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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии
საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman (Кириллица)**, для текста на грузинском языке следует использовать **AcadNusx**. Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - <http://www.spinesurgery.ru/files/publish.pdf> и http://www.nlm.nih.gov/bsd/uniform_requirements.html В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректур авторам не высылаются, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or computer-printed on a single side of standard typing paper, with the left margin of 3 centimeters width, and 1.5 spacing between the lines, typeface - **Times New Roman (Cyrillic)**, print size - 12 (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf

In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

**Articles that Fail to Meet the Aforementioned
Requirements are not Assigned to be Reviewed.**

ავტორთა საქურაღებოლ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დაიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx**. შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შედეგების ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფხიხლებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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IMPACT OF BLASTOCYSTIS HOMINIS INFECTION ON IMMUNOLOGICAL PARAMETERS IN PATIENTS WITH DIARRHEA: A CROSS-SECTIONAL STUDY

Safaa Hussein Abdullah Al-Oda¹, Shatha Khudiar Abbas², Khetam Habeeb Rasool³.

^{1,2,3}College Department of Biology, College of Science, Mustansiriyah University, Baghdad, Iraq.

Abstract.

Blastocystis parasites are common intestinal parasites found in various hosts, including humans. This study involved two groups: the patient group, consisting of 220 samples, and the control group, consisting of 100 samples. The participants' age range was 4-40 years, and the samples were obtained from Al-Kadhimiya Teaching Hospital and Al-Shaheed Mohammed Baqir Al-Hakeem Hospital in Baghdad, Iraq. Stool samples were examined under a light microscope using Lugol's Iodine Stain and direct wet smears. The age group did not show a significant difference ($P \geq 0.05$) in patients with diarrhea infected with the *Blastocystis hominis* parasite compared to the control group. Furthermore, males had a higher infection rate (58.00%) compared to females (42.00%), and this rate was statistically significant ($P \leq 0.05$).

The aim of this study was to evaluate the effect of *Blastocystis hominis* infection on the levels of certain immunological parameters. The results of the ELISA technique for immunological examinations revealed a significant increase ($P \leq 0.01$) in the levels of IL-10 and IL-17 in the serum of patients with diarrhea infected with the *Blastocystis hominis* parasite compared to the control group. The immunological tests also showed a significant increase ($P \leq 0.01$) in IgG, IgM antibodies, and IgA levels in patients with diarrhea infected with *Blastocystis hominis* parasite compared to the control group. These findings suggest that *Blastocystis* infection may influence immunological responses.

Key words. *Blastocystis Hominis*, Interleukin-10, Interleukin-17, Immunoglobulin-A, Immunoglobulin-M, Immunoglobulin-G.

Introduction.

Blastocystis parasites are among the most prevalent eukaryotic organisms in human feces worldwide. However, their prevalence is higher in developing countries (30-100%) compared to developed countries (1.5-15%). This difference is attributed to factors such as inadequate personal and environmental hygiene, limited access to safe water supply, and insufficient waste removal services [1,2]. Various factors, including immune status, geographic location, age, and dietary habits, influence the prevalence of *Blastocystis* sp. infection [2,3]. Poor hygiene, consumption of contaminated food, contact with animals, and contaminated water are identified as risk factors for *Blastocystis* transmission, contributing to the high incidence of infection in developing countries [4].

Historically, *Blastocystis* diagnosis relied on light microscopy of fecal smears or in vitro cultures. The organism exhibits four morphological forms: vacuolar, granular, amoeboid, and cyst [5,6]. The lack of distinct morphological features previously obscured the understanding of *Blastocystis* diversity. Based on the genetic heterogeneity of the small subunit ribosomal RNA (SSU rRNA), *Blastocystis* is currently classified into at least 28

subtypes (STs) including ST1-ST17, ST21, and ST23-ST32. These subtypes, found in mammalian and avian hosts, are likely separate species [7-9].

Numerous studies have demonstrated that *Blastocystis* sp. can elicit immune responses in infected individuals, including secretory and humoral antibody secretions such as IgA and IgG. However, these immune responses are significantly higher in individuals infected with symptomatic *Blastocystis* sp. Isolates than those infected with asymptomatic isolates [6,10]. *B. hominis*, for instance, has been reported to secrete a protease that can cause various diseases and syndromes, leading to symptoms such as intense neural activity, abdominal pain, muscle cramps, and generalized pains, which are not typically observed in bacterial and viral infections [11]. Additionally, some individuals infected with *B. hominis* exhibit skin allergy symptoms like erythema, itching, and urticaria, likely due to IgE secretion in response to the parasite's surface antigens [12,13].

The host's immune response against *Blastocystis* spp. infection is not yet fully understood [14]. Therefore, the objective of the present study was to evaluate the serological levels of proinflammatory and anti-inflammatory cytokines, as well as antibodies, in patients with diarrhea infected with *Blastocystis hominis* parasite, and compare them with a control group.

Materials and methods.

The study was conducted between November 2022 and March 2023 at Al-Kadhimiya Teaching Hospital and Al-Shaheed Mohammed Baqir Al-Hakeem Hospital in Baghdad, Iraq. The study involved two groups: the patient group and the control group.

The patient group consisted of 220 samples collected from individuals who were presented with gastrointestinal symptoms, including acute diarrhea and abdominal pain. The control group, on the other hand, consisted of 100 samples. Both male and female participants from various age groups (4 to 40 years) were included in the study.

Stool examinations were performed using microscopy to analyze the samples. Additionally, laboratory examinations were conducted to assess physical characteristics such as consistency, presence of mucus, and color.

Microscope Examination: The collected stool samples were divided into two portions for microscopy analysis. One portion was treated with Lugol's iodine (2-5%), while the other portion was treated with normal saline (0.9%).

Blood samples and measurement of immunological parameters:

Blood samples were obtained from both the patient and control groups using disposable syringes. A total of 5 ml of blood was collected into gel tubes and centrifuged at room temperature at 2000 rpm for 15 minutes to separate the serum. The collected serum was then stored at -20°C until further use.

To measure the serum levels of IL-10, IL-17, IgA, IgM, and IgG, specific ELISA kits (Mybiosource, USA) were utilized.

The ELISA assays were performed following the manufacturer's instructions, adhering to the prescribed protocols and procedures.

Statistical Analysis:

The Statistical Analysis System (SAS, 2018) program was employed to determine the impact of different groups (patients and controls) on the study parameters. The t-test was utilized to compare means and determine statistical significance. The chi-square test was employed to compare percentages and determine statistical significance at probability levels of 0.05 and 0.01.

Results and Discussion.

The current study involved the collection of 220 stool samples from individuals presenting with gastrointestinal symptoms, including acute diarrhea and abdominal pain. Microscopic examination was performed on all samples using Lugol's Iodine Stain and direct wet smears. Among the examined cases, 100 were found to be positive for *Blastocystis hominis* based on microscopic examination, while 120 cases yielded negative results.

The microscopic examination involved observing the samples under a microscope at both low power (x10) and high power (x40). The observed forms of *Blastocystis hominis* exhibited a characteristic vacuolar morphology, characterized by a central body or vacuole surrounded by a thin cytoplasmic rim containing up to six nuclei.

This study categorized participants into four age groups. The first age group (4-10 years) had 16 (16%) individuals in the control group and 19 (19%) individuals in the patient group. The second age group (11-20 years) consisted of 23 (23%) individuals in the control group and 27 (27%) individuals in the patient group. The third age group (21-30 years) included 34 (34%) individuals in the control group and 32 (32%) individuals in the patient group. The fourth age group (31-40 years) comprised 27 (27%) individuals in the control group and 22 (22%) individuals in the patient group. The P-value for all age categories was greater than 0.05.

The mean ± SE (mg/dL) of the control group was (19.53 ± 2.06), while the mean ± SE (mg/dL) of the patient group was (17.02 ± 1.37), with a P-value greater than 0.05, as shown in Table (1).

Table 1. Distribution of the study samples is categorized according to age in both the control and patients' groups.

Variables	Control without Blastocystis / No (%)	Patients infected with Blastocystis / No (%)	P value
Average age (years ± SE)	19.53 ± 2.06	17.02 ± 1.37	0.302 NS
4– 10 yr.	16 (16.00%)	19 (19.00%)	0.612 NS
11– 20 yr.	23 (23.00%)	27 (27.00%)	0.571 NS
21– 30 yr.	34 (34.00%)	32 (32.00%)	0.805 NS
31– 40 yr.	27 (27.00%)	22 (22.00%)	0.475 NS
Total	100	100	

NS: Non-Significant.

The study found no significant correlation between age and *Blastocystis hominis* infection, which is consistent with previous

research conducted by Merza et al. [15] in Duhok City, Bugis et al. [16] in Saudi Arabia, and El Safadi et al. [17] in Lebanon. However, some studies, such as Dagci et al. [18], have reported a higher frequency of *Blastocystis* infection among the 20-29 age group in symptomatic patients. This higher frequency was also observed in the current study, where the infection was most common in the 21-30 age group. Possible reasons for the higher infection rate among 21–30- year-olds may include factors such as increased exposure to contaminated environments, close contact with infected individuals, or dietary habits.

The study further observed that among patients with diarrhea and *Blastocystis hominis* infection, males had a higher proportion (58%) compared to females (42%). The P-values for gender distribution were 0.0499 for females and 0.033 for males, indicating a statistically significant difference in gender distribution between the healthy population and patients with *Blastocystis hominis* infection, as shown in Table (2).

Table 2. Distribution of study samples according to gender in the control and patients groups.

Variables	Control without Blastocystis / No (%)	Patients infected with Blastocystis / No (%)	P-value
Female	62 (62.00%)	42 (42.00%)	0.0499 *
Male	38 (38.00%)	58 (58.00%)	0.0330 *

* (P<0.05)

These findings are consistent with previous studies conducted by Sylla et al. [19], Bugis et al. [16], and Khalili et al. [20], which also reported a higher prevalence of *Blastocystis hominis* infection in males compared to females. Sylla et al. [19] found a rate of 53.5% in males and 46.5% in females, Bugis et al. [16] reported a rate of 51.6% in males and 48.4% in females, while Khalili et al. [20] found a rate of 61% in males and 39% in females. The comparison of gender distribution in *Blastocystis hominis* infection across this study underscores the significance of accounting for regional and demographic factors. Several additional factors may contribute to the observed differences in infection rates between males and females. Behavioral differences between the genders, including variations in behavior and lifestyle patterns, can play a role. Males may be more prone to occupational exposures, hobbies, or activities that involve contact with contaminated environments or water sources, thus increasing their risk of infection. Moreover, variations in personal hygiene practices between males and females could also contribute to the disparity. Poor hand hygiene, inadequate sanitation practices, or a higher likelihood of engaging in activities with potential exposure to the parasite can elevate the risk of infection among certain populations. Considering these multifaceted factors alongside regional and demographic characteristics is essential for a comprehensive understanding of the higher infection rate among males in *Blastocystis hominis* infection.

The Level of IL-10 and IL-17 in the Study Groups:

The current study revealed that patients infected with *Blastocystis* exhibited significantly higher levels of IL-10 (132.644 ± 1.084 pg/ml) compared to the healthy control group

(89.01 ± 1.73 pg/ml). Additionally, there was a significant increase in IL-17 levels among Blastocystis-infected patients (342.107 ± 3.729 pg/ml) compared to the healthy control group (239.86 ± 3.79 pg/ml). These findings, as presented in Table (3), suggest that Blastocystis infection is linked to elevated levels of IL-10 and IL-17, indicating an immune response and potential involvement in the pathogenesis of the infection.

Table 3. Comparison between patients and control groups in IL-10 and IL-17.

Group	Mean ± SE (pg/ml)	
	IL-10	IL-17
Patients	132.644 ± 1.084	342.107 ± 3.729
Control	89.01 ± 1.73	239.86 ± 3.79
T-test	3.896 **	11.768 **
P-value	0.0001	0.0003

** (P≤0.01).

In this study, Blastocystis-infected patients showed significantly higher levels of IL-10 compared to the healthy control group, consistent with previous studies' findings (Deng & Tan [21]; Yakoub et al., [22]). However, contrasting results were reported by Abdel-Hafeez et al. [14], who observed a decrease in IL-10 expression in mice infected with Blastocystis. Another study by El-Zawawy et al. [23] found elevated levels of IL-17 in patients with both Hashimoto's thyroiditis and Blastocystis hominis infection, suggesting a stimulating effect of Blastocystis on proinflammatory cytokine production. Wu et al. [24] also reported higher levels of IL-17 in mice infected with Blastocystis. The increase in IL-17 levels indicates its role in the inflammatory response and host defense against pathogens [25]. However, IL-17 can also contribute to inflammatory pathology in certain contexts [26].

The Level of IgG, IgM, and IgA Antibodies in the Study Groups:

The study revealed significant differences between Blastocystis-infected patients and the healthy control group regarding serum antibody levels. The patient group exhibited a notable increase in IgM (134.45 ± 3.54 g/dL vs. 93.91 ± 2.51 g/dL), IgG (21.26 ± 0.71 g/dL vs. 19.45 ± 0.45 g/dL), and IgA (246.26 ± 3.35 g/dL vs. 157.61 ± 3.24 g/dL) compared to the healthy control group. These differences were highly significant (P ≤ 0.01) for IgM and IgA and not significant for IgG, as shown in Table (4).

Table 4. Comparison of IgM, IgG, and IgA between patient and control groups.

Parameter	Mean ± SE (g/dL)		
	IgM	IgG	IgA
Patients	134.45 ± 3.54	21.26 ± 0.71	246.26 ± 3.35
Control	93.91 ± 2.51	19.45 ± 0.45	157.61 ± 3.24
T-test	10.568 **	2.084 NS	10.457 **
P-value	0.0002	0.0890	0.0001

** (P≤0.01).

The levels of IgM and IgA were found to be significant, indicating an immune response in the infected group compared to the control group. However, it is worth noting that the IgG

levels did not show significant elevation. This observation may be attributed to the timing of the measurements, which plays a crucial role in accurately interpreting the results. In our study, the samples from the infected group were collected 3-7 days after the presumed time of infection, capturing the early phase of the immune response.

The immune response against Blastocystis hominis involves the production of immunoglobulins IgG, IgA, and IgM, which play important roles in defending against extracellular pathogens. IgG is particularly effective against Blastocystis and constitutes a significant portion of circulating immunoglobulins [27]. The humoral immune response involves B cells producing different types of antibodies to fight infections [28]. IgM antibodies are released initially as a first line of defense against infection, indicating a current infection, while IgG antibodies can persist in the body and signal a past infection [29].

Blastocystis hominis employs adaptive mechanisms, such as Cystein Protease, to colonize and evade the host's immune system. Cystein Protease can bind with IgA, breaking it down and preventing colonization or invasion by the parasite [30]. The modified immune response allows Blastocystis to successfully colonize the host.

The results of the present study align with previous studies that found higher levels of IgA, IgG, and IgM in Blastocystis-infected patients compared to healthy individuals [31,32]. Increased IgG antibodies have been shown to stimulate the cellular immune response and indicate long-term immunity against pathogenic antigens. However, a contradictory study observed lower IgM levels in individuals with B. hominis compared to the control group [33].

Overall, the production of immunoglobulins is vital in defending against Blastocystis, but the interaction between the parasite and the immune system is complex, involving adaptive mechanisms and modifications to evade immune responses.

Conclusion.

The analysis indicated that there was no significant difference in the age distribution between patients infected with the Blastocystis hominis parasite and the control group. However, a statistically significant difference was observed in the infection rate between males (58.00%) and females (42.00%).

Infection with the B. hominis parasite in patients with diarrhea has an impact on stimulating the cellular immune response. This is evident by the increased levels of IL-10 and IL-17. Additionally, it stimulates the humoral immune response, as indicated by the increased levels of IgG, IgM, and IgA antibodies, when compared to the control group.

Conflict of interest statement.

The authors declare the absence of obvious or potential conflicts of interest related to the publication of this article.

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Conformity with the principles of ethics.

All patients signed an informed consent to participate in the study. The local Ethics Committee at the College of Science at Mustansiriyah University approved the study.

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