



Intestinal Parasitic Infection and their Hematological Impact among Infants and Children in Duhok/ Iraq

Zaynab M. Haji

Department of Biology/ College of Science/ University of Zakho/ Kurdistan Region/ Iraq

Wijdan M. S. Mero

*Department of Medical Microbiology/ College of Science/ Knowledge University/ Kirkuk Road
44001/ Erbil/ Iraq*

p-ISSN: 1608-9391

e-ISSN: 2664-2786

Article information

Received: 2/6/2025

Revised: 12/7/2025

Accepted: 6/8/2025

DOI:

10.33899/rsci.v35i3.65254

corresponding author:

Zaynab M. Haji

zaynab.haji@staff.uoz.edu.krd

ABSTRACT

This cross-sectional study estimated the prevalence of intestinal parasites among 550 infants and children of both genders aged <1-15 years and evaluated their effects on some blood parameters in Duhok province, Iraq. The study started from September 2024 to February 2025. The samples were obtained from Hevi Pediatric Hospital and some Private Clinics. Stool samples, were examined macroscopically, followed by microscopic examination using Direct Wet Mount, Zinc Sulfate Concentration and Modified Ziehl-Neelsen Technique to detect *Cryptosporidium* spp. The overall prevalence of intestinal parasites was 21.27%, males reported insignificantly higher parasite prevalence than females (22.03% vs 20.45%). Ages of <1-5 years exhibited the highest prevalence (24.87%). Protozoa constituted 23.27%, with 18.73% for *Entamoeba* spp., while Helminthes were detected in only 1.09% of the cases. Infected children showed insignificantly lowered mean Hb, and the RBCs mean count among males only. Whereas, among female was significantly high ($P=0.032$) lowered the mean counts of WBCs and eosinophils among both genders were insignificantly increased.

Whereas, a high significant ($P=0.0015$) increase of eosinophils occurred among children aged 11-15 years. In conclusion this study revealed a high prevalence of intestinal parasites among infants and children particularly males and small ages. Parasitic infection insignificantly lowered mean Hb and RBCs count particularly in females. While the mean WBCs were insignificantly increased and eosinophil's counts were high significantly increased especially among ages of 11-15 years. This situation requires further detailed studies.

Keywords: Blood parameters, Intestinal parasites, Infectious diseases, Prevalence. Insulin resistance

INTRODUCTION

Globally, intestinal parasitic infections are a major source of mortality and morbidity (Farrell *et al.*, 2018). The risk of getting these diseases is increased in underdeveloped country due to inadequate sanitation and sanitary practices (Hakizimana *et al.*, 2023). Approximately 3.5 billion individuals are thought to be impacted, and 450 million people, mostly children, are ill as a result of these diseases (Damen *et al.*, 2011; Ahmed, 2023). Intestinal parasites most frequently affect infants and children, which can stunt their growth and raise their chance of contracting other illnesses, including giardiasis, amoebiasis, and ascariasis, which typically afflict children under five (Hakizimana *et al.*, 2023). Protozoa and helminths are the two main categories which inhibit the human gastrointestinal tract (Harhay *et al.*, 2010). Since these infections can result in iron deficiency anemia, retardation in the development, and other physical and mental health issues, they are considered a major public health concern (Siddig *et al.*, 2017)

Worldwide, intestinal protozoan infections are often widespread. They are a primary contributor to diarrheal illnesses. *Giardia lamblia*, *Cryptosporidium parvum*, and *E. histolytica* are the protozoan parasites that are most commonly found in stool samples. *C. parvum* is now known to be a significant contributor to diarrhea in young children and individuals with weakened immune systems (Ismael *et al.*, 2024). They are characterized by stomach discomfort, vomiting, flatulence, and weight loss. Diarrhea symptoms can be severe in young children, as well as in those who are malnourished or possess compromised immune systems. Alongside protozoa, intestinal infections caused by some helminthic parasites impose a significant burden on impoverished nations.

Hymenolepis nana has a worldwide distribution and is regarded as the most common tapeworm affecting children (Shahnazi *et al.*, 2019). Hemoglobin levels may decrease in some pathological conditions, including parasite infections, malnutrition, hemorrhage, and persistent infections leading to anemia. Packed cell volume is associated with anemia, since a reduction in packed cell volume occurs due to particular diseases, including anemia. White blood cells are fundamental constituents of blood, and serve to confer resistance against pathogens, parasites, tumors, and many illnesses (Al-Mozan *et al.*, 2017). Reduced hemoglobin, packed cell volume, and red blood cell count are common in individuals with some parasitic infections. On the other hand, parasitic infections tend to increase white blood cell numbers, particularly eosinophil's (Al-Hasheme *et al.*, 2020). Considering these facts, the current study was adopted to gain an insight into the prevalence of Intestinal Parasitic Infections (IPI) in infants and children and to determine their effects on some blood parameters among infected subject in Duhok province/Iraq.

MATERIALS AND METHODS

Study subject

A total of 550 stool samples were randomly obtained from infants and children with 50 blood samples (25 from children without any gastroenteritis symptoms and free from intestinal parasites used as control, and other 25 from those with parasitic infection) between September 2024 and February 2025 including both genders, and different ages (<1 – 15 years) from Hevi Pediatric Hospital and some Private clinics in Duhok City. Gender, age, and other study-related data were entered into a unique questionnaire form, which was then utilized for data analysis.

Ethical consideration

An ethical approval was taken before performing the study from the General Directorate of Duhok Health (no. 25092024-8-6) for taking patients samples, consent and Data.

Laboratory analysis

Stool examination: The obtained stool samples were examined by:

1. Macroscopic examination

The macroscopic analysis of stool samples focused on different characteristics, including color, consistency, texture, and the presence of blood, mucus, or helminth segments. The examination revealed a range of colors in the feces, particularly yellow, brown, semi-brown, and greenish tones.

2. Microscopic examination:

For microscopic examination the following methods were used:

1. Direct wet mount method:

To look for parasitic stages including cysts, trophozoites, eggs, larvae, and helminthic segments. A small fleck from each stool sample was taken using a wooden stick and emulsified in a drop of normal saline. A drop of Lugol's iodine was then added to stain it and smeared on a clean slide, in a region around 2 cm in diameter. Thereafter covered with a coverslip and observed under the microscope. Suspicious items are analyzed via high-power objective lenses (40X) and (100X) with oil immersion to detect parasites. At least three smears were prepared from different part of each stool sample and examined.

2. Concentration method using zinc sulfate flotation technique

In order to identify protozoan cysts, helminthic eggs and larvae the Zinc Sulfate Flotation Technique was used (Inês *et al.*, 2016). Two grams of each stool sample were combined with 10–12 milliliters of normal saline and then stirred with a glass rod. Large particles were removed from the mixture by passing it through two layers of moist surgical gauze, even though protozoan trophozoites cannot be found using this procedure since they would disintegrate. For two minutes, the supernatant was centrifuged at 1500–2000 rpm. This process was carried out three times; each time, the sediment was resuspended in normal saline, the supernatant liquid was decanted, and finally the tube was filled to half inch to the rim with Zinc Sulfate solution (specific gravity of 1.18) the mixture was stirred, then centrifuged for 1.5 minute at 1500 rpm. The tube contents were poured into a rack tube, stirred and left for one minute to stand. Finally, 2 loops full from the surface was placed on a clean glass slide into a drop of normal saline and a drop of iodine, mixed, covered with coverslip and observed under the microscope using (40x) and (100x) magnifications.

3. Modified Ziehl-Neelsen (MZN): For the detection of *Cryptosporidium* spp.

A smear was prepared directly from each stool sample. After that, it was left to dry in the open air or on a slide warmer set at 40°C. After that, following a one-minute thorough flooding with Carbol fuchsin for 1 minute, the slide was rinsed with deionized distilled water and destained with acid alcohol for thirty seconds. This process was repeated three times and then rinsed again with the same water. Methylene blue was applied for two minutes, followed by a fast wash with distilled water and a slide-dryer drying period of around five minutes, covered with a coverslip, and observed under 40x. We verified the interior morphology using 100x oil immersion objectives.

Blood examination

Blood samples were taken from infected and non-infected children (used as control). Two milliliters of blood was withdrawn from the vein of each child using a sterile syringe then placed in an EDTA tube with an anticoagulant that has been fully labeled and used to estimate the complete blood count (CBC) by Coulter count. Included: hemoglobin mean level, RBCs, WBCs mean counts and WBCs differential mean count.

Exclusions and inclusions criteria

All participants or their accompanying parents who were willing to offer informed permission and consented to provide specimens, as well as those not presently using anti parasitic or antimicrobial drugs, and healthy children to be used as control were included in this study. On the other hand, this research excluded individuals who refused to provide adequate amount of blood/ or to give stool sample, who did not sign informed permission, or were currently receiving anti parasitic or antibiotic drugs.

Statistical analysis

After inputting all data into an Excel sheet, the frequency, mean, and standard error were calculated. Then, all data were imported into SPSS (version 25) software, and the prevalence of intestinal parasites was analyzed for significant differences using the Chi-square (χ^2) test and ANOVA test. The relationship between intestinal parasitic infection, blood parameters, and several factors was considered statistically significant at the $P < 0.05$ level as compared to other parameters.

RESULTS AND DISCUSSTION

1. Prevalence of intestinal parasites among infants and children in Duhok province.

A total of 550 stool samples were collected from infants and children. The results revealed an infection rate of 21.27 % (117/550) with different intestinal parasites. as illustrated in (Table 1). According to gender, males showed a higher insignificant ($P=0.652$) infection rate than females (22.03% vs. 20.45%).

Intestinal parasites are considered a significant health issue impacting children in the Kurdistan region, Iraq and worldwide. According to WHO (1998). Amoebiasis, ascariasis, hookworm infection, and trichuriasis are among the ten most common intestinal diseases globally. The Current infection rate with different intestinal parasites is lower than that reported by Ismael *et al.* (2024) which was 27.7% in Duhok city among different ages. Similarly, higher rates have been reported in other studies conducted in Kurdistan region and other parts of Iraq, including the cities of Duhok, Erbil and Baghdad (Salih *et al.*, 2022; Hama and Rahemo, 2014; Saleh, 2023); which were 40.96%, 32.2% and 27.3%, respectively. While lower rates have been reported in Khanaqin and Karbala (Abed, 2020; Al-sultany and Al-Morshidy, 2023) which were 19.37% and 13%, respectively. The difference may be due to the type of population involved in studies or to the number of tested samples or methods of examination.

This study reported insignificantly a higher infection rate among males than females (22.03% vs. 20.45%). Similarly, studies performed in Duhok and Karbala Salih *et al.*, (2022); Al-sultany and Al-Morshidy, (2023) reported higher rates of intestinal parasites among males than females (56.66% vs. 43.33% and 14.1% vs. 11.7%), respectively. While the current results contradict with a study performed in Baghdad, that reported a higher infection rate among females than males at 67.3% vs 32.67% (Saleh, 2023). The higher rates in males may be due to higher outdoor activities of males than females, in addition, androgens cause males to attract leukocytes excessively, which increases the risk of immune-mediated disease, behavioral, immunological, and hormonal variations may be the cause of the difference in infection rates between males and females (Sellau *et al.*, 2020).

Table (1): Prevalence of intestinal parasites among examined stool samples and their relationship to gender.

No. Examined	No. Infected (%)	Males		Females	
		No. Examined	No. Infected (%)	No. Examined	No. Infected (%)
550	117 (21.27)	286	63 (22.02)	264	54 (20.45)

$X^2 = 0.203$

P value= 0.652

2. The detected parasite species

As regard to parasite species, the results revealed an infection rate of 24.36% (134/550) this rate is higher than the total prevalence due to the presence of more than one parasite in the same sample as illustrated in (Table 2). Protozoa constituted the highest rate of 23.27% (128/550), while helminthes were only 1.09%. Among protozoan, 18.73% (103/550) were infected with *Entamoeba* spp., while other protozoa were reported at low rates. Among Helminthes the most encountered species was *A. lumbricoides* eggs which was detected in 3 cases, constituting 50% of total Helminthes, and very low rates with eggs of *Hymenolepis nana* (0.36%) and *Enterobius vermicularis* (0.18%).

These results are in line with the study conducted in the same city by Hassan and Mero (2020) they reported the highest rate of protozoan infection (95.20%) than helminthic infection (4.80%).

Similarly, in Khanaqin, Abed (2020) reported protozoan infection at 18.13% while 1.24% for Helminthes. Also, in Baghdad/Iraq, Salman *et al.*, (2019) reported higher rate of protozoan infection (15.2%) than the helminthic infection (0.55%). In Duhok city Salih *et al.*, (2022) also reported the highest rate (21.67%) with *Entamoeba histolytica*, followed by *E. vermicularis* (13.48%), *G. lamblia*

(5.46%), *B. hominis* (0.34%). Also, in Erbil/Iraq Al-Daoudy *et al.*, (2021) stated that *E. histolytica* was the most prevalence parasite (80.1%), followed by *G. lamblia* (19.8%) and *H. nana* (0.1%). In Karbala Al-sultany and Al-Morshidy, (2023) reported the highest rate (10.54%) with *E. histolytica*, followed by *G. lamblia* (2.46%), *Cryptosporidium* spp. (0.4%), *H. nana* (0.24%), *E. vermicularis* (0.13%), *T. hominis* (0.03%).

The high prevalence of amoebiasis and the presence of other protozoan and helminthic parasites are attributed to their direct life cycle and transmission in addition to the contaminated water, poor preventive measures and Health awareness all these factors contribute in the prevalence of these parasites (Hadi, 2011).

Table (2): Prevalence of different species of intestinal parasite among studied cases (n=550).

Parasites	No. of infected	% of infection
Protozoa		
<i>Entamoeba</i> spp.	103	18.73
<i>Giardia lamblia</i>	10	1.82
<i>Blastocystis</i> spp.	4	0.73
<i>Cryptosporidium</i> spp.	11	2.0
Subtotal	128	23.27
Helminthes		
<i>Hymenolepis nana</i>	2	0.36
<i>Enterobius vermicularis</i>	1	0.18
<i>Ascaris lumbricoides</i>	3	0.55
Subtotal	6	1.09
Total	134	24.36

3. Disrtibution of intestinal parasites species according to age

The distribution of infection according to age is illustrated in (Table 3). It appears that somewhat the relationship between age and rate of infection is consistent among different ages, with slightly insignificant ($P=0.275$) higher rate (24.87%) among ages of <1-5 years. As regard to parasite species, *Entamoeba* spp. was recorded among all ages with the highest rate (20.16%) among ages of <1-5 years even though it was recorded at high rates among other ages as well. In Duhok city Hassan *et al.* (2023) also recorded highest rate of *E. histolytica* at 35.79% among ages of 6-12 years.

The present results contradict with those of Ismael *et al.* (2024) in Duhok city since they reported the highest rate of 57.1% among ages of 5-9 years. Similarly, Al-sultany and Al-Morshidy (2023) in Karbala city, reported the highest infection rate (17.2%) among children aged 5-10 years.

The increase in the rate of infection with the increase in age may be attributed to different factors, eating street food, children are more active and playing outdoor, or to the poor application of personal hygiene.

Table (3): The distribution of intestinal parasite species according to age.

Age	Number of examined	<i>Entamoeba</i> spp.	<i>G. lamblia</i>	<i>Blastocyst</i> spp.	<i>Cryptosporidi</i> um spp.	<i>H. nana</i>	<i>E. vermicularis</i>	<i>A. lumbricoides</i>	Infected children	% of infected
<1-5	382	77(20.16)	5(1.31)	3(0.79)	8(2.09)		1(0.26)	1(0.26)	95	24.87
6-10	110	17(15.45)	3(2.75)		3(2.73)	1(0.91)		1(0.91)	25	22.73
11-15	58	9(15.52)	2(3.45)	1(1.72)		1(1.72)		1(1.72)	14	24.14
Total	550	103(18.73)	10(1.82)	4(0.73)	11(2)	2(0.36)	1(0.18)	3(0.55)	134	24.36

$X^2= 14.422$

P value =0.275

4. Effect of intestinal parasites on some blood parameters according to gender.

The effect of infection with various species of intestinal parasites on different blood parameters among children from both genders and their comparison with non-infected children is illustrated in (Table 4). It appears that parasitic infection insignificantly lowered the mean Hb level among both genders and the mean RBCs count among males only. Whereas, the mean RBCs count among female children was high significantly ($P=0.032$) lowered in comparison to non-infected females as indicated in (Table 4). Furthermore, the mean counts of WBCs and eosinophils among both genders were insignificantly increased in comparison to non-infected control children.

Variable results in this direction have been reported in previous studies conducted in Iraq, such as in DhiQar and Al-Qadisiya Provinces Daoud *et al.* (2014) and Alomashi and Al-Shabbani (2019) did not find any significant effect of the gender on the mean blood count. On the other hands, in Ramadi city, Khalil (2013) reported a decrease in the level of hemoglobin among infected patient.

Another study in Kerbala by Al-Hasheme *et al.* (2020) recorded decreases in the mean Hb level and RBCs count among infected patient compared to control group. The decrease in certain hematological parameters (RBCs, Hb, and PCV) might be related to the parasite location in intestinal tract, because the parasites that inhibit the proximal parts of intestine like the duodenum and jejunum, where the absorption of essential nutrients, vitamins, iron and other essential elements occur. Such parasites will hinder the absorption of carbohydrates, lipids, vitamins (including D and B12), folic acid, iron, and zinc, the inadequate absorption of these substances mainly iron causes iron deficiency, leading to anemia due to its function in hemoglobin formation (Al-Hasheme *et al.*, 2020).

As for the results of mean WBCs count, the present study reported insignificant increase in the mean number of WBCs in infected children compared to non-infected. These results are in line with the studies performed in Zakho city and Kerbala by Allu (2024) and Al-Hasheme *et al.* (2020) they recorded an increase in mean count of WBCs in infected patient compared to control group. While, disagreed with the study of Khalil (2013) in Ramadi who recorded a decreased-on WBCs mean count among infected children. Leukocytes are essential elements of the immune system, participating in both innate and humoral immune responses. They navigate the circulation and provoke inflammatory and cellular responses to injury or infections (Prinyakupt and Pluempitiwiriyawej, 2015). The decrease or increase in their mean count may be due to the type of immune system of each individual.

Table (4): Mean level of Hb., the mean counts of RBC, WBC and Eosinophil's among infected and non-infected children of both genders.

Gender	Hb g/dl						RBCs count 10 ¹² /L				WBCs count 10 ⁹ /L				Eosinophil's %			
	Infected			Control			Infected		Control		Infected		Control		Infected		Control	
	No.	Mean	SE	No.	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Male	17	12.4	±0.36	17	13.3	±0.36	4.87	±0.25	4.8	±0.17	11.24	±2.44	8.6	±1.11	56.88	±2.13	42.85	±2.07
Female	8	11.4	±0.43	8	13.6	±0.33	4.21	±0.31	5.19	±0.11	8.95	±0.79	8.7	±1.04	48.14	±2.89	39.72	±2.03
	F value = 0.003, P value = 0.959						F value = 4.90, P value = 0.032				F value = 0.46, P value = 0.51				F value = 0.04, P value = 0.84			

5. Effect of intestinal parasites on some blood parameters according to age.

The relationship between age and some blood parameters is illustrated in (Table 5). It appears that the infection insignificantly affected the blood parameters among different ages. The mean value of Hb level and RBCs mean count of infected children of all ages is insignificantly lower as compared with that of non-infected. While the mean WBCs counts were insignificantly increased among infected children at all ages compared to non-infected children. As regard to mean count of eosinophil's, they also insignificantly increased among ages from 2-10 years, except at ages of 11-15 years among which the mean eosinophil count was high significantly ($P=0.0015$) increased.

These results are in line with the studies conducted in DhiQar province by Al-Mozan *et al.*, (2017) and in Kerbala by Al-Hasheme *et al.* (2020) they reported an increase in the mean count of

eosinophil's during parasitic infection. Since the primary cause of increased eosinophil number in the blood is parasitic infections. Eosinophil's function as effectors against parasitic organisms. Parasitic illnesses are associated with a polarized Th2-type immune response, marked by reactive cell types including eosinophils and mast cells (Ustun *et al.*, 2004).

Table (5): Means of Hb level/dl., RBC, WBC and Eosinophil's counts of infected and non-infected children from different ages.

Age	Hb g / dl						RBC Count				WBC Count				Eosinophil's %			
	Infected			Control			Infected		Control		Infected		Control		Infected		Control	
	No.	Mean	SE	No.	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
2-5	12	11.9	±0.41	10	13.1	±0.47	4.6	±0.31	4.8	±0.23	11.3	±2.92	8.2	±0.49	45.2	±1.89	41.6	±2.97
6-10	9	12.4	±0.43	10	13.5	±0.33	4.7	±0.31	4.9	±0.19	9.5	±1.94	9.2	±0.95	59.8	±2.08	36.5	±2.09
11-15	4	12.3	±0.38	5	13.9	±0.32	4.5	±0.33	4.9	±0.09	10.2	±2.24	9.9	±1.83	68.1	±0.86	53.7	±3.19
	F value = 0.06, P value = 0.94						F value = 0.35, P value = 0.71				F value = 1.71, P value = 0.19				F value = 7.37, P value = 0.0015			

6. Effect of infection with different parasite species on blood parameters

The relationship between infection with different parasite species and blood parameters among infected children. The impact of some parasites varies, either increasing or decreasing effect, depending on the species of the parasite as illustrated in (Table 6). The lowest mean level of Hb (12 g/dl) and lowest mean RBCs count were observed among children infected with *Entamoeba* spp. and *Cryptosporidium* spp. Similarly, the highest mean counts of WBCs were also reported among children infected with these parasites. While the highest Eosinophil's mean count was reported among children infected with *Cryptosporidium* spp. only.

The current study results showed significant changes in blood parameters of children infected with *Entamoeba* spp. and *Cryptosporidium* spp., since both of them decreased mean Hb level and RBCs mean count, and increased the mean counts of WBCs and eosinophils. As related to *Entamoeba* spp. the results are partly consistent with those of Allu (2024) in Zakho city, who reported a decrease in mean Hb level and increase in WBCs mean count in patients infected with *E. histolytica* and *G. lambelia*. Also, to a study performed in DhiQar province by Daoud *et al.* (2014) that showed infection with *E. histolytica* and *H. nana* decreased the Hb level in infected patient, and they reported the highest WBCs mean count in cases of infection with *E. histolytica* and *G. lambelia* in addition, infection with *E. histolytica* and *H. nana* caused increases in the mean number of eosinophils.

Table 6: The relationship between infection with some protozoan parasites and the investigated blood parameters among infected children.

Parasites	No. of Infected	Hb g/dl		RBC count 10 ¹² /L		WBC count 10 ⁹ /L		Eosinophil's %	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
<i>Entamoeba</i> spp.	16	12.3	±0.3	4.6	±0.2	10.7	±2.1	51.9	±3.3
<i>G. lambelia</i>	3	13	±0.3	5.1	±0.1	8.9	±1	55	±2.4
<i>Cryptosporidium</i> spp.	6	12	±0.4	4.7	±0.3	11.6	±1.2	61.6	±2.2
Control	Number 25	13.4	±0.3	4.8	±0.1	8.8	±1	41.6	±2.8

CONCLUSIONS

The prevalence of intestinal parasite among infants and children in the current study was high, this may be attributed to multiple factors such as undernutrition, poor socioeconomic conditions, poor hygiene practices, unavailability and type of latrines in rural and suburban areas, eating inadequately washed raw vegetables or fruits, and drinking un potable water. All these factors are associated with the increase in the prevalence of intestinal parasitic infection and diarrheal disease. The outcome of

this study showed a notable effect of the detected protozoan parasites on the mean values of some blood parameters. Therefore, it is recommended to apply the preventive measures and health awareness strategies by health sectors to increase the population awareness through implementing programs that concentrate on health education, hygiene application particularly personal hygiene after using latrine, washing fruit and vegetables thoroughly and administering antiparasitic medications to infected children or adults. The application of these measures will reduce the prevalence of these parasites within the population.

ACKNOWLEDGEMENT

The authors thank the Biology Department, Science College, University of Zakho, for proving research facilities. Thanks, are also, due to the Duhok Directorates of Health Authorities for providing ethical clearance, to Hevi Pediatric Hospital for providing us with stool samples and permeation for using their laboratory, to the private clinics for providing samples. Finally, we thank all participants from who samples and data were collected.

REFERENCES

- Abed, N. D. (2020). Prevalence of intestinal parasites among children in Khanaqin city east of Diyala/Iraq. *Indian J. Public Health Res. Devel.*, **11**(02), 1136. DOI: org/10.37506/mlu.v20i2.1182
- Ahmed, M. (2023). Intestinal parasitic infections in 2023. *Gastro.*, **16**(3)127–140. DOI:10.14740/gr1622
- Al-Daoudy, A. A. K.; Ali, F.; Sadiq, L. B.; Mamand, A. S.; Salah, R.; Muhammed, H. (2021). Investigation of intestinal protozoan infections among food-handlers in Erbil City/ Iraq. *Plant Arch.*, **21**(1), 1367-1372. DOI:org/10.51470
- Al-Hasheme, I. H. M.; Al-Tammime, T. A. A. H.; l-Morshidy, K. A. H. (2020). Study of some hematological and immunological parameters associated with the infection of intestinal parasites in the holy city of Kerbala, Iraq. *Ann. Trop. Med. Health*, **23**(12), 207-231. DOI:org/10.36295/ASRO.2020.231207
- Allu, M. A. (2024). The effect of infection on some intestinal parasite on some hematological parameters for diarrhea patients in Zakho City/ Kurdistan Region/ Iraq. *Intern. J. Multidisc. Res.*, **6**(1), 1-10. DOI: org/10.36948/ijfmr. 2024.v06i01.13405
- Al-Mozan, H. D. K.; Daoud, Y. T.; Dakhil, K. M. (2017). Intestinal parasitic infection effect on some blood components. *J. Cont. Med. Sci.*, **3**(9), 159-162. DOI:org/10.22317/jcms.v3i9.128
- Alomashi, G. B.; Al-Shabbani, A. H. (2019). Prevalence of intestinal parasitic infestation in anemic patients attended to Al-Diwaniyah Teaching Hospital at Al-Qadisiya Province/Iraq. *Intern. J. Pharmac. Qual. Assur.*, **10**(3), 60-65. DOI: 10.25258/ijpqa.10.3.22
- Al-sultany, A. K.; Al-Morshidy, K. A. (2023). An epidemiological study of intestinal parasites in children attending the pediatric teaching hospital in the holy city of Karbala/ Iraq. *Med. J. Babylon*, **20**(1), 95-100. DOI:10.4103/MJBL.MJBL276_22.
- Damen, J. G.; Luka, J.; Biwan, E. I.; Lugos, M. (2011). Prevalence of intestinal parasites among pupils in rural North Eastern/ Nigeria. *Nigerian Med. J.*, **52**(2), 144-147.
- Daoud, Y. T.; Dakhil, K. M.; Al-Mozan, H. D. K. (2014). Study the infection with intestinal parasites *Entamoeba histolytica* and its effect on the blood nature in children from DhiQar province. *Al-Qadisiya Med. J.*, **10**(18), 152-158. DOI:org/10.28922/qmj.2014.10.18.152-158
- Farrell, S. H.; Coffeng, L. E.; Truscott, J. E. Werkman, M.; Toor, J.; de Vlas, S. J.; Anderson, R. M. (2018). Investigating the effectiveness of current and modified World Health Organization guidelines for the control of soil-transmitted helminth infections. *Clin. Infect. Dise.*, **66**(4), 253-259. DOI: 10.1093/cid/ciy002
- Hadi, Z. S. (2011). A Study of prevalence of intestinal parasitic infection in Shatrah district/ DhiQar governorate. *J. Educ. pure Sci. Univ. DhiQar*, **1**(5), 28-39.

- Hakizimana, E.; Kim, J. Y.; Oh, S.; Yoon, M.; Yong, T. S. (2023). Intestinal parasitic infections among children aged 12–59 months in Nyamasheke District/ Rwanda. *Paras., Hosts Dise.*, **61**(3), 304. DOI:org/10.3347/PHD.23045
- Hama, A. A.; Rahemo, Z. I. (2014). Intestinal parasitosis in relation to hemoglobin concentration among primary schoolchildren in Erbil province Kurdistan/ Iraq. *Intern. Sci. J.*, **1**(1), 96-99.
- Harhay, M. O.; Horton, J.; Oliaro, P. L. (2010). Epidemiology and control of human gastrointestinal parasites in children. *Expert Rev. Anti-Inf. Ther.*, **8**(2), 219-234. DOI:10.1586/eri.09.119.
- Hassan, A. O.; Mero, W. M. (2020). Prevalence of intestinal parasites among displaced people living in displacement camps in Duhok Province/ Iraq. *Intern. J. Microb.*, **17**(1), 1-8. DOI: 10.5580/IJMB.55008
- Hassan, A. O.; Salih, J. M.; Al-Saeed, A. T. M. (2023). Prevalence of intestinal parasites and associated risk factors among rural areas in Duhok province. *J. Adv. Zool.*, **44**(03) 72-81. DOI: org/10.17762/jaz.v44i3.328
- Inês, E. D. J.; Figueiredo Pacheco, F. T.; Carneiro Pinto, M.; Silva de Almeida Mendes, P.; da Costa-Ribeiro, H.; Matos Soares, N.; AquinoTeixeira, M. C. (2016). Concordance between the zinc sulphate flotation and centrifugal sedimentation methods for the diagnosis of intestinal parasites. *Biom.*, **36**(4), 519-524. DOI: 10.7705/biomedica.v36i4.2799
- Ismael, S. S.; Abdullah, B. H.; Sadiq, A. J.; Ajaj, J. S.; Ali, N. S.; Omer, D. M.; Nori, N. Y. (2024). Prevalence of intestinal protozoan parasites among children attending the hevi pediatric hospital in Duhok Province/ Kurdistan Region/ Iraq. *Arch. Razi Inst.*, **79**(3), 507-512. DOI: 10.32592/ARI.2024.79.3.507
- Khalil, E. M. (2013). Study of intestinal parasites and its effects on some blood components levels in Ramadi City. *J. Univ. Anbar Pure Sci.*, **7**(1), 63-71.
- Prinyakupt, J.; Pluempitiwiriyawej, C. (2015). Segmentation of white blood cells and comparison of cell morphology by linear and naïve Bayes classifiers. *Biom. Engin. Online*, **14**, 1-19. DOI :10.1186/s12938-015-0037-1
- Saleh, H. H. (2023). A Study on intestinal parasites that cause diarrhea and some of physiological effects on children in Baghdad. *Tikrit J. Pharmac. Sci.*, **17**(1), 46-57. DOI: 10.25130/tjphs.2023.17.1.5.46.57
- Salih, J. M.; Hassan, A. O.; Al-Saeed, A. T. M. (2022). Intestinal parasites and associated risk factors among primary school children in Duhok city-Kurdistan region/Iraq. *J. Duhok Univ.*, **25**(2), 50-56. DOI:10.26682/sjuod.2022.25.2.5
- Salman, A. O.; Mhaisen, F. T.; Al-Tae, A. A. (2019). On the occurrence of some intestinal parasites among Diarrheic children attending a hospital in Al-Karkh Side/ Baghdad City/ Iraq. *Biolog. Appl. Envir. Res.*, **3**(2), 93-102.
- Sellau, J.; Groneberg, M.; Fehling, H.; Thye, T.; Hoenow, S.; Marggraff, C.; Lotter, H. (2020). Androgens predispose males to monocyte-mediated immunopathology by inducing the expression of leukocyte recruitment factor CXCL1. *Nat. Commun.*, **11**(1), 3459. DOI: 10.1038/s41467-020-17260-y
- Shahnazi, M.; Mehrizi, M. Z.; Alizadeh, S. A.; Heydarian, P.; Saraei, M.; Alipour, M.; Hajjalilo, E. (2019). Molecular characterization *Hymenolepis nana* based on nuclear rDNA ITS2 gene marker. *African Health Sci.*, **19**(1): 1346-1352. DOI: 10.4314/ahs.v19i1.6
- Siddig, H. S.; Mohammed, I. A.; Mohammed, M. N.; Bashir, A. M. (2017). Prevalence of intestinal parasites among selected group of primary school children in Alhag Yousif Area/ Khartoum/ Sudan. *Intern. J. Med. Res. Health Sci.*, **6**(8), 125-131.
- Ustun, S.; Turgay, N.; Delibas, S. B.; Ertabaklar, H. (2004). Interleukin (IL) 5 levels and eosinophilia in patients with intestinal parasitic diseases. *World J. Gastro.: WJG*, **10**(24), 3643. DOI: 10.3748/wjg.v10.i24.3643
- World Health Organization (1998). Public health significance of intestinal parasitic infections. *Bull World Health Organ.*, **65**(5):575-588.
-

العدوى الطفيلية المعوية وتأثيرها الدموي لدى الرضع والأطفال في دهوك، العراق

زينب موسى حاجي

قسم علوم الحياة/ كلية العلوم/ جامعة زاخو/ إقليم كردستان/ العراق

وجدان محمد صالح ميرو

قسم الأحياء الدقيقة الطبية/ كلية العلوم/ جامعة نولج/ طريق كركوك 44001/ أربيل/ العراق

الملخص

تهدف هذه الدراسة المقطعية إلى تقدير انتشار الطفيليات المعوية بين الرضع والأطفال ومن كلا الجنسين وبأعمار >1-5 سنة. وتقييم تأثيرها على بعض المعايير الدموية في محافظة دهوك، العراق. أجريت الدراسة من ايلول 2024 لغاية شباط 2025. جمعت 550 عينة براز من مستشفى هيفي للأطفال وبعض العيادات الخاصة. فُحصت ظاهرياً وأعقبها الفحص المجهرى باستخدام ثلاث طرق: الفحص المباشر بالمسحة الرطبة، وتقنيات التركيز بكبريتات الخارصين وزيل-نيلسن المعدلة، للكشف عن أنواع *Cryptosporidium spp.* بلغت النسبة الكلية للطفيليات المعوية 21.27%، وسجل الذكور نسبة إصابة أعلى بفرق غير معنوي مقارنة بالإناث (22.03% مقابل 20.45%)، وكانت أعلى نسبة إصابته بالطفيليات (24.27%) بين الأعمار >1-5 سنوات. شكّلت الأوليات 23.27% منها، وكانت أعلى نسبة بانواع *Entamoeba spp.* بمعدل 18.73%، بينما كانت نسبة الديدان 1.09%. أظهر الأطفال المصابون انخفاضاً غير معنوي في متوسط الهيموغلوبين (Hb)، وفي متوسط عدد خلايا الدم الحمراء (RBCs) بين الذكور فقط. في حين انخفض هذا المتوسط لدى الإناث بشكل معنوي عال ($P=0.032$) وارتفع متوسط عدد خلايا الدم البيضاء (WBCs) والحمضات لدى كلا الجنسين بشكل غير معنوي، بينما حدثت زيادة معنوية عالية ($P=0.0015$) في الحمضات بين الأطفال الذين تراوحت أعمارهم بين 11 و15 سنة. نستنتج من هذه الدراسة ان الطفيليات المعوية واسعة الانتشار بين الرضع والأطفال، لا سيما الذكور والفئات العمرية الصغيرة، وأدت الإصابة بها إلى خفض متوسط الهيموغلوبين وعدد خلايا الدم الحمراء بشكل غير معنوي وخاصة لدى الإناث، في حين ارتفع متوسط عدد خلايا الدم البيضاء والحمضات بشكل غير معنوي بين مختلف الأعمار باستثناء الفئات العمرية من 11 إلى 15 سنة التي حدثت عندها زيادة معنوية عالية بالحمضات. يتطلب هذا الوضع إجراء مزيد من الدراسات التفصيلية.

الكلمات الدالة: الانتشار، الطفيليات المعوية، الأمراض المعدية، معايير الدم.