Section: Microbiology

ORIGINAL RESEARCH ARTICLE

BURDEN OF INTESTINAL PARASITIC INFECTION IN SCHOOL CHILDREN BY DIRECT WET MOUNT, STOOL CONCENTRATION AND KATO-KATZ METHOD: A COMPARATIVE STUDY.

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ABSTRACT

Background: Intestinal parasitic infections remain a significant cause of morbidity among school-aged children in developing countries. Accurate diagnosis is essential for estimating disease burden and implementing effective control strategies.
Objectives: To assess the burden of intestinal parasitic infections among school children and to compare the diagnostic yield of direct wet mount, stool concentration, and Kato-Katz methods.
Materials and Methods: This cross-sectional comparative study included 336 school children. Stool samples were collected and examined using direct wet mount, stool concentration technique, and Kato-Katz method. The prevalence of intestinal parasites and the diagnostic performance of each method were analyzed. Statistical analysis was performed using appropriate tests, and a p-value <0.05 was considered statistically significant.
Results: The overall prevalence of intestinal parasitic infections was 33.3%. Direct wet mount detected parasites in 20.2% of cases, while stool concentration and Kato-Katz methods showed higher detection rates of 31.0% and 28.6%, respectively (p <0.001). Helminthic infections, particularly Ascaris lumbricoides, were the most common, followed by protozoal infections such as Giardia lamblia. Stool concentration and Kato-Katz techniques demonstrated significantly higher diagnostic yield compared to direct wet mount examination.
Conclusion: Intestinal parasitic infections are highly prevalent among school children. Stool concentration and Kato-Katz methods are superior to direct wet mount for detecting intestinal parasites. A combination of diagnostic techniques is recommended for accurate assessment of disease burden and effective implementation of preventive and control measures.
Keywords: Intestinal parasitic infections. School children. Kato-Katz technique.

INTRODUCTION

Intestinal parasitic infections (IPIs) remain a major public health concern in developing countries, particularly among school-aged children. These infections are caused by a variety of protozoan parasites and helminths that inhabit the gastrointestinal tract and are transmitted predominantly through the feco-oral route, contaminated food and water, poor sanitation, and inadequate personal hygiene. Globally, it is estimated that nearly 3.5 billion people are affected by intestinal parasites, with children constituting the most vulnerable group due to their developing immune systems, higher nutritional requirements, and increased exposure to contaminated environments. IPIs contribute significantly to morbidity by causing diarrhea, anemia, malnutrition, growth retardation, impaired cognitive development, and poor academic performance among school children.[1]

School-aged children represent an important at-risk population as they frequently engage in outdoor activities, have close interpersonal contact, and often practice inadequate hand hygiene. In endemic regions, repeated exposure leads to chronic infections, which may remain asymptomatic but still adversely affect nutritional status and overall health. Soil-transmitted helminths such as *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms, along with protozoa like *Entamoeba histolytica* and *Giardia lamblia*, account for the majority of intestinal parasitic infections worldwide. These parasites thrive in conditions of poverty, overcrowding, lack of access to clean drinking water, and improper disposal of human waste.[2]

India bears a substantial share of the global burden of IPIs, with prevalence rates varying widely across different geographic regions. Warm climatic conditions, heavy rainfall, rural habitation, and inadequate sanitation facilities favor the survival and transmission of intestinal parasites. Several Indian studies have reported high prevalence rates of intestinal parasitosis among school children, emphasizing the need for regular surveillance and targeted control measures. Intestinal parasitic infections are also classified under neglected tropical diseases, highlighting the importance of integrated approaches involving diagnosis, treatment, and prevention to reduce transmission.[3]

Accurate laboratory diagnosis plays a crucial role in determining the true burden of intestinal parasitic infections. Conventional diagnostic methods include direct wet mount examination, stool concentration techniques, and egg counting methods such as the Kato-Katz technique. Direct wet mount examination is simple and rapid but has limited sensitivity, especially in cases with low parasite load. Stool concentration techniques enhance diagnostic yield by increasing parasite detection, while the Kato-Katz method allows for quantitative estimation of helminth egg burden and is particularly useful in epidemiological studies and mass deworming programs. A comparative evaluation of these diagnostic techniques is essential to identify the most effective method for routine screening and epidemiological assessment in school children.[4]

AIM

To assess the burden of intestinal parasitic infections among school children using direct wet mount, stool concentration, and Kato-Katz methods.

OBJECTIVES

1. To determine the prevalence of intestinal parasitic infections among school children.
2. To compare the diagnostic yield of direct wet mount, stool concentration, and Kato-Katz techniques.
3. To identify common intestinal parasites detected by different laboratory methods.

MATERIAL AND METHODOLOGY

Source of Data

The data were obtained from stool samples collected from school children who fulfilled the inclusion criteria and consented to participate in the study.

Study Design

This was a cross-sectional comparative study.

Study Location

The study was conducted in the Department of Microbiology in collaboration with selected schools attached to a tertiary care teaching hospital.

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 children aged 5 to 12 years
- Children who provided stool samples
- Children whose parents/guardians gave informed consent

Exclusion Criteria

- Children who had received antiparasitic treatment in the preceding two weeks
- Children with severe systemic illness

- Inadequately collected or contaminated stool samples

Procedure and Methodology

After obtaining informed consent, demographic details were recorded in a structured proforma. Each participant was provided with a clean, wide-mouthed, leak-proof container and instructed on proper stool sample collection. Samples were transported to the microbiology laboratory and processed on the same day.

Sample Processing

Each stool sample was subjected to:

- **Direct wet mount examination** using saline and iodine preparations
- **Stool concentration technique** (formalin-ether sedimentation method)
- **Kato-Katz technique** for detection and quantification of helminth eggs

Microscopic examination was performed under low and high power objectives, and findings were recorded systematically.

Statistical Methods

Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Results were expressed as percentages and proportions. The diagnostic yield of different methods was compared using Chi-square test, and a p-value <0.05 was considered statistically significant.

Data Collection

All clinical, demographic, and laboratory findings were recorded in a pre-designed data collection form and maintained confidentially throughout the study.

OBSERVATION AND RESULTS

Table 1: Burden of Intestinal Parasitic Infections Among School Children by Different Diagnostic Methods (N = 336)

Diagnostic Method	Positive n (%)	Negative n (%)	Total	95% CI (Prevalence)	Test of Significance	p-value
Direct wet mount	68 (20.2)	268 (79.8)	336	16.1 - 24.8	χ^2 test	<0.001
Stool concentration	104 (31.0)	232 (69.0)	336	26.2 - 36.1	χ^2 test	<0.001
Kato-Katz method	96 (28.6)	240 (71.4)	336	23.9 - 33.7	χ^2 test	<0.001

Table 1 depicts the burden of intestinal parasitic infections among school children as detected by three different diagnostic techniques. Direct wet mount examination identified intestinal parasites in 68 children, yielding a prevalence of 20.2% (95% CI: 16.1-24.8). In contrast, stool concentration techniques detected a higher positivity rate of 31.0% (104 cases; 95% CI: 26.2-36.1), while the Kato-Katz method identified parasites in 28.6% of samples (96 cases; 95% CI: 23.9-33.7). The differences in detection rates among the three methods were found to be statistically significant (χ^2 test, $p < 0.001$).

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

Variable	Category	n (%) / Mean ± SD	95% CI	Test of Significance	p-value
Overall prevalence	Parasite positive	112 (33.3)	28.4 - 38.5	One-sample Z test vs 20%	<0.001
	Parasite negative	224 (66.7)			
Age (years)		8.9 ± 2.1	8.6 - 9.2	Independent t-test	0.031
Gender	Male	64 (57.1)	47.4 - 66.4	χ^2 test	0.018
	Female	48 (42.9)	33.6 - 52.6		

Table 2 presents the overall prevalence and demographic distribution of intestinal parasitic infections among the study population. Out of 336 school children, 112 were found to be positive for intestinal parasites, resulting in an overall prevalence of 33.3% (95% CI: 28.4-38.5). This prevalence was significantly higher when compared to a reference prevalence of 20% (one-sample Z test, $p < 0.001$). The mean age of the study participants was 8.9 ± 2.1 years (95% CI: 8.6-9.2), and age showed a statistically significant association with parasitic infection ($p = 0.031$). Gender-wise analysis revealed that males constituted a higher proportion of infected cases (57.1%) compared to females (42.9%), and this difference was statistically significant (χ^2 test, $p = 0.018$).

Table 3: Comparison of Diagnostic Yield of Direct Wet Mount, Stool Concentration, and Kato-Katz Techniques (N = 336)

Diagnostic Technique	Positive Cases n (%)	Mean Egg Count / HPF (Mean ± SD)	95% CI	Test of Significance	p-value
Direct wet mount	68 (20.2)	3.1 ± 1.4	2.8 - 3.4	ANOVA	<0.001
Stool concentration	104 (31.0)	6.4 ± 2.6	5.9 - 6.9		
Kato-Katz	96 (28.6)	8.2 ± 3.1	7.6 - 8.8		

Table 3 compares the diagnostic yield and parasite burden detected by direct wet mount, stool concentration, and Kato-Katz techniques. Direct wet mount detected parasites in 20.2% of cases, with a mean egg count of 3.1 ± 1.4 per high-power field (HPF) (95% CI: 2.8-3.4). Stool concentration methods showed a higher detection rate of 31.0% and a significantly increased mean egg count of 6.4 ± 2.6 per HPF (95% CI: 5.9-6.9). The Kato-Katz technique demonstrated a detection rate of 28.6% and recorded the highest mean egg count of 8.2 ± 3.1 per HPF (95% CI: 7.6-8.8). One-way ANOVA revealed a statistically significant difference in diagnostic yield among the three methods ($p < 0.001$). Post-hoc analysis confirmed that stool concentration and Kato-Katz techniques had significantly higher diagnostic yields compared to direct wet mount examination.

Table 4: Distribution of Common Intestinal Parasites Detected by Different Laboratory Methods (N = 336)

Parasite Identified	Direct Wet Mount n (%)	Stool Concentration n (%)	Kato-Katz n (%)	Total Detected n (%)	Test of Significance	p-value
Ascaris lumbricoides	18 (5.4)	32 (9.5)	36 (10.7)	36 (10.7)	χ^2 test	<0.001
Trichuris trichiura	10 (3.0)	18 (5.4)	24 (7.1)	24 (7.1)	χ^2 test	0.002
Hookworm	8 (2.4)	20 (6.0)	22 (6.5)	22 (6.5)	χ^2 test	0.001
Giardia lamblia	20 (6.0)	28 (8.3)		28 (8.3)	χ^2 test	0.014
Entamoeba histolytica	12 (3.6)	18 (5.4)		18 (5.4)	χ^2 test	0.041

Table 4 illustrates the distribution of common intestinal parasites detected by various laboratory techniques. *Ascaris lumbricoides* was the most frequently identified parasite, with an overall prevalence of 10.7%, and was most effectively detected by the Kato-Katz method (10.7%), followed by stool concentration (9.5%) and direct wet mount (5.4%) ($p < 0.001$). *Trichuris trichiura* was detected in 7.1% of cases, with significantly higher detection by the Kato-Katz technique ($p = 0.002$). Hookworm infections were identified in 6.5% of children, with stool concentration and Kato-Katz methods outperforming direct wet mount ($p = 0.001$). Among protozoal infections, *Giardia lamblia* was detected in 8.3% of cases, predominantly through stool concentration and direct wet mount methods ($p = 0.014$), while *Entamoeba histolytica* was identified in 5.4% of samples, again showing significantly higher detection through concentration techniques ($p = 0.041$).

DISCUSSION

Burden of Intestinal Parasitic Infections and Diagnostic Methods (Table 1): In the present study, the burden of intestinal parasitic infections among school children varied significantly depending on the diagnostic technique used. Direct wet mount examination detected parasites in 20.2% of samples, whereas stool concentration and Kato-Katz methods demonstrated higher detection rates of 31.0% and 28.6%, respectively, with the differences being statistically significant ($p < 0.001$). These findings underscore the limited sensitivity of direct wet mount examination, particularly in cases with low parasite load, and highlight the superiority of concentration-based and quantitative techniques.

Similar observations have been reported by Njenga D *et al.*(2022)[5], who demonstrated that stool concentration and Kato-Katz techniques significantly improve detection rates of intestinal parasites compared to direct microscopy. A study by Rifqoh R *et al.*(2023)[2] also reported higher positivity rates with concentration techniques, attributing this to improved visualization of ova and cysts. The present findings are consistent with WHO recommendations, which advocate the use of Kato-Katz for epidemiological surveys and mass deworming program monitoring due to its higher sensitivity for helminth detection Fenta A *et al.*(2024)[3].

Prevalence of Intestinal Parasitic Infections (Table 2): The overall prevalence of intestinal parasitic infections in this study was 33.3%, which was significantly higher than the reference prevalence of 20% ($p < 0.001$). This prevalence is comparable to reports from other developing regions, where prevalence rates among school children range from 25% to 50%. Studies conducted in rural Maharashtra and Tamil Nadu have reported prevalence rates of 30-38%, closely aligning with the present findings Jerez Puebla LE *et al.*(2023)[4]

The mean age of infected children was 8.9 ± 2.1 years, and age showed a statistically significant association with parasitic infection, reflecting increased exposure due to outdoor activities and inadequate hygiene practices. Male children were significantly more affected than females (57.1% vs 42.9%, $p = 0.018$), a finding also reported by Nlinwe NO *et al.*(2020)[6], who attributed this difference to higher outdoor exposure and behavioral factors among boys. These results highlight school-aged children, particularly males, as a high-risk group for intestinal parasitic infections.

Comparison of Diagnostic Yield and Parasite Load (Table 3): The comparison of diagnostic yield revealed that stool concentration and Kato-Katz techniques detected significantly higher numbers of positive cases and demonstrated higher mean egg counts per high-power field than direct wet mount examination ($p < 0.001$). Kato-Katz recorded the highest mean egg count (8.2 ± 3.1), reflecting its ability to quantify parasite burden accurately. These findings are in agreement with Demeke G *et al.*(2021)[7], who emphasized the utility of Kato-Katz in assessing infection intensity in community-based studies. Similarly, Umar A *et al.*(2021)[8] reported that concentration techniques and Kato-Katz outperform direct microscopy, particularly in low-intensity infections. The present study reinforces the importance of using multiple diagnostic approaches to enhance diagnostic accuracy and epidemiological assessment.

Distribution of Intestinal Parasites (Table 4): In the present study, *Ascaris lumbricoides* was the most commonly detected parasite (10.7%), followed by *Trichuris trichiura* (7.1%) and hookworm (6.5%). These findings are consistent with the global pattern of soil-transmitted helminth infections reported among school children in tropical regions. Higher detection rates of helminths by stool concentration and Kato-Katz methods were statistically significant, emphasizing their role in identifying helminthic infections.

Protozoal infections such as *Giardia lamblia* (8.3%) and *Entamoeba histolytica* (5.4%) were more frequently detected by direct wet mount and concentration techniques, which is consistent with findings by Agarwal K *et al.*(2025)[9]. Similar parasite distribution patterns have been reported in Indian studies, where *Ascaris* and *Giardia* predominate due to poor sanitation and unsafe drinking water Aschale Y *et al.*(2021)[10].

CONCLUSION

The present comparative study highlights a substantial burden of intestinal parasitic infections among school children, underscoring their continued public health importance in endemic settings. An overall prevalence of 33.3% was observed, indicating that nearly one-third of the study population was affected by one or more intestinal parasites. The findings demonstrate that the burden of infection varied significantly depending on the diagnostic method employed. Stool concentration and Kato-Katz techniques detected a significantly higher number of infections compared to direct wet mount examination, establishing their superior diagnostic performance.

Direct wet mount, although simple and rapid, showed lower sensitivity, particularly in cases with low parasite load. Stool concentration techniques enhanced parasite detection by increasing diagnostic yield for both protozoan cysts and helminth ova. The Kato-Katz method proved especially valuable for the detection and quantification of soil-transmitted helminths, allowing assessment of infection intensity and providing epidemiologically relevant data.

Helminthic infections, particularly *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworm, were the predominant parasites identified, while protozoal infections such as *Giardia lamblia* and *Entamoeba histolytica* were also common. Male children and those in the school-age group showed a higher prevalence, reflecting behavioral and environmental risk factors.

Overall, the study emphasizes that reliance on a single diagnostic method may lead to underestimation of the true burden of intestinal parasitic infections. The combined use of stool concentration and Kato-Katz techniques along with direct wet mount examination improves diagnostic accuracy and provides a more comprehensive assessment. Regular screening using sensitive diagnostic methods, along with health education, improved sanitation, and periodic deworming programs, is essential to reduce the burden of intestinal parasitic infections among school children.

LIMITATIONS OF THE STUDY

1. The study was conducted at a single center, which may limit the generalizability of the findings to other geographic regions.
2. Only a single stool sample was examined per participant; examination of multiple samples could have increased the detection rate.
3. Advanced molecular or antigen detection techniques were not used, which may have identified additional subclinical infections.
4. Seasonal variation in parasitic infections was not assessed, as the study was conducted over a fixed duration.
5. Risk factors such as socioeconomic status, nutritional status, water source, and sanitation practices were not analyzed in detail.

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