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Prevalence and Clinical Characteristics of Pediatric Parasitic Gastroenteritis with a Comparative Analysis of Diagnostic Methods

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ABSTRACT

Introduction: Parasitic gastroenteritis is a major cause of gastrointestinal complaints in children. The aim of this study was to determine the prevalence and clinical findings of parasitic infections in pediatric patients. We also analysed the distribution by age groups and seasonal patterns, compared the detection rate and diagnostic yield of different methods, and investigated associations between clinical findings and specific parasites.

Methods: This prospective study was conducted in 300 pediatric patients who presented to Karabük Training and Research Hospital with gastrointestinal symptoms. Demographic data, clinical symptoms, and stool characteristics (such as consistency and appearance) were systematically recorded for each patient. All clinical samples were analysed for gastrointestinal parasites using various diagnostic methods, including macroscopic examination, direct microscopy, flotation, concentration methods, and the immunochromatographic rapid test (ICT). The detection rates were compared, and correlations between clinical findings and parasite infections were analysed.

Results: Parasitic infections were detected in 26% of children, with the highest susceptibility observed in infants and young children. Among pediatric patients, the most common symptoms were diarrhoea (36.7%), abdominal pain (30.3%), fever (25.7%), and colitis (25.3%). The predominant pathogens were *Entamoeba histolytica* (22.7%), followed by *Blastocystis hominis* (6%) and *Giardia duodenalis* (4%). *Cryptosporidium parvum* appeared to be more frequently observed in patients with abdominal pain and diarrhoea; *Enterobius vermicularis* was more frequently observed in febrile patients. Rapid ICT showed a higher detection rate (23.3%) than traditional microscopy (22.7%). The consistency of watery, mucous stools was a significant clinical predictor of parasitic infection ($p<0.05$). Positive cases peaked in autumn, particularly in September.

Conclusion: ICTs showed a higher detection rate than the conventional microscopic method in this study. The correlation between stool consistency and parasitic infection serves as an important diagnostic clue for paediatricians in emergency departments and outpatient settings during clinical decision-making.

Keywords: Pediatric gastroenteritis, rapid diagnostic tests, diarrhoea, gastrointestinal parasites

Introduction

Gastrointestinal infections are the second most common infectious diseases after respiratory infections. According to World Health Organization data, there are over 1.7 billion cases of diarrheal disease worldwide each year (1). The situation is particularly critical in the pediatric age group. More than 654 million school-age children and more than 260 million preschool-age children live in areas that require treatment for parasitic infections (1,2).

The impact of gastrointestinal parasitic infections on child mortality rates is substantial. According to UNICEF 2024 data, diarrheal diseases are the third leading cause of death in children under 5 years of age, causing 443,832 child deaths annually (3). These deaths account for 9% of the total under-5 mortality rate (4,5).

The clinical impact of pediatric intestinal parasites is multidimensional, causing long-term health problems beyond acute gastrointestinal symptoms. Systematic reviews show that *Ascaris lumbricoides* is significantly associated with growth retardation (6). *Giardia duodenalis* (*G. duodenalis*) infections cause anemia and malnutrition by inhibiting the absorption of iron, vitamins, minerals, proteins, lipids, and carbohydrates, leading to physical and mental developmental delays (7). Chronic infections negatively affect school performance and result in long-term educational losses due to absenteeism (8).

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Parasitic disease prevalence is affected by various factors, including environmental conditions, infrastructure, education level, water quality, hygiene practices, climate, gender, age, cleanliness habits, economic status, and dietary habits (9,10). Gastrointestinal symptoms are common causes of pediatric hospitalization, with nausea, vomiting, diarrhea, and abdominal pain accounting for a significant number of emergency department visits (11). Viral gastroenteritis causes diarrhea (92.2%), vomiting (68.7%), and abdominal pain (60.8%), while parasitic gastroenteritis presents with similar symptoms (12). The main transmission route for most intestinal parasite infections is the fecal-oral route, which is especially prevalent in countries with low socioeconomic conditions (13,14).

The most common pediatric gastrointestinal parasites are *Entamoeba histolytica* (*E. histolytica*) complex (9.28-36%), *G. duodenalis* (10-64.8%), *Blastocystis* spp. (up to 88.7% by polymerase chain reaction), and *Cryptosporidium* spp. (1.8-5%) (15,16). Distribution varies by age: children under 2 years account for 67.85% of Cryptosporidium infections, Giardia affects all pediatric age groups, and *E. histolytica* is more prevalent in children under 1 year and those aged 48-59 months (17). Diagnostic methods for gastrointestinal parasites include direct microscopy, serological and molecular methods, and rapid diagnostic tests (immunochromatographic card tests). While direct microscopic examination is the cornerstone of parasitologic diagnosis, the zinc sulfate flotation method performs better for protozoan cysts and *Hymenolepis nana*, whereas the formalin-ethyl acetate sedimentation method is superior for detecting heavy helminth eggs and larvae (14,18-23).

Our study aimed to investigate intestinal parasites in pediatric patients using various diagnostic methods (macroscopic examination, direct microscopy, zinc sulfate flotation, formalin-ethyl acetate sedimentation, rapid diagnostic tests); determine prevalence by age, sex, clinical symptoms, and seasonal distribution; and compare the detection rate and diagnostic yield of each method. These results will help to develop optimal diagnostic algorithms for pediatric gastrointestinal parasitic infections and to improve infection control.

Methods

Study Design

This prospective cross-sectional study was conducted between May 2023 and April 2024 at the Microbiology Laboratory of Karabük Training and Research Hospital. The study was approved by the Karabük University Non-Interventional Ethics Committee (decision number: 2022/787, date: 20.01.2022). Informed consent was not required, as the study used only anonymized routine clinical stool samples and associated data.

Study Population

A total of 300 pediatric patients (aged 0-18 years) presenting at the hospital's microbiology laboratory with gastrointestinal symptoms were included in the study. The study group comprised 160 (53.3%) males and 140 (46.7%) females.

Sample Collection and Processing

Fresh stool samples were collected in sterile, wide-mouthed, capped containers and transported to the laboratory. Samples were processed within 2 hours of collection. For each sample, macroscopic examination, direct microscopic examination, stool concentration methods, and immunochromatographic rapid diagnostic tests were systematically applied. Demographic data, clinical symptoms, and stool characteristics (consistency, appearance, etc.) were systematically recorded for each patient.

Laboratory Analysis

Macroscopic Examination

Stool samples were first examined macroscopically. During this evaluation, the color (yellow, green, brown, black), consistency (watery, soft, semi-solid, solid), and other macroscopic features were recorded.

Direct Microscopic Examination

Stool samples (2-3 mg) were examined by wet-mount preparation with saline and Lugol's iodine.

Zinc Sulfate Flotation Method

A stool sample (1 g) was suspended in 10 mL of distilled water, filtered, and centrifuged. After the supernatant was discarded, zinc sulfate solution was added, and the mixture was vortexed and recentrifuged. A coverslip was placed on the meniscus for 10 minutes and was then examined microscopically.

Formalin-Ethyl Acetate Sedimentation Method

Stool samples (1 g) were fixed in 10% formalin for 10 minutes, filtered, and centrifuged. After adding 7 mL of formalin and 3 mL of ethyl acetate, the mixture was shaken vigorously and centrifuged. The sediment layer from the four-layer separation was examined by wet-mount preparation.

Immunochromatographic Rapid Diagnostic Test

A commercial immunochromatographic test (ICT) (Crypto/Giardia/Entamoeba Combo Test, Monlab, Spain) was used to detect *Cryptosporidium parvum* (*C. parvum*), *G. duodenalis,* and *E. histolytica*-specific antigens according to the manufacturer's specifications. Species-level identification of *E. histolytica* was based on immunochromatographic antigen detection, which specifically detects *E. histolytica* and does not cross-react with other Entamoeba species test sensitivities were 82.4% for *E. histolytica*, *92.4%* for *G. duodenalis,* and 80.0% for *C. parvum*.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics 27.0 (IBM, USA). Descriptive statistics were presented as mean ± standard deviation for continuous variables and number (percentage) for categorical variables. Relationships between categorical variables were evaluated using chi-square or Fisher's exact tests, with $p<0.05$ considered statistically significant.

Results

This study included stool samples from 300 pediatric patients aged 0-18 years, of whom 160 were males (53.3%) and 140 were females (46.7%). The mean age of the study population was 6.08 years. Age distribution analysis revealed that 37% (n=111) of participants were in the 0-2 years age group, 26% (n=78) in the 6-10 years age group, 15% (n=45) in the 3-5 years age group, 11.3% (n=34) in the 15-18 years age group, and 10.7% (n=32) in the 11-14 years age group.

The most common gastrointestinal symptoms were diarrhea (36.7%, n=110), abdominal pain (30.3%, n=91), fever (25.7%, n=77), and colitis (25.3%, n=76). All stool samples were subjected to macroscopic examination, direct smear, zinc sulfate flotation, formol-ethyl acetate sedimentation, and ICT. At least one parasite species was detected in 26% (78/300) of samples.

Parasite prevalence was 27.8% (39/140) in females and 24.3% (39/160) in males, with no significant association between prevalence and gender ($p>0.05$). When the distribution of parasite-positive cases across age groups was examined as proportions of the total cohort (n=300), the largest proportion of positive cases was observed in the 0-2-year age group (27/300, 9%), followed by the 6-10-year group (22/300, 7.3%), the 3-5-year group (11/300, 3.7%), the 11-14-year group (9/300, 3%), and the 15-18-year group (9/300, 3%). These values represent the distribution of positive cases in the total cohort, and no significant association was found between age groups and parasite positivity ($p>0.05$).

Macroscopic evaluation of parasite-positive samples showed the following: watery-mucous (50%, 39/78), watery (28.2%, 22/78), mucous (11.5%, 9/78), bloody (6.4%, 5/78), mucous-bloody (2.6%, 2/78), and normal consistency (1.3%, 1/78). Watery and mucoid consistencies showed a significant association with parasite presence ($p<0.05$). Microscopic examination revealed parasite positivity in 43% (31/72) of samples with leukocytes and in 36.3% (4/11) of samples with erythrocytes; however, neither association was statistically significant ($p>0.05$).

The detected parasite species were *E. histolytica* (22.7%, 68/300), *Blastocystis hominis* (*B. hominis*) (6%, 18/300), *G. duodenalis* (4%, 12/300), *C. parvum* (2.3%, 7/300), *and Enterobius vermicularis* (*E. vermicularis*) (0.7%, 2/300). Single parasites were found in 18.3% (55/300), two species in 5.7% (17/300), and three species in 2% (6/300) of samples. The most common co-infection was *E. histolytica and B. hominis* (4.3%, 13/300). Detailed frequency distributions are presented in Table 1.

When the distribution of detected parasite species across age groups was examined as proportions of the total cohort, *E. histolytica* accounted for the largest share of positive cases in both the 0-2-year and 6-10-year age groups (21/300; 7% of the total cohort in each group) (Table 2). Statistical analysis indicated that there was no significant association between age-stratified groups and the distribution of identified parasite species ($p>0.05$).

Comparison of diagnostic methods revealed positivity rates of direct microscopy, 22.7% (68/300); zinc sulfate flotation, 16% (48/300); formol ethyl acetate sedimentation, 18.3% (55/300); and ICT, 23.3% (70/300). No parasites were detected macroscopically. By species, detection rates were highest for *E. histolytica* using both ICT and direct microscopy; for *C. parvum* and *G. duodenalis* using ICT; and for *B. hominis* and *E. vermicularis* using direct microscopy. Detailed distributions are presented in Table 3.

The most common symptoms in pediatric patients were diarrhea, abdominal pain, fever, and colitis. *E. histolytica* caused the highest diarrhea rate (16%), followed by *B. hominis* (4%) and *G. duodenalis* (3%). *C. parvum* was observed more frequently in patients with abdominal pain and diarrhea, whereas *E. vermicularis* was observed more frequently in febrile patients. No significant association was found between symptoms and parasite species ($p>0.05$). Distribution details are presented in Table 4.

When the monthly and seasonal distributions of parasite-positive cases were examined as proportions of the total cohort (n=300), September accounted for the largest share (21/300, 7%). By season, the distribution of positive cases within the total cohort was as follows: autumn 33/300 (11%), summer 22/300 (7.4%), spring 14/300 (4.7%), and winter 9/300 (3%) (Table 5). As these values represent proportions of the total cohort rather than within-month or within-season positivity rates, they reflect the temporal distribution of positive cases instead of monthly or seasonal prevalence. No significant differences were found in the monthly or seasonal distribution ($p>0.05$).

Discussion

In this study, the prevalence of intestinal parasitic infection was 26% among pediatric patients with gastrointestinal symptoms. Similar studies from Türkiye show substantial regional variation, with higher rates reported in Kocaeli and Iğdır (39% and 35%) and lower rates in Denizli and Konya (10.2% and 6.4%) (24-27). These differences likely reflect regional climate, socioeconomic conditions, hygiene levels, and diagnostic methods. International data also demonstrate heterogeneity: high prevalence in Peru and Malaysia (42% and 40.4%) indicates inadequate sanitation, whereas lower rates such as 20.1% in Chile reflect

Table 1. Distribution of the frequencies and associations of the identified parasites

Parasites	n	%
E. histolytica	68	22.7
C. parvum	7	2.3
G. duodenalis	12	4
B. hominis	18	6
E. vermicularis	2	0.7
E. histolytica + *G. duodenalis*	2	0.7
E. histolytica + *B. hominis*	13	4.3
G. duodenalis + *B. hominis*	1	0.3
E. histolytica + *Enterobius vermicularis*	1	0.3
E. histolytica + *C. parvum* + *G. duodenalis*	5	1.6
E. histolytica + *C. parvum* + *B. hominis*	1	0.3

E. histolytica: Entamoeba histolytica, G. duodenalis: Giardia duodenalis, B. hominis: Blastocystis hominis, C. parvum: Cryptosporidium parvum, E. vermicularis: Enterobius vermicularis

stronger health systems (28-30). The 30.4% prevalence reported in China is comparable to our findings (31). The epidemiological distribution of intestinal parasite infections in the pediatric age group is determined by the interaction of several factors, including environmental conditions, hygiene, and socioeconomic status. While some studies report higher positivity rates in older children, several investigations have identified peak prevalence among children aged 0-5 years (32-37). In our study, we detected that the 0-2 age group accounted for the largest share of parasite-positive cases within the total cohort. In early childhood, increased oral exploratory behaviour, immature hand hygiene, and immature immune function likely contribute to this susceptibility.

A comprehensive meta-analysis conducted in Iran found a 38% prevalence of intestinal parasites, with *E. vermicularis* (16.5%) and *G. duodenalis* (15.1%) identified as the predominant pathogens (38). In a study of 2000 pediatric patients in Bangladesh, *Entamoeba dispar* (*E. dispar*) (6.5%) and *E. histolytica* (4.2%) were found to be the main pathogens (38,39). In epidemiological studies conducted in Türkiye, regional differences were found. *G. duodenalis* was reported as the predominant parasite in Denizli (26), Van (40) and Manisa (37) provinces, while *B. hominis* was found in Iğdır (25). In another study conducted in Van, *G. duodenalis* and *B. hominis* were reported as co-dominant pathogens (36). In our study, the highest prevalence was found for *E. histolytica* (22.7%), followed by *B. hominis* (6%), *G. duodenalis* (4%), *and E. vermicularis* (0.7%). The lower prevalence of *B. hominis* compared with the rates reported in some studies in the literature (40-42) may be due to the ongoing debate about the pathogenicity of this organism and the lack of standardisation of diagnostic criteria across laboratories.

In infectious gastroenteritis caused by intestinal parasites, macroscopic examination of faecal samples is an important part of the diagnostic algorithm. In the study conducted by Çiçek and Yılmaz (40) on a pediatric cohort with gastrointestinal symptoms, it was reported that stool samples with parasite positivity were predominantly watery or excessively watery in consistency, while a mucoid character was observed less frequently. Similarly, the study by Doğan et al. (43), which investigated methodological differences in the laboratory diagnosis of intestinal parasites, emphasised that the presence of mucus in the stool has a predictive value for parasitic infection. In our study, 39 (50%) of the 78 faecal samples that were positive for parasites had a watery, mucoid

Table 2. Distribution of parasite-positive cases across age groups

Age (year)	*E. histolytica*		*C. parvum*		*E. vermicularis*		*B. hominis*		*G. duodenalis*	
	n	%	n	%	n	%	n	%	n	%
0-2	21	7	2	0.7	1	0.3	8	2.7	5	1.7
3-5	10	3.3	1	0.3	0	0	0	0	2	0.7
6-10	21	7	3	1	1	0.3	3	1	3	1
11-14	9	3	0	0	0	0	2	0.7	0	0
15-18	7	2.3	1	0.3	0	0	5	1.7	2	0.7
Total	68	22.7	7	2.3	2	0.7	18	6	12	4

All percentages reflect proportions of the total study cohort (n=300). *E. histolytica: Entamoeba histolytica, G. duodenalis: Giardia duodenalis, B. hominis: Blastocystis hominis, C. parvum: Cryptosporidium parvum, E. vermicularis: Enterobius vermicularis*

Table 3. The distribution of parasite species according to diagnostic methods

Parasites	Microscopy				Flotation				Sedimentation				ICT method			
	+	%	-	%	+	%	-	%	+	%	-	%	+	%	-	%
E. histolytica	63	21	5	1.7	45	15	23	7.7	50	16.7	18	6	63	21	5	1.7
C. parvum	6	2	1	0.3	6	2	1	0.3	6	2	1	0.3	7	2.3	0	0
E. vermicularis	2	0.7	0	0	0	0	2	0.7	1	0.3	1	0.3	0	0	2	0.7
B. hominis	17	5.7	1	0.3	11	3.7	7	2.3	12	4	6	2	0	0	18	6
G. duodenalis	9	3	3	1	9	3	3	1	10	3.3	2	0.7	11	3.7	1	0.3

ICT: Immunochromatographic rapid test, (+): Positive, (-): Negative, *E. histolytica: Entamoeba histolytica, G. duodenalis: Giardia duodenalis, B. hominis: Blastocystis hominis, C. parvum: Cryptosporidium parvum, E. vermicularis: Enterobius vermicularis*

Table 4. The distribution of parasite species according to clinical symptoms

Symptoms	*E. histolytica*		*B. hominis*		*G. duodenalis*		*C. parvum*		*E. vermicularis*	
	n	%	n	%	n	%	n	%	n	%
Nausea-vomiting	30	10	7	2.3	5	1.7	2	0.7	1	0.3
Abdominal pain	30	10	9	3	9	3	5	1.7	0	0
Diarrhea	48	16	12	4	9	3	5	1.7	1	0.3
Colitis	28	9.3	7	2.3	6	2	3	1	0	0
Fever	21	7	5	1.7	4	1.3	4	1.3	2	0.7

Table 5. Distribution of detected parasite species by months and seasons*

		E. histolytica		*C. parvum*		*G.duodenalis*		*B. hominis*		*E. vermicularis*		Total	
		n	%	n	%	n	%	n	%	n	%	n	%
Spring	March	3	1	1	0.3	2	0.7	0	0	0	0	6	2
	April	0	0	0	0	0	0	0	0	0	0	0	0
	May	7	2.3	1	0.3	0	0	5	1.7	1	0.3	8	2.7
Summer	June	6	2	2	0.7	3	1	2	0.7	0	0	6	2
	July	5	1.7	0	0	1	0.3	2	0.7	0	0	5	1.7
	August	11	3.7	0	0	0	0	1	0.3	1	0.3	11	3.7
Autumn	September	19	6.3	2	0.7	3	1	2	0.7	0	0	21	7
	October	5	1.7	0	0	0	0	2	0.7	0	0	6	2
	November	3	1	0	0	2	0.7	2	0.7	0	0	6	2
Winter	December	3	1	0	0	0	0	1	0.3	0	0	3	1
	January	4	1.3	1	0.3	1	0.3	1	0.3	0	0	4	1
	February	2	0.7	0	0	0	0	0	0	0	0	2	0.7

*All percentages reflect proportions of the total study cohort (n=300)

consistency, and this finding was statistically significant ($p<0.05$). This result indicates a significant correlation between the macroscopic characteristics of faecal samples and the presence of parasitic infection. Careful documentation of faecal consistency, the presence of mucus, and other macroscopic parameters can provide additional information for parasitological examination and thus contribute to an increased detection rate.

Laboratory diagnostic methods for intestinal parasites show considerable heterogeneity. Yula et al. (33) reported commercial test kits had the highest detection rate, Çiçek and Yılmaz (40) found trichrome staining superior, while Karakuş et al. (25) demonstrated modified acid-fast staining performed best. In our study, ICT achieved the highest detection rate, followed by native-Lugol, sedimentation, and flotation techniques.

In parasite-specific diagnostic evaluation, *E. histolytica*, the predominant pathogen, was detected at equal rates (21%) by direct microscopy and ICT. ICT was more efficient at detecting *G. duodenalis* (3.7%) and *C. parvum* (2.3%), whereas native Lugol's showed higher detection rates for *B. hominis (5.7%) and E. vermicularis* (0.7%). Çiçek and Yılmaz (40) found *Cryptosporidium* spp. (predominant pathogen) was best detected by trichrome staining. These results emphasise that the different diagnostic approaches have detection-rate profiles specific to parasite species, and that a multimodal approach is required for optimal diagnosis.

Literature reports parasite positivity most commonly in patients with abdominal pain (78%) and nausea (51.7%) (24,25), while other studies note diarrhea, fever, vomiting, growth retardation, weakness, and loss of appetite (40). In our study, the main symptoms were diarrhea, abdominal pain, fever, gastroenteritis, colitis, and nausea and vomiting. Parasite positivity was highest in diarrhea cases, followed by nausea and vomiting; however, no significant correlation was found between symptoms and parasite positivity or parasite species ($p>0.05$). Symptoms of parasitic infections are typically non-specific, requiring comprehensive medical evaluation and laboratory testing.

The seasonal distribution of parasitic infections varies depending on precipitation, climate, and geography. The literature reports that parasites of the gastrointestinal tract are most frequently detected in the summer and autumn months (35,44). In India, it has been reported that increased rainfall, flooding and contamination, especially in the summer months, can increase the parasite detection rate up to 97.4% (45). In our study, positive cases peaked in autumn, particularly in September, but no statistically significant correlation was found between the distributions by month and by season ($p>0.05$).

Study Limitations

This study has several limitations. It was conducted at a single center, which may limit the generalizability of the results. Although multiple diagnostic methods were used, microscopy remains operator-dependent, which may affect detection accuracy. The study did not include molecular tests, which could have improved the detection rate for some parasites. In particular, although the ICT used in this study specifically detects *E. histolytica* antigens, the absence of molecular confirmation represents a limitation, as the possibility of misidentification with *E. dispar* cannot be entirely excluded. Nonetheless, these limitations do not undermine the overall contribution of the study, which provides valuable data on prevalence patterns and the comparative performance of commonly used diagnostic methods in pediatric parasitic infections.

Conclusion

In this study, ICTs showed a higher detection rate for gastrointestinal parasites than conventional microscopy, suggesting that ICT may be a useful complement to microscopic methods in pediatric settings. The significant association between stool consistency, particularly watery or

mucoid stools, and parasitic infection serves as an important clinical screening indicator for pediatricians in emergency and outpatient settings. These findings emphasize the value of integrating rapid diagnostic tools with clinical evaluation to improve the accuracy, efficiency, and patient-centeredness of management for pediatric parasitic infections.

Ethics

Ethics Committee Approval: The study was approved by the Karabük University Non-Interventional Ethics Committee (decision number: 2022/787, date: 20.01.2022).

Informed Consent: Informed consent was not required, as the study used only anonymized routine clinical stool samples and associated data.

Footnotes

Authorship Contributions: Surgical and Medical Practices - M.A.İ., E.D.; Concept - M.A.İ., M.Y.Ç.; Design - M.Y.Ç.; Data Collection or Processing - M.A.İ., M.Y.Ç., E.D.; Analysis or Interpretation - M.A.İ., M.Y.Ç., E.D.; Literature Search - M.A.İ., M.Y.Ç., E.D.; Writing - M.A.İ., M.Y.Ç.

Conflict of Interest: No conflict of interest was declared by the authors.

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