal parasitic infections were prevalent in 32.6% children and young adolescents. *Ascaris lumbricoides* and *Giardia lamblia* were the most common parasites. There was a statistically significant influence of environmental factors, particularly access to clean drinking water and poor hygienic conditions on the frequency of these infections.

LIMITATIONS & RECOMMENDATIONS

Our study had a few limitations, such as cross-sectional design, a single-centered study, and the use of convenience sampling, limiting the generalizability of the findings. The reliance on self-reported data for hygiene practices introduced the possibility of recall bias or social desirability bias. The study was conducted over 6 months, but parasitic prevalence may vary seasonally, which was not discussed.

The study recommended that targeted public health interventions focusing on improving water & sanitation infrastructure and promoting hygiene education should be implemented. Routine deworming programs, particularly in schools, are essential for reducing the burden of parasites such as *Ascaris lumbricoides*, etc. Health education campaigns focused on promoting hygiene practices, such as handwashing and safe food handling, can further reduce the spread of parasitic infections.

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Authors' Contributions:
U.A: Performed data analysis, interpretation, and drafted the initial manuscript.
S.N: Contributed to study design, methodology development, and critical revision of the manuscript.
A.Q: Conceived and designed the study, supervised data collection.
A.A: Participated in data collection, laboratory work, and tabulation of results.
N.Y: Assisted in literature review, data entry, and formatting of figures and tables.
Z.W: Supervised the overall project, reviewed the final manuscript critically for important intellectual content, and approved it for publication.

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