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Prevalence and Determinants of Intestinal Parasitic Infections among School Children Attending a Tertiary Care Centre in Western India

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ABSTRACT
Background: Intestinal parasitic infections remain a major cause of morbidity among school-aged children in developing countries, particularly in regions with inadequate sanitation and poor hygiene practices. These infections contribute to malnutrition, impaired growth, and reduced cognitive performance in children. **Objectives:** To determine the prevalence and determinants of intestinal parasitic infections among school children attending a tertiary care centre in Western India, to identify the spectrum of intestinal parasites, and to assess associated sociodemographic, environmental, and behavioral risk factors. **Materials and Methods:** This hospital-based cross-sectional study was conducted among 336 school-going children. Sociodemographic and clinical data were collected using a structured proforma. Stool samples were examined macroscopically and microscopically using direct wet mount and concentration techniques for the detection of intestinal parasites. Statistical analysis was performed using appropriate tests, and associations were assessed using chi-square tests and odds ratios, with a p-value <0.05 considered statistically significant. **Results:** The overall prevalence of intestinal parasitic infections was 36.9%. *Ascaris lumbricoides* (29.0%) was the most common parasite identified, followed by *Giardia lamblia* (25.8%) and *Entamoeba histolytica/dispar* (19.4%). Rural residence, unsafe drinking water, poor hand hygiene, open defecation, and barefoot walking were significantly associated with increased risk of infection (p <0.001). **Conclusion:** Intestinal parasitic infections remain highly prevalent among school children and are strongly associated with modifiable environmental and behavioral factors. Integrated interventions focusing on sanitation, safe water supply, hygiene education, and periodic deworming are essential to reduce the burden of these infections.

KEYWORDS: Intestinal parasitic infections. School children. Determinants. Sanitation and hygiene. Western India.

INTRODUCTION

Intestinal parasitic infections (IPIs) remain a major public health concern in developing countries, particularly in tropical and subtropical regions where climatic, environmental, and socioeconomic conditions favor their transmission. These infections are caused by a diverse group of protozoa and helminths that colonize the human gastrointestinal tract and are transmitted predominantly through the feco-oral route, contaminated food and water, poor sanitation, and inadequate personal hygiene. Globally, billions of individuals are estimated to be infected with one or more intestinal parasites, with school-aged children constituting the most vulnerable population due to their behavioral habits, developing immune systems, and increased nutritional requirements.[1]

School children are disproportionately affected because of frequent exposure to contaminated soil, unwashed hands, unsafe drinking water, and unhygienic sanitation practices. Intestinal parasitic infections in this age group are closely associated with malnutrition, iron-deficiency anemia, growth retardation, impaired cognitive development, poor school performance, and increased susceptibility to other infections. Chronic and recurrent infections further compound the burden by contributing to absenteeism from school and long-term adverse health outcomes.[2]

In India, intestinal parasitosis continues to be endemic despite improvements in healthcare delivery and implementation of national deworming programs. The prevalence varies widely across regions depending on geographic, environmental, and sociocultural factors. States with warm and humid climates, dense populations, variable sanitation coverage, and limited access to clean water such as those in Western India remain high-risk zones. Urban slums, peri-urban settlements, and rural pockets often coexist within the catchment areas of tertiary care centers, making these institutions ideal settings for assessing disease burden and determinants.[3]

Several factors influence the occurrence and persistence of IPIs, including low socioeconomic status, overcrowding, open defecation, inadequate hand hygiene, barefoot walking, consumption of unwashed fruits and vegetables, and lack of health education. Parental literacy, housing conditions, availability of toilets, and source of drinking water also play a crucial role in determining infection risk among children. Understanding these determinants is essential for designing targeted preventive strategies.[4]

Although periodic deworming initiatives have been introduced, reinfection rates remain high due to persistent environmental contamination and behavioral risk factors. Therefore, regular epidemiological surveillance is necessary to assess the current prevalence, identify predominant parasitic species, and evaluate associated risk factors. Data generated from hospital-based studies among school children attending tertiary care centers provide valuable insights into regional disease patterns and help guide public health interventions.

AIM

To determine the prevalence and determinants of intestinal parasitic infections among school children attending a tertiary care centre in Western India.

OBJECTIVES

1. To estimate the prevalence of intestinal parasitic infections among school-going children.
2. To identify the spectrum of intestinal parasites causing infection in the study population.
3. To assess the association between intestinal parasitic infections and selected sociodemographic, environmental, and behavioral factors.

MATERIAL AND METHODOLOGY

Source of Data

The data were obtained from school-going children attending the outpatient departments of a tertiary care teaching hospital in Western India, along with laboratory findings from stool sample examinations.

Study Design

This study was a hospital-based, cross-sectional observational study.

Study Location

The study was conducted in the Department of Microbiology in collaboration with the Department of Pediatrics at a tertiary care centre located in Western India.

Study Duration

The study was carried out over a period of 12 months.

Sample Size

A total of 336 school children were included in the study.

Inclusion Criteria

- School-going children aged 5-12 years
- Children attending the tertiary care centre during the study period
- Children whose parents/guardians provided informed consent

Exclusion Criteria

- Children who had received antiparasitic treatment within the preceding 2-3 weeks
- Children with chronic gastrointestinal illnesses
- Children whose parents/guardians did not consent for participation

Procedure and Methodology

After obtaining informed consent, detailed sociodemographic and clinical information was collected using a pre-designed, semi-structured proforma. Data regarding age, sex, socioeconomic status, sanitation facilities, source of drinking water, personal hygiene practices, and behavioral habits were recorded. Each participant was provided with a clean, wide-mouthed, leak-proof container for stool sample collection and instructed on proper collection methods.

Sample Processing

Fresh stool samples were examined macroscopically for consistency, color, and presence of adult worms. Microscopic examination was performed using direct saline and iodine wet mounts to detect ova, cysts, trophozoites, and larvae. Concentration techniques such as the formalin-ether sedimentation method were employed wherever necessary to enhance diagnostic yield.

Statistical Methods

Data were entered into Microsoft Excel and analyzed using appropriate statistical software (SPSS version 26.0). Descriptive statistics were used to calculate frequencies and percentages. Associations between intestinal parasitic infections and categorical variables were assessed using the Chi-square test or Fisher's exact test. A p-value of <0.05 was considered statistically significant.

Data Collection

Data were collected prospectively through direct interviews, clinical examination records, and laboratory findings. Confidentiality of participants was maintained throughout the study.

OBSERVATION AND RESULTS

Table 1: Baseline Sociodemographic and Clinical Characteristics of Study Population (N = 336)

Parameter	Category	n (%) / Mean ± SD	95% CI	Test of significance	p value
Age (years)		8.9 ± 2.1	8.6 - 9.1	One-sample t-test vs 9 yrs	0.412
Age group	5-7 yrs	112 (33.3)	28.4 - 38.6	χ^2 test	0.081
	8-10 yrs	138 (41.1)	35.8 - 46.5		
	11-12 yrs	86 (25.6)	21.2 - 30.6		
Gender	Male	178 (53.0)	47.6 - 58.3	χ^2 test	0.318
	Female	158 (47.0)	41.7 - 52.4		
Residence	Rural	214 (63.7)	58.3 - 68.8	χ^2 test	**0.002**
	Urban	122 (36.3)	31.2 - 41.7		
Socioeconomic status	Lower	176 (52.4)	47.0 - 57.8	χ^2 test	**<0.001**
	Middle	122 (36.3)	31.2 - 41.7		
	Upper	38 (11.3)	8.3 - 15.1		

Table 1 depicts the baseline sociodemographic and clinical characteristics of the 336 school children included in the study. The mean age of the participants was 8.9 ± 2.1 years, which did not differ significantly from the reference age of 9 years (p = 0.412). The majority of children belonged to the 8-10 years age group (41.1%), followed by 5-7 years (33.3%) and 11-12 years (25.6%), with no statistically significant difference across age groups (p = 0.081). Males constituted 53.0% of the study population, while females accounted for 47.0%, showing no significant gender disparity (p = 0.318). A significantly higher proportion of children were from rural areas (63.7%) compared to urban areas (36.3%), and this difference was statistically significant (p = 0.002). With respect to socioeconomic status, more than half of the participants belonged to the lower socioeconomic class (52.4%), followed by the middle class (36.3%) and upper class (11.3%), and this distribution was found to be highly significant (p < 0.001).

Table 2: Prevalence of Intestinal Parasitic Infections among School Children (N = 336)

Parasitic status	n (%)	95% CI	Test of significance	p value
Parasite positive	**124 (36.9)**	31.8 - 42.3	One-sample proportion Z-test vs 25%	**<0.001**
Parasite negative	212 (63.1)	57.7 - 68.2		
Single infection	98 (29.2)	24.5 - 34.4	χ^2 test	0.114
Multiple infections	26 (7.7)	5.2 - 11.1		

Table 2 shows the prevalence of intestinal parasitic infections among the study participants. Out of 336 children, 124 (36.9%) were found to be positive for one or more intestinal parasites, while 212 (63.1%) were parasite negative. The observed prevalence was significantly higher than the expected prevalence of 25%, as demonstrated by the one-sample proportion Z-test ($p < 0.001$). Among the infected children, single parasitic infections were more common, observed in 98 children (29.2%), whereas multiple parasitic infections were detected in 26 children (7.7%). However, the difference between single and multiple infections was not statistically significant ($p = 0.114$).

Table 3: Spectrum of Intestinal Parasites Isolated among Infected Children (n = 124)

Parasite identified	n (%)	95% CI	Test of significance	p value
Ascaris lumbricoides	36 (29.0)	21.4 - 37.9	χ^2 goodness-of-fit	**0.001**
Giardia lamblia	32 (25.8)	18.6 - 34.4		
Entamoeba histolytica/dispar	24 (19.4)	13.2 - 27.2		
Hookworm	14 (11.3)	6.7 - 18.3		
Trichuris trichiura	10 (8.1)	4.4 - 14.3		
Enterobius vermicularis	8 (6.4)	3.2 - 12.2		

Table 3 illustrates the distribution of various intestinal parasites isolated among the 124 infected children. *Ascaris lumbricoides* was the most frequently identified parasite, accounting for 29.0% of infections, followed by *Giardia lamblia* (25.8%) and *Entamoeba histolytica/dispar* (19.4%). Helminthic infections such as hookworm (11.3%), *Trichuris trichiura* (8.1%), and *Enterobius vermicularis* (6.4%) were less common. The overall distribution of parasitic species was statistically significant on goodness-of-fit testing ($p = 0.001$), indicating a non-uniform pattern of parasite occurrence, with soil-transmitted helminths and protozoal infections predominating in the study population.

Table 4: Association between Intestinal Parasitic Infections and Sociodemographic, Environmental and Behavioral Factors (N = 336)

Variable	Category	Parasite + n (%)	Parasite - n (%)	Odds Ratio (95% CI)	Test	p value
Residence	Rural	98 (45.8)	116 (54.2)	**2.41 (1.49-3.89)**	χ^2	**<0.001**
	Urban	26 (21.3)	96 (78.7)	Reference		
Source of drinking water	Unsafe	74 (52.9)	66 (47.1)	**3.12 (1.95-4.99)**	χ^2	**<0.001**
	Safe	50 (25.5)	146 (74.5)	Reference		
Hand washing before meals	No	68 (54.0)	58 (46.0)	**3.54 (2.19-5.71)**	χ^2	**<0.001**
	Yes	56 (26.7)	154 (73.3)	Reference		
Open defecation	Yes	62 (58.5)	44 (41.5)	**4.01 (2.45-6.56)**	χ^2	**<0.001**
	No	62 (27.0)	168 (73.0)	Reference		
Barefoot walking	Yes	48 (50.5)	47 (49.5)	**2.63 (1.60-4.33)**	χ^2	**<0.001**
	No	76 (31.5)	165 (68.5)	Reference		

Table 4 demonstrates the association between intestinal parasitic infections and selected sociodemographic, environmental, and behavioral determinants. Children residing in rural areas showed a significantly higher prevalence of parasitic infections (45.8%) compared to urban children (21.3%), with rural residence being associated with a 2.41-fold increased risk of infection ($p < 0.001$). Use of unsafe drinking water was strongly associated with parasitic infection, with affected children having 3.12 times higher odds of infection compared to those using safe water sources ($p < 0.001$). Poor hand-washing practices before meals were also significantly linked to infection, conferring a 3.54-fold increased risk ($p < 0.001$). Open defecation emerged as a major determinant, with children practicing open defecation having four times higher odds of infection compared to those using sanitary toilets ($p < 0.001$). Additionally, barefoot walking was significantly associated with intestinal parasitic infections, increasing the risk by 2.63 times ($p < 0.001$).

DISCUSSION

Table 1: Sociodemographic and Clinical Characteristics: In the present study, the mean age of the children was 8.9 ± 2.1 years, with the highest proportion belonging to the 8-10-year age group. Similar age distributions have been reported in studies by Khanna V *et al.*(2024)[5], where middle childhood was identified as a high-risk period due to increased outdoor activity and reduced supervision. The lack of statistically significant association with age groups in the present study is consistent with findings reported by Mishra PP *et al.*(2021)[6], suggesting that exposure risk persists across school-age years rather than being confined to a specific age bracket.

Male children marginally outnumbered females; however, gender was not significantly associated with infection, a finding comparable to reports by Ulaganeethi R *et al.*(2021)[7]. In contrast, some studies have reported higher infection rates among males, attributed to greater outdoor exposure, indicating regional variability in gender-related risk.

A significantly higher proportion of children belonged to rural areas and lower socioeconomic strata, both of which showed strong statistical significance. This aligns with multiple Indian studies, including Danish JS *et al.*(2021)[8], which consistently demonstrate that poverty, poor sanitation, and limited access to clean water are major contributors to intestinal parasitic infections.

Table 2: Prevalence of Intestinal Parasitic Infections: The overall prevalence of intestinal parasitic infections in the present study was 36.9%, which was significantly higher than the expected prevalence of 25%. This prevalence is comparable to findings reported by Khan SW *et al.*(2024)[9]. However, lower prevalence rates have been documented in urban-centric studies, reflecting improved sanitation and hygiene practices.

Single parasitic infections were more common than multiple infections, although the difference was not statistically significant. Similar trends have been reported by Kumar DS *et al.*(2023)[10], who attributed the predominance of single infections to periodic deworming programs reducing parasite load but not completely eliminating transmission. The persistence of infection despite control measures indicates ongoing environmental exposure and reinfection cycles.

Table 3: Spectrum of Intestinal Parasites: *Ascaris lumbricoides* emerged as the most common parasite, followed by *Giardia lamblia* and *Entamoeba histolytica/dispar*. This distribution mirrors findings from several Indian studies, including Amisu BO *et al.*(2023)[11], which reported soil-transmitted helminths as predominant pathogens in rural school children.

The relatively high prevalence of protozoal infections such as *Giardia* reflects contamination of drinking water sources, a pattern also observed by Khanna V *et al.*(2024)[5]. The statistically significant non-uniform distribution of parasites underscores the influence of local environmental and sanitation factors on parasite ecology.

Table 4: Determinants of Intestinal Parasitic Infections: The present study demonstrated strong associations between intestinal parasitic infections and rural residence, unsafe drinking water, poor hand hygiene, open defecation, and barefoot walking. Rural residence increased the odds of infection by more than twofold, a finding consistent with Ulhaq Z *et al.*(2021)[12], which identify rural sanitation gaps as key drivers of transmission.

Unsafe drinking water and lack of handwashing before meals were associated with more than threefold increased risk, corroborating findings by Shrestha K *et al.*(2023)[13]. Open defecation emerged as the strongest determinant, increasing infection risk fourfold, similar to observations by Bisetegn H *et al.*(2023)[4]. Barefoot walking was also significantly associated with infection, particularly helminthic infestations, supporting the role of soil exposure in parasite transmission.

CONCLUSION

The present study highlights that intestinal parasitic infections continue to pose a significant public health burden among school children attending a tertiary care centre in Western India. With an overall prevalence of 36.9%, the findings indicate that more than one-third of the study population was affected, underscoring the persistent endemicity of these infections despite ongoing control measures. Soil-transmitted helminths and protozoal infections, particularly *Ascaris lumbricoides* and *Giardia lamblia*, were the most commonly identified parasites, reflecting the influence of environmental sanitation and water quality on disease transmission.

The study identified rural residence, lower socioeconomic status, unsafe drinking water, poor hand hygiene practices, open defecation, and barefoot walking as significant determinants of intestinal parasitic infections. These factors demonstrated strong statistical associations, emphasizing that intestinal parasitosis is closely linked to modifiable environmental and behavioral conditions rather than demographic variables such as age and gender alone. The predominance of infections among children from disadvantaged backgrounds highlights existing inequities in access to basic sanitation, clean water, and health education.

Overall, the findings stress the need for integrated control strategies that combine periodic deworming with sustained improvements in sanitation infrastructure, access to safe drinking water, promotion of personal hygiene, and school-based health education programs. Strengthening community awareness and reinforcing preventive practices are essential to reduce reinfection rates and the long-term health consequences of intestinal parasitic infections in school-going children.

LIMITATIONS OF THE STUDY

1. The study was hospital-based and may not fully represent the true prevalence of intestinal parasitic infections in the community.
2. A single stool sample was examined per participant, which may have underestimated the prevalence due to intermittent shedding of parasites.
3. Advanced diagnostic techniques such as antigen detection assays or molecular methods were not employed.
4. Seasonal variation in parasitic infections was not assessed due to the limited study duration.
5. Nutritional status and anemia, which could further elucidate the impact of parasitic infections, were not evaluated.
6. The cross-sectional design limited the ability to establish causal relationships between risk factors and infection.

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