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Research Article

Prevalence of Parasitic Infections in Children of Some Rural and Suburban Areas in Wasit Province, Iraq

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About Article

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ABSTRACT

Intestinal parasitic infections are a public health burden and a major cause of illness in many countries worldwide. The diseases lead to various health threats including growth retardation and mental health-related disorders, especially in children. The study aims to investigate the prevalence and typing of the species of intestinal parasites among children of both sexes who undergoing different abdominal disturbances in some rural and suburban areas located in Wasit province (Iraq). A total of 500 children of <10 years old and both sexes with a history of abdominal disturbances (diarrhea, abdominal pain, and/or anemia) were selected from different rural and sub-urban areas in Wasit province (Iraq). Fresh fecal samples were collected into plastic containers and examined traditionally using three diagnostic methods: direct saline/iodine wet mount, acid fast stain, and cellophane tape. This study revealed that 46.8% of the study population was infected with at least one intestinal parasite. Subsequently, single infection was shown in 78.21%; while, mixed infections were seen in 21.79% of the study population. According to the number of parasites identified in each mixed infection, 82.35%, 15.69%, and 1.96% were reported with two, three, and four parasites, respectively. In single infections, the prevalence rate of *Entamoeba histolytica* and *Enterobius vermicularis* was the highest whereas *Balantidium coli*, *Trichuris trichiura*, *Strongyloides stercoralis*, *Taenia* spp., and *Hymenolepis nana* were the lowest. According to sex, the prevalence rate of intestinal parasites was significantly higher in males (69.66%) than in females (30.34%). According to study areas, our findings revealed that intestinal parasitic infections were, significantly more prevalent in suburban (54.7%) than rural (45.3%) areas. According to the findings of this study, different intestinal parasitic infections can infect children of both sexes in rural and suburban areas; however, the prevalence rate of these species is varied significantly in relation to each factor. It is important to understand the prevalence and effects of each infection among various areas and the association of each parasite to different risk factors such as age, sex and area in order to effectively implement therapeutic interventions and prevention controls.

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1. INTRODUCTION

Affecting roughly 3.5 billion people annually, intestinal parasitic infections are among the most prevalent infectious diseases. They result in over 450 million health issues, such as diarrhea, abdominal pain, undernutrition, general malaise and weakness, and stunted growth and physical development (El-Sayed & Ramadan, 2017; Rahman, 2022). In regions where soil-transmitted helminths, a leading source of intestinal parasitic diseases, are prevalent, more than 267 million preschool-aged and 568 million school-aged children reside (Riaz *et al.*, 2020). Another method parasitic diseases may spread is via foodborne parasite infections. Up to 2010, there were 45,927 recorded fatalities and 23.2 million cases of foodborne parasite illness (not including enteric protozoa), according to the WHO. Foodborne enteric protozoa were responsible for an additional 67.2 million instances of disease (Torgerson *et al.*, 2015; Chávez-Ruvalcaba *et al.*, 2021; Gemechu & Aliyo, 2024). According to Abdoli *et al.* (2024), severe infections caused neurological and mental disorders as well as significant impairment. Children are particularly vulnerable to these illnesses, and they often get infected again (Fauziah *et al.*, 2022).

2. LITERATURE REVIEW

Because of their underdeveloped immune systems, children are especially susceptible to infections (Simon *et al.*, 2015). The immune system is still maturing and not yet completely formed in early life. Important early protection is provided by the passive transmission of IgG antibodies via nursing, which is often done until the kid is two years old. Two food-related nondirective feeding behaviors in toddlers and preschoolers, food neophobia and fussiness/picky eating, may result in a restricted, unhealthy diet that negatively impacts their weight and nutritional status (Lloyd & Saglani, 2017; Fouda *et al.*, 2018; Baranowski *et al.*, 2021). They are more likely to have parasite infections as their sensory activities, such taste and touch awareness, grow (Lieberman *et al.*, 2018). By 2030, the WHO wants to eradicate childhood stunting and the mortality and morbidity associated with intestinal parasite infections in preschool-aged children (Raj *et al.*, 2022; Gabain *et al.*, 2023).

Intestinal parasite infections can now be diagnosed using a number of diagnostic techniques that have been developed with greater sensitivity and specificity. However, the majority of these tools are only suitable for in vitro research and are very costly to apply to large numbers of samples (Al-Abedi *et al.*, 2022; Gharban, 2022; Al-Eodawee *et al.*, 2023). However, because to their simplicity, speed, and affordability, traditional approaches continue to be more useful in the field. Numerous research conducted in Iraq have shown that it is still unknown how common intestinal parasites are in the various regions of Wasit province. Thus, the goal of the current research is to find out how common intestinal parasites are and what species they are in children who are experiencing various gastrointestinal problems in different rural and suburban districts of Wasit province (Iraq).

3. METHODOLOGY

3.1. Samples

A total of 500 children of <10 years old and both sexes with a history of abdominal disturbances (diarrhea, abdominal pain, and/or anemia) were selected from different rural and sub-urban areas in Wasit province (Iraq). Each study patient was subjected to the collection of fresh fecal samples into disposable plastic containers, with adding 10% of formalin solution to avoid of egg hatching (Gharban *et al.*, 2022).

3.2. Diagnostic methods

Direct saline/iodine wet mount

This method was made by mixing a small quantity of feces in 1-2 drops of saline and a drop of iodine on a clean glass slide, covered with cover-slip and examined under low power objective (10X) and low light to detect of trophozoites and cysts of protozoa, and eggs and larvae of helminthes (Zaman *et al.*, 2017).

3.3. Acid fast stain

Modified Ziehl-Neelsen stain method was used to detect of coccidian protozoa, in particular, the oocysts of *Cryptosporidium* species as following: fecal smears was made directly from stool sample, dried with air, fixed with methanol for 3 minutes, stained with strong carbol fuchsin 20 minutes, rinsed with tap water, decolorized in acid alcohol for 20 seconds, rinsed with tap water, counterstained with 0.4% malachite green for 40 seconds, rinsed with tap water, dried, and finally examined using 40X and 100X, (Harrington, 2008; Noor *et al.*, 2012).

3.4. Cellophane tape method

This test was used to identify the worm or eggs of pinworm parasite. Using a clear cellophane tape, the sticky side was pressed firmly against the skin and extended within the anal opening (about 2-3 centimeters) for few seconds. Gently, the sticky side of cellophane tape was placed against the surface of the clear glass slide, removed, and examined under the microscope using the lower power (10X) objective (Calik *et al.*, 2011).

3.5. Statistical analysis

Two computer applications, Microsoft Office Excel and GraphPad Prism Software, were used to input, table, figure, and evaluate all of the diagnostic results that were acquired as well as the data that was gathered about sex and residency. To find significant differences in the P-value at less than 0.05, the t-test and One-Way Analysis of Variance (ANOVA) were used (Gharban *et al.*, 2024).

3.6. Ethical approval

Both the College of Veterinary Medicine at the University of Wasit (Wasit, Iraq) and the Medical Laboratory Technologies Department at Kut University College authorized the current work.

4. RESULTS AND DISCUSSION

Microscopic examination of totally 500 fresh fecal samples revealed that 234 (46.8%) were having at least one parasitic infection (Figure 1). According to type of infection, single infection was shown in 78.21% (183/234) children; while, mixed infections were seen in 21.79% (51/234) of study population

(Figure 2). According to number of parasites identified in mixed infection, 82.35% (42/51), 15.69% (8/51) and 1.96% (1/51) were reported with two, three and four parasites, respectively (Figure 3). In single infections, prevalence rate of intestinal parasites was varied significantly in study population (Table 1). Significantly, prevalence rate of *Entamoeba histolytica* (25.08%) and *Enterobius vermicularis* (20.68%) was the highest whereas *Balantidium coli* (4.07%), *Trichuris trichiura* (3.05%), *Strongyloides stercoralis* (2.71%), *Taenia* spp. (1.36%), and *Hymenolepis nana* (0.34%) were the lowest when compared to other parasitic infections; *Ancylostoma duodenale* (15.59%), *Cryptosporodium* spp. (12.88%), *Ascaris lumbricoides* (7.8%), and *Enterobius vermicularis* (6.44%).

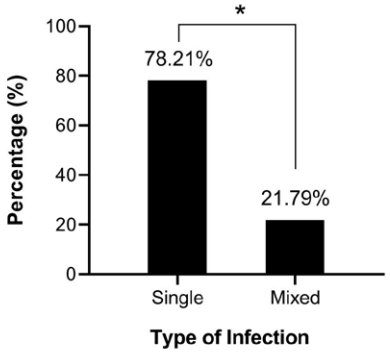

Figure 2. Prevalence rate of intestinal parasites according to type of infection

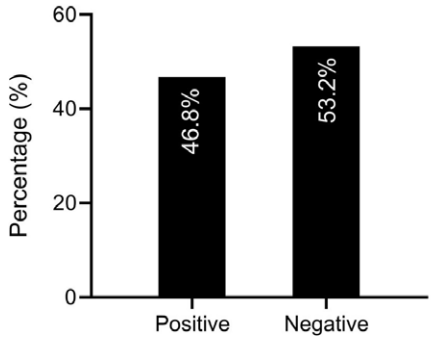

Figure 1. Total results for examination of fresh fecal samples of study children (Total no: 500)

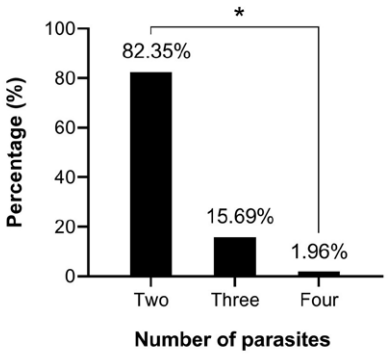

Figure 3. Number of intestinal parasites identified in mixed infections of study population

Table 1. Prevalence rate of different intestinal parasitic species among the single infections

No.	Parasite	Positive	
		No.	%
1	*Ancylostoma duodenale*	46	15.59
2	*Ascaris lumbricoides*	23	7.8
3	*Balantidium coli*	12	4.07
4	*Cryptosporodium* spp.	38	12.88
5	*Entamoeba histolytica*	74	25.08
6	*Enterobius vermicularis*	19	6.44
7	*Giardia lamblia*	61	20.68
8	*Hymenolepis nana*	1	0.34
9	*Strongyloides stercoralis*	8	2.71
10	*Taenia* spp.	4	1.36
11	*Trichuris trichiura*	9	3.05
p-value		**0.0047** **	

According to sex of study population, the results of current study showed that the prevalence rate of intestinal parasites was significantly higher (p<0.0239) in males [69.66% (163/234)] than females [30.34% (71/234)], (Figure 4).

Concerning the type of infection, insignificant differences were detected between single and mixed infections in both males [31.15% (57/183) and 27.45% (14/51), respectively] and females [68.85% (126/183) and 72.55% (37/51], (Table 2). Regarding the association between parasitic species and sex of study population, females were appeared at significant higher risk of infection (p<0.0003) with *Enterobius vermicularis* (26.32%), *Ancylostoma duodenale* (23.91%), *Cryptosporodium* spp.

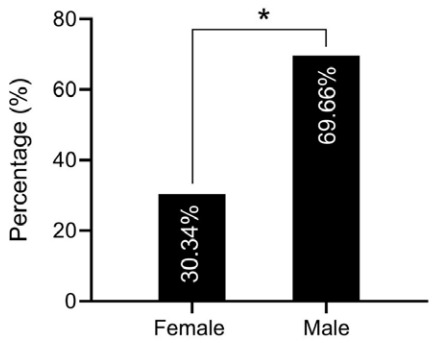

Figure 4. Prevalence rate of intestinal parasites among the females and males of study population

(23.68%), *Trichuris trichiura* (22.22), and *Entamoeba histolytica* (21.62) when compared to other parasitic species; *Balantidium coli* (16.67%), Giardia lamblia (14.75%), *Strongyloides stercoralis* (12.5%), *Ascaris lumbricoides* (8.7%), *Hymenolepis nana* (0%), and *Taenia* spp. (0%); whereas for males, significant increases were observed in *Hymenolepis nana* (100%), *Taenia* spp. (100%) when compared to other parasitic infections including *Ascaris lumbricoides* (91.3%), *Strongyloides stercoralis* (87.5%), Giardia lamblia (85.25%), *Balantidium coli* (83.33%), *Entamoeba histolytica* (78.38%), *Trichuris trichiura* (77.78%), *Cryptosporodium* spp. (76.32%), *Enterobius vermicularis* (73.68%), (Table 3).

According to study areas, our finding revealed that intestinal parasitic infections were, significantly (p<0.0398), more prevalent in suburban [54.7% (128/234)] than rural [45.3% (106/234)] areas (Figure 5). For type of infection, rural areas showed significant (p<0.0227) higher prevalence of single [51.37% (94/183)] more than mixed [23.53% (12/51)] infections; while in contrast in suburban areas, mixed infection [76.47% (39/51)] was significantly (p<0.0139) more prevalent than single [48.63% (89/183)] infection (Table 4).

In rural areas, the more prevalent single parasitic species was *Balantidium coli* (50%) and *Trichuris trichiura* (44.44%) when compared to other parasitic species including *Entamoeba histolytica* (39.19%), *Enterobius vermicularis* (37.7%), *Ancylostoma duodenale* (36.96%), *Ascaris lumbricoides* (34.78%), *Enterobius vermicularis* (26.32%), *Cryptosporodium* spp. (5.26%), *Hymenolepis nana* (0%), *Strongyloides stercoralis* (0%), and *Taenia* spp. (0%). In suburban areas, the more prevalent single parasitic species was *Hymenolepis nana* (100%), *Strongyloides stercoralis* (100%), *Taenia* spp. (100%), and *Cryptosporodium* spp. (94.74%) when compared to *Enterobius vermicularis* (73.68%), *Ascaris lumbricoides* (65.22%), *Entamoeba histolytica* (64.86%), *Ancylostoma duodenale* (63.04%), Giardia lamblia (62.3%), *Trichuris trichiura* (55.56%), and *Balantidium coli* (50%), (Table 5).

Table 2. Type of infection among the females and males of study population

Type of infection	Total No.	Female		Male	
		No.	%	No.	%
Single	183	57	31.15	126	68.85
Mixed	51	14	27.45	37	72.55
p-value		**0.0601**		**0.0667**	

Table 3. Prevalence rate of single parasitic infection among females and males of study population

No.	Parasite	Total No.	Female		Male	
				%	No.	%
1	*Ancylostoma duodenale*	46	11	23.91	35	76.09
2	*Ascaris lumbricoides*	23	2	8.7	21	91.3
3	*Balantidium coli*	12	2	16.67	10	83.33
4	*Cryptosporodium* spp.	38	9	23.68	29	76.32
5	*Entamoeba histolytica*	74	16	21.62	58	78.38
6	*Enterobius vermicularis*	19	5	26.32	14	73.68
7	*Giardia lamblia*	61	9	14.75	52	85.25
8	*Hymenolepis nana*	1	0	0	1	100
9	*Strongyloides stercoralis*	8	1	12.5	7	87.5
10	*Taenia* spp.	4	0	0	4	100
11	*Trichuris trichiura*	9	2	22.22	7	77.78
p-value			**0.0003*** **		**0.0001 **** **	

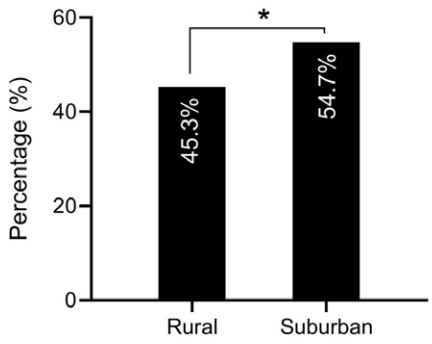

Figure 5. Prevalence rate of intestinal parasites among the rural and suburban areas of study population

4.1. Discussion

In populations in resource-poor tropical and sub-tropical nations, intestinal parasite infestations remain the leading cause of chronic illnesses (Chifunda & Kelly, 2019; Khubchandani & Bub, 2019). Intestinal parasites have shown extraordinary resilience in maintaining a constant population in their hosts, even in the face of efforts to regulate or reduce their incidence in impacted locations (Cable *et al.*, 2017). The degree to which intestinal parasites may exacerbate the clinical manifestations of diarrhea, abdominal discomfort, and/or anemia is not well recognized (Ananthakrishnan & Xavier, 2020). According to the current study's findings, intestinal parasite infestations affected 46.8% of the patients. The prevalence of intestinal parasites varies greatly, according to numerous previous studies

Table 4. Type of infection among the rural and suburban areas of study population

Type of infection	Total No.	Rural		Suburban	
		No.	%	No.	%
Single	183	94	51.37	89	48.63
Mixed	51	12	23.53	39	76.47
p-value		**0.0227** *		**0.0139** *	

Table 5. Prevalence rate of single parasitic infection among the rural and suburban areas of study population

No.	Parasite	Total No.	Rural		Suburban	
			No.	%	No.	%
1	*Ancylostoma duodenale*	46	17	36.96	29	63.04
2	*Ascaris lumbricoides*	23	8	34.78	15	65.22
3	*Balantidium coli*	12	6	50	6	50
4	*Cryptosporodium* spp.	38	2	5.26	36	94.74
5	*Entamoeba histolytica*	74	29	39.19	45	64.86
6	*Enterobius vermicularis*	19	5	26.32	14	73.68
7	Giardia lamblia	61	23	37.7	38	62.3
8	*Hymenolepis nana*	1	0	0	1	100
9	*Strongyloides stercoralis*	8	0	0	8	100
10	*Taenia* spp.	4	0	0	4	100
11	*Trichuris trichiura*	9	4	44.44	5	55.56
p-value			**0.0018** **		**0.0291** *	

conducted in Iraq and other neighboring countries. These include: 46.53% (Alshawi *et al.*, 2013) and 57.95% (Hussein *et al.*, 2011) in Iraq; 10.66% (Arani *et al.*, 2008) and 38% (Daryani *et al.*, 2017) in Iran; 32.2% (Al-Shammari *et al.*, 2001) and 47.01% (Wakid, 2010) in the Kingdom of Saudi Arabia; 44.6% (Doni *et al.*, 2015) and 60% (Quihui-Cota *et al.*, 2017) in Turkey; 85% in Lebanon (Osman *et al.*, 2016); 10.2% in Qatar (Abu-Madi *et al.*, 2010); 64.45% in Sudan (Gabbad & Elawad, 2014); 7.7% in the United Arab Emirates (Dash *et al.*, 2010); and 58.7% in Yemen (Al-Haddad & Baswaid, 2010). In comparison to earlier research, the relatively stable prevalence of intestinal parasites in Iraq may be explained by a lack of knowledge and health education, the effects of contaminated environments, especially water resources, and the lack of widespread and practical improvements to sanitary conditions and health services.

The findings that are consistent with the findings of studies by Aly and Mostafa (2010) and Zaglool *et al.* (2011) regarding single and mixed infections may be related to patients' unsanitary practices, the presence of asymptomatic carriers who are constantly at risk of spreading the infection within their community, and the consumption of tainted food and water that contains pathogenic parasites (Qadri & Khalil, 1987; Mehraj *et al.*, 2008).

Males had a much larger intestinal parasite infestation than

females, which was in conflict with Imam *et al.* (2015) and Amer *et al.* (2018) and correlated with Hussein *et al.* (2011) and Osman *et al.* (2016). These results may be explained by the fact that men spend the majority of their time on the streets, where they are exposed to pollutants while playing in the dirt and swimming in rivers, especially in the summer.

According to this research, there were notable differences in intestinal parasites between rural and suburban settings. Rural residents may be at risk for intestinal parasite infections due to social and environmental factors such as proximity to parasite sources, lack of access to clean water, and direct animal interaction.

5. CONCLUSION

Children of both sexes in rural and suburban settings may get various intestinal parasite infections, according to the study's results; however, the prevalence rate of these species varies greatly depending on each component. To properly apply therapeutic treatments and preventative measures, it is critical to comprehend the incidence and consequences of each infection in diverse regions as well as the correlation between each parasite and numerous risk variables, including age, sex, and location. The present results need more evidence, and future studies should include behavioral, socioeconomic, seasonal, regional, and deworming program aspects. Health professionals may concentrate more on creating suitable and focused treatments when they analyze the particular kind of parasite that is causing the infection. Lastly, control operations should focus on younger, often asymptomatic age groups to minimize environmental contamination from egg dispersion if parasite transmission is to be totally eliminated.

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