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Comparison of iron and some hematological parameters between patients with *Giardia lamblia* and healthy control

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Abstract

Giardia lamblia, a protozoan parasite featuring flagella .and binucleation, is capable of infecting a diverse range of mammalian hosts. The incidence of human giardiasis, a veritable cosmopolitan pathogen, is most pronounced in developing nations.

The objective of the present study was to evaluate the impact of an infection caused by the *Giardia lamblia* parasite on iron levels and various hematological parameters in patients.

the study conducted between August 2022 and February 2023, blood samples were collected from people who were infected and non-infected with *Giardia lamblia* to evaluate the element iron and some blood indicators and the extent to which they were affected by infection. 60 blood samples (36 males and 24 females) were taken from people infected with Giardia, and 30 blood samples (15 males and 15 females) were taken from healthy people (controls). The infection was diagnosed by a direct smear and cultured in the

laboratory. The control group underwent both clinical and laboratory examinations to confirm the absence of any disease.

The findings of the present investigation exhibit a noteworthy reduction in the average levels of serum iron (SI), mean number of red blood cells (RBC), hemoglobin (Hb), and percentage of the packed cell volume (PCV) in people with the disease compared to healthy subjects, while a significant increase in the mean of the total number of white blood cells (WBC) was recorded in patients compared to healthy subjects.

Individuals with *Giardia lamblia* may exhibit notable changes in several hematological factors. Routine assessment of hematological factors is necessary for timely detection and effective treatment of giardiasis.

Keywords: *Giardia lamblia*, SI, RBC, Hb, PCV, WBC

Introduction

Intestinal parasite infection is a public health issue. One of the intestinal parasites that infects the duodenum in people and causes severe diarrheal disorders is the *Giardia lamblia* parasite, which causes giardiasis (1).

Giardiasis is spread through the fecal-oral route by ingesting infectious cysts either directly or indirectly. After eating cysts, the incubation period can last anywhere between 9 and 15 days(2). Zoonotic transmission is also possible (3,4).

Where diarrhea occurs as a result of a defect in the digestive system that results in frequent defecation accompanied by the production of liquid or semi-liquid stools, it can negatively affect children's development and growth, leading to the loss of fluids and ions from the body and the occurrence of dehydration(5).

giardia can cause clinical infection in all ages with varying symptoms. These can range from asymptomatic carrier state to severe abdominal pain, vomiting, flatulence, malabsorption, diarrhea, anorexia, and weight loss. Some patients may also develop post-infectious irritable bowel disease and chronic fatigue(6). The rate of infection with the giardia parasite is affected by several factors, including the geographical area, the age of the affected person,, the economic and social status, nutritional habits and health, and the immune status of the host(7). Giardia infection with this parasite is widespread in Iraq (8–10).

Due to the significance of this parasite in causing diarrhea in both children and adults, a study was conducted to assess its impact on iron and other blood parameters.

Materials and methods

Fresh stool samples were observed for parasites using the X40 lens method by Paniker (11). Multiple fields were examined before deeming a slide negative.

Blood samples were obtained from healthy and infected patients using a 5-ml disposable syringe. The blood sample was divided into two aliquots, which were 2 and 3 ml. The first aliquot was dispensed in sterilized tubes with EDTA to prevent coagulation, and this was used to analyze some hematological parameters by Hemolyzer Analyticon (Germany). The second aliquot was put into a tube and spun at 3000 rpm for 10 minutes to obtain serum, which was stored in a deep freezer or used right away for serum iron analysis.

Detection of human iron: Prior to use, samples are removed from the refrigerator to let them reach room temperature (18-25°C) for 30 minutes. We take 100 µl of the sample and put it in a clean container, then put it in the

device (Lindo Wind C100) with a wavelength of 560, wait for 17 minutes, and then read the result.

Results and discussion

The findings demonstrated how giardiasis affected mean SI levels. The results revealed a significant decrease ($P < 0.05$) in the overall means of SI in patients when compared with the control group, as well as a significant decrease ($P < 0.05$) in mean SI levels in both male and female patients compared to their respective control groups, as shown in table 1.

Table 1. The average SI levels in infected and uninfected subjects

Subjects	Mean $\pm$ SD S.I. in Male	Mean $\pm$ SD S.I. in Female	Mean $\pm$ SD S.I. in Total	P-value
control	83.91 $\pm$ 21.79	76.62 $\pm$ 10.88	81.00 $\pm$ 18.34	0.294
patients	39.91 $\pm$ 5.24	41.83 $\pm$ 11.62	40.55 $\pm$ 7.90	0.487
P-value	0.000*	0.000*	0.000*	

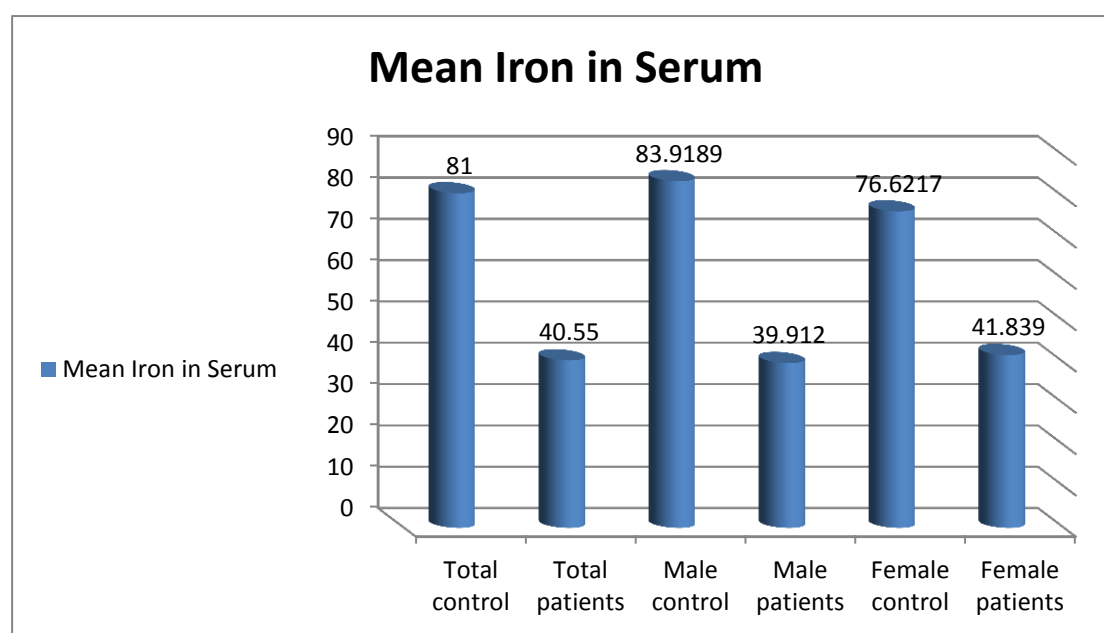


Figure 1. Mean values with standard deviation of SI levels were calculated for both infected and uninfected subjects.

Giardiasis infection leads to changes and a decrease in the level of some blood elements, including iron, which leads to effects on the cellular, enzymatic, and physiological functions of the infected person (12). The outcome aligns with previous research indicating that Giardia can lead to iron-deficiency anemia in subjects. (13,14).

Indicating that the infection of the digestive system resulting from parasitic infection, particularly Giardia, leads to malabsorption syndrome and delayed absorption. growth for impact children(15).

The results showed the effect of giardiasis on hematological parameters in patients. The result showed a decrease in the mean RBC number of patients when compared there with the control group; also, the result showed a significant decrease ($P \leq 0.05$) in the mean RBC number when compared there between male patients and male control, as well as a significant decrease ($P \leq 0.05$) in the mean RBC number when compared there between female patients and female control, as shown in table 2.

Table 2. RBC number means (SD) in infected and healthy persons

Subjects	Mean $\pm$ SD RBC (10^6/L) in Male	Mean$\pm$ SD RBC (10^6/L) in Female	Mean $\pm$ SD RBC (10^6/L) in Total	P-value
control	4.80 $\pm$ 0.26	4.53 $\pm$ 0.42	4.66 $\pm$ 0.73	0.04
patients	3.99 $\pm$ 0.52	3.66 $\pm$ 0.36	3.82 $\pm$ 0.47	0.007
P-value	0.00	0.00	0.00	

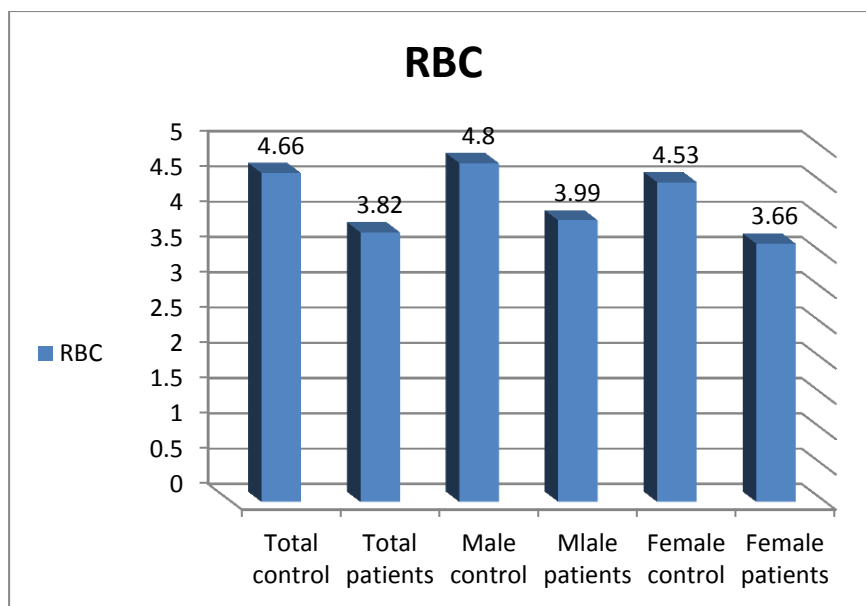


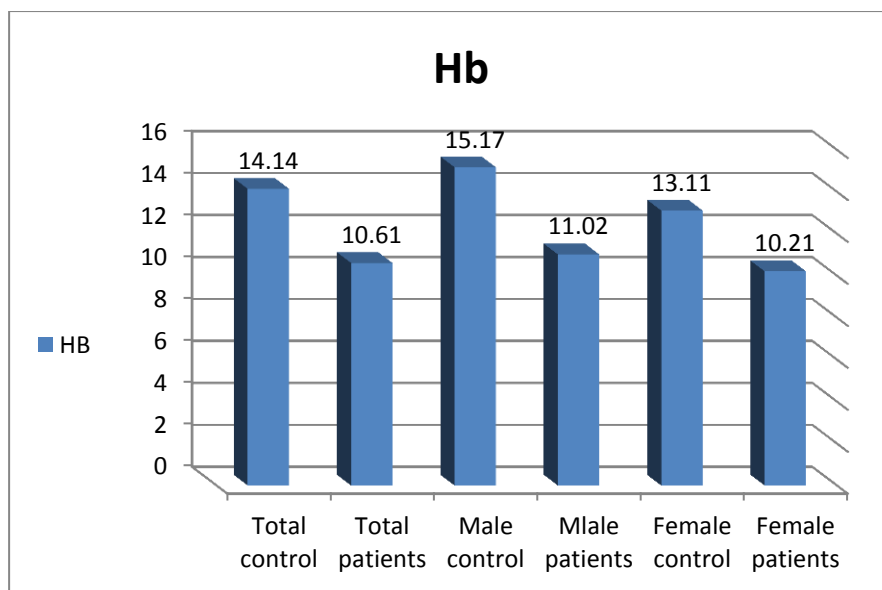
Figure 2. RBC number means (SD) in infected and healthy persons.

As shown in table 3. and Figure 3. The result indicated a significant decrease ($P < 0.05$) in average Hb levels of patients compared to control group. Additionally, there was a significant decrease ($P \leq 0.05$) in male and female patients compared to their respective control groups.

Table 3. Hb level averages (SD) in infected and healthy subjects

Subjects	Mean $\pm$ SD HB (g /dL) in Male	Mean $\pm$ SD HB (g /dL) in Female	Mean $\pm$ SD HB (g /dL) in Total	P-value
control	15.17 $\pm$ 0.96	13.11 $\pm$ 1.15	14.14 $\pm$ 1.48	0.00
patients	11.02 $\pm$ 2.32	10.21 $\pm$ 1.62	10.61 $\pm$ 2.03	0.122
P-value	0.00	0.00	0.00	

Figure 3. Hb level averages (SD) in infected and healthy subjects



The results demonstrated a significant decrease ($P < 0.05$) in the mean PCV levels of patients when compared with the control group; they also demonstrated a significant decrease ($P < 0.05$) in mean PCV levels among male and female patients compared to their respective control groups, as demonstrated in Table 4 and Figure 4.

Table 4. PCV levels' averages in both infected and normal people

Subjects	Mean $\pm$ SD PCV(%) in Male	Mean $\pm$ SD PCV(%) in Female	Mean $\pm$ SD PCV(%) in Total	P-value
control	41.76 $\pm$ 2.77	40.63 $\pm$ 2.63	41.20 $\pm$ 2.72	0.26
patients	35.70 $\pm$ 2.37	32.49 $\pm$ 1.97	34.09 $\pm$ 2,70	0.00
P-value	0.00	0.00	0.00	

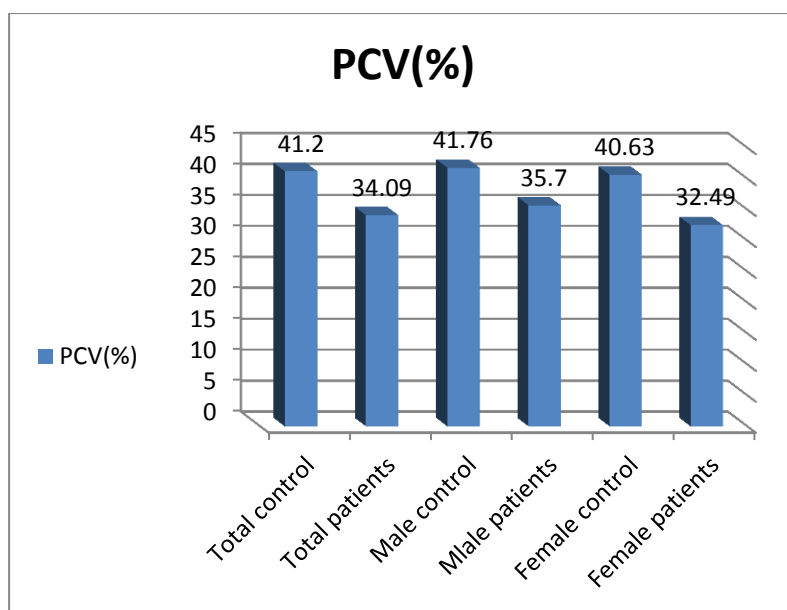


Figure (4) PCV levels' averages in both infected and normal people

The findings align with previous research that demonstrated a notable reduction in RBC, Hb, and PCV means among individuals with protozoan parasite infections. (16,17). The study demonstrated a decline in hemoglobin levels amongst those with Giardia. This decline is likely due to Giardia attaching to intestinal cells and causing malabsorption of necessary nutrients, leading to a lack of blood constituents.(18).

The study revealed a considerable rise in total WBC number among patients compared to the control group. Both male and female patients showed a significant increase compared to their respective controls. These findings are presented in table 5. and figure 5.

Table 5. The average of the total WBC number in infected and healthy participants.

Subjects	Mean ± SD WBC($10^3/\mu\text{L}$) in Male	Mean± SD WBC($10^3/\mu\text{L}$) in Female	Mean ± SD WBC($10^3/\mu\text{L}$) in Total	P-value
control	5.86± 1.49	6.00± 1.23	5.93± 1.34	0.79
patients	12.75± 2.72	12.57± 2.55	12.66± 2.62	o.79
P-value	0.00	0.00	0.00	

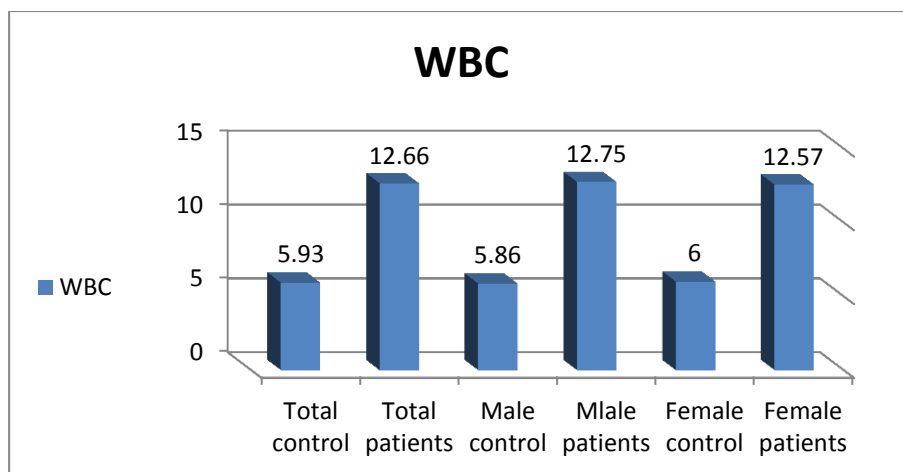


Figure 5. The average of the total WBC number in infected and healthy.

participants During infections, the body's white blood cell count typically rises in response to foreign organisms. This finding is consistent with other studies(16,19). This result disagrees with other studies (20,21).

The increase in leukocytes is caused by the immune response to infection, and the higher increase in eosinophil is due to their role in fighting parasitic infections.(22).

Conclusion and recommendation

Giardiasis causes decreases in SI, RBC, Hb, and PCV, and increases total WBC. It alters hematology and causes health issues. Personal and environmental hygiene can minimize anemia. The study highlights the need for controlling gastrointestinal protozoan parasites in Iraq.

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