ЭПИДЕМИОЛОГИЯ
EPIDEMIOLOGY

DETECTION OF SOME INTESTINAL PROTOZOAN PARASITES IN PREGNANT AND NON-PREGNANT WOMEN OF NASIRIYA PROVINCE IN IRAQ

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RESUME

Background. *Intestinal helminths and protozoan parasites cause parasitic infections, which are among the most widespread human infections in developing nations. The most prominent parasitic cause of diarrhea worldwide is enteric intestinalis, which is also particularly common in underdeveloped nations.*

The aim of the study*. To estimate the incidence of some Intestinal parasitic infections (IPIs) in pregnant women compare with incidence of IPIs in non-pregnant women.*

Materials and methods*. Fecal samples collected from the subjects who visited Bint Al-Huda Hospital in Dhi Qar from a period February 2024 to February 2025, n = 228, of which 128 were pregnant women and 100 were non-pregnant women, information was collected for each patient. To find out how common IPIs are, samples were processed and evaluated as soon as they were collected using concentration techniques and standard direct faecal smear microscopy. The oocysts of Cryptosporidium spp. Identified using modified acid-fast staining.*

Results*. The total rate of infection with IPIs among expectant mothers was higher than in the non-pregnant women's. Also, the highest incidence of parasites in pregnant women was Entamoeba histolytica, followed by Entamoeba coli, then Cryptosporidium parvum, and the least of them was Giardia lamblia, while the lowest infection was Blantidium coli. The age range in pregnant women of 25–30 years had the highest infection rate. While the age group of 35–45 years had the lowest infection percentage. Blood group A had the highest infection rate, whereas blood group O had the lowest infection rate. The highest rate of infection was in the second trimester, while the lowest rate of infection was in the first trimester.*

Conclusion*. Research revealed that IPIs are a high for pregnant women in Thi-Qar province. A relatively high prevalence of enteric parasite infection observed in expectant mothers. Timely medical care for pregnant women and their unborn children depends on adequate health education.*

Keywords*: Intestinal protozoan parasites, pregnant women, blood group*

Received: 06.05.2025
Accepted: 24.11.2025
Published: 25.12.2025

For citation: Rabab Ali Al-Mosawi, Ebtesam Mohsen Al-Azawe, Bassad A. Al-Aboody. Detection of some intestinal protozoan parasites in pregnant and non-pregnant women of Nasiriya province in Iraq. *Acta biomedica scientifica*. 2025; 10(6): 238-244. doi: 10.29413/ABS.2025-10.6.25

ВЫЯВЛЕНИЕ НЕКОТОРЫХ КИШЕЧНЫХ ПРОСТЕЙШИХ ПАРАЗИТОВ У БЕРЕМЕННЫХ И НЕБЕРЕМЕННЫХ ЖЕНЩИН В ПРОВИНЦИИ НАСИРИЯ В ИРАКЕ

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РЕЗЮМЕ

Обоснование. *Кишечные гельминты и простейшие паразиты могут вызывать паразитарные инфекции, которые являются одними из самых распространённых инфекций среди людей в развивающихся странах. Наиболее распространённой паразитарной причиной диареи во всём мире является кишечная палочка, которая также особенно распространена в слаборазвитых странах.*
Цель исследования. *Оценить частоту встречаемости некоторых кишечных паразитарных инфекций у беременных и небеременных женщин.*
Материалы и методы. *Образцы кала были взяты у пациентов, которые посещали больницу Бинт Аль-Худа в Ди-Каре в период с февраля 2024 по февраль 2025 года (n = 228). Было проанализировано 228 образцов, 128 из которых были взяты у беременных, а 100 – у небеременных женщин. По каждому пациенту была собрана информация. Для определения распространенности кишечных паразитарных инфекций образцы были обработаны и оценены сразу после их сбора с использованием методов концентрирования и стандартной прямой микроскопии мазков кала. Ооцисты Cryptosporidium spp. были идентифицированы с помощью модифицированного окрашивания кислотоустойчивыми бактериями.*
Результаты. *Общий уровень заражения кишечными паразитарными инфекциями среди беременных женщин был выше, чем среди небеременных женщин. Результаты исследования показали следующую последовательность встречаемости паразитарных организмов: Entamoeba histolytica – наиболее часто выявляемый паразит среди беременных женщин; Entamoeba coli занимает второе место по частоте обнаружения; Cryptosporidium parvum выявлен с меньшей частотой по сравнению с первыми двумя видами; Giardia lamblia – наименее распространенный вид паразитов в исследуемой группе; Blantidium coli – самый низкий уровень инфицирования. Наибольшая частота инфицирования наблюдалась у беременных женщин в возрасте 25–30 лет, и наоборот, в возрастной группе 35–45 лет частота инфицирования была самой низкой. Группа крови A показала наибольшую частоту инфицирования, в то время как группа крови O показала наименьшую частоту инфицирования. Во втором триместре был самый высокий уровень инфицирования, в то время как в первом триместре был самый низкий уровень.*
Заключение. *Исследование показало, что кишечные паразитарные инфекции распространены среди беременных женщин в провинции Ти-Кар. В этом районе среди будущих матерей наблюдается относительно высокая заболеваемость кишечными паразитарными инфекциями. Своевременный доступ беременных женщин и их нерожденных детей к медицинской помощи зависит от надлежащего медицинского образования и осведомленности.*

Ключевые слова: *кишечные простейшие паразиты, беременные женщины, группа крови*

Статья поступила: 06.05.2025
Статья принята: 24.11.2025
Статья опубликована: 25.12.2025

Для цитирования: Рабаб Али Аль-Мосави, Эбтесам Мохсен аль-Азаве, Басад А. Аль-Абуди. Выявление некоторых кишечных простейших паразитов у беременных и небеременных женщин в провинции Насирия в Ираке. *Acta biomedica scientifica*. 2025; 10(6): 238-244. doi: 10.29413/ABS.2025-10.6.25

INTRODUCTION

Intestinal helminths and protozoan parasites cause parasitic infections, which are among the most widespread human infections in developing nations. The most frequent parasites that cause enteric protozoan infections are *Cryptosporidium* spp, *Giardia lamblia* and *Entamoeba histolytica*. The most prominent parasitic cause of diarrhea worldwide is enteric intestinalis, which is also particularly common in underdeveloped nations [1]. Some types of protozoan parasites can also be found in the human intestinal tract, but they are not pathogenic, such as *Entamoeba coli* [2].

IPIs transmitted by the fecal-oral pathway and share trophozoite and oocyst stages in their life cycles. The consumption of oocyst-contaminated food or drink must happen for fecal-oral transmission to occur. In general, close human-human contact circumstances and unsanitary surroundings encourage transmission [3].

Infants, children, young women, and pregnant women are especially vulnerable to IPIs, according to the WHO 2023 assessment [4].

In addition to competing with the host for nutrients, intestinal parasites have other ways for influencing the host's dietary condition. People may have less of an appetite and eat less because of certain infections. They may hinder the efficient absorption of nutrients by causing intestinal irritation. Giardia lamblia and Entamoeba histolytica are two protozoan parasites that can harm the intestinal mucosa and result in malabsorption, diarrhea, and blood loss [5].

Pregnant women considered more susceptible to infections than the general population due to the physiological and immunological adaptations that occur during pregnancy. These adaptations are essential for maintaining tolerance to the developing fetus, but they also reduce the mother's ability to combat certain pathogens, increasing the risk of infections such as intestinal parasitic infections. Therefore, IPIs affect both pregnant mothers and their unborn children's health. However, the degree of severity varies depending on a number of variables, including a person's hygiene, lack of safe drinking water, parasite load, species, inter-pregnancy intervals, environment, nutrition, immunity, and the presence of concurrent diseases [6].

The study's aim was to compare the incidence of infection with some intestinal protozoan parasites in pregnant and non-pregnant women. Also, aimed to investigate the prevalence of intestinal parasitic infections (IPIs) among a selected population and to assess the potential association between ABO blood groups and susceptibility to these infections. The main goal of intestinal parasite prevention in pregnant women is to reduce maternal and neonatal morbidity and mortality.

MATERIALS AND METHODS

This study focused exclusively on pregnant women because intestinal parasitic infections during pregnancy can negatively affect the fetus, potentially leading to adverse pregnancy outcomes such as low birth weight, preterm delivery, and impaired fetal development. Study was conducted from February 2024 to February 2025. Two hundred twenty eight stool samples were collected from married women attending a teaching hospital called Bint Al-Huda, Thi-Qar province, for the detection of intestinal protozoan parasitic infection. Each sample using clean, sterile, and properly labeled containers. It transported to the parasitology laboratory within two to four hours of collection. Wet samples were immediately prepared with normal saline and iodine to preserve parasite motility, particularly for amoebas histolytica. The remaining portions of the samples were preserved in 10 % formalin for later use in concentration and staining techniques (including modified Ziehl-Neelsen stain for *Cryptosporidium parvum*). This procedure minimized degradation and ensured accurate identification of *E. histolytica*, *E. coli*, *Giardia lamblia*, *E. coli*, and *Giardia parvum*. Out of 228, 128 were pregnant women, and 100 were non-pregnant women. The age range of participants was from 18–45 years.

The study included all patients who were able to donate stool samples during their appointments. To determine the prevalence of intestinal parasites in patients, each sample was processed and evaluated as soon as it was collected using standard direct fecal smear microscopy and concentration techniques utilizing Lugol's iodine preparations and normal saline. In order to analyze the motility of the organisms, which is frequently a defining property of protozoa, direct wet mount was predominantly utilized to discover motile types of protozoa [7]. The oocysts of *Cryptosporidium* spp. were identified using modified acid fast staining in the fecal specimens following the procedures described by Ignatius R, et al [8]. Statistical analysis performed using IBM SPSS Statistics version 25 (Chi square and *t*-test).

RESULTS

The study showed the total percentage of infection with intestinal protozoan parasites in pregnant women compared to the non-pregnant women as control group. The infection rate with IPIs for pregnant women was higher 78 (60.93 %) than the infection rate for non-pregnant women 20 (20 %) (Table 1).

In general, 'Results' of the study showed Percentage of infection with IPIs among pregnancies women according to type of parasites. The result revealed that the highest incidence of intestinal parasites was *Entamoeba histolytica* (34.61 %), followed by *Entamoeba coli* (19.23 %), then *Cryptosporidium parvum* (17.94 %), and the least of it was *Giardia lamblia* (15.38 %), while the lowest infection was of the *Blantidium coli* (12.82 %) (Fig. 1).

The study showed the incidence of infection among pregnant women according to age: the age range of 25–30 years had the highest infection rate, while the age group of 35–45 years had the lowest infection percentage (Fig. 2).

The result showed the incidence of infection among pregnant women according to blood groups: blood group A had the highest infection rate, whereas blood group O had the lowest infection rate (Fig. 3).

The study showed the incidence of infection in expectant mothers according to the period of pregnancy: the highest rate of infection was in the second trimester, while the lowest rate of infection was in the first and the third trimesters (Fig. 4).

DISCUSSION

The study revealed that the incidence of intestinal protozoan infections was high and was higher than that of non-pregnant women. The study's findings are consistent with those of several other studies, including those by [9].

In general, regions with poor sanitation and economic deprivation have a higher prevalence of intestinal protozoan infections [10].

TABLE 1

THE TOTAL INCIDENCE OF INTESTINAL PROTOZOAN PARASITES AMONG PREGNANT WOMEN COMPARED WITH THE CONTROL GROUP

Group	No. of sample exam.	Positive sample		Negative sample		*p*-value
		No.	%	No.	%	
Pregnant women	128	78	60.93	50	39.06	0.00
Non-pregnant women (control)	100	20	20	80	80	0.00
Total	228	98	42.98	130	57.02	0.00

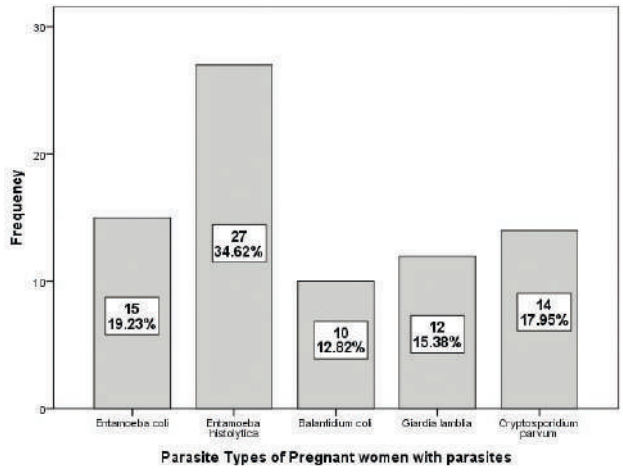

FIG. 1.
Percentage of infection with intestinal protozoan parasites among pregnant women in the according to type of parasites

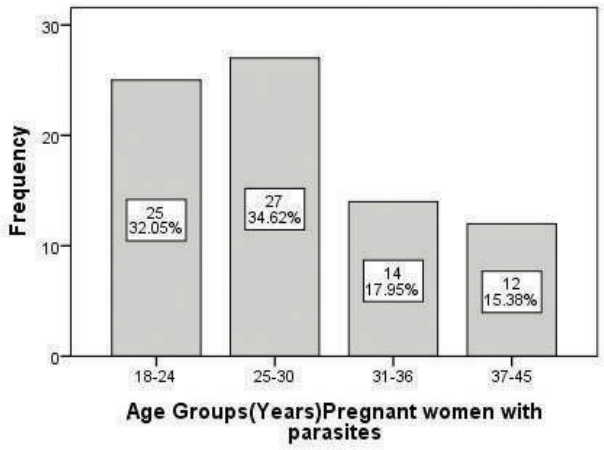

FIG. 2.
Percentage of intestine protozoan parasites infection among pregnant women according age groups

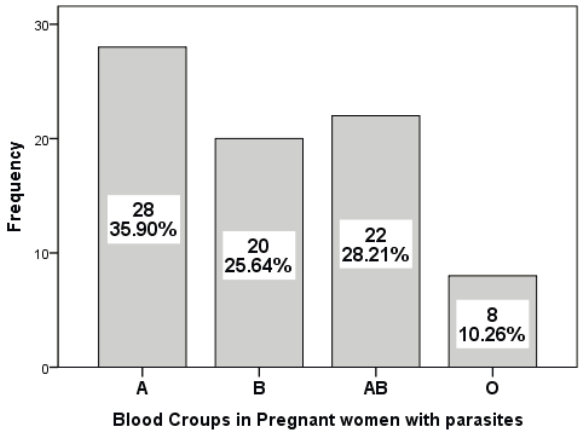

FIG. 3.
Percentage of intestinal protozoan parasites infection among pregnancies women according blood groups

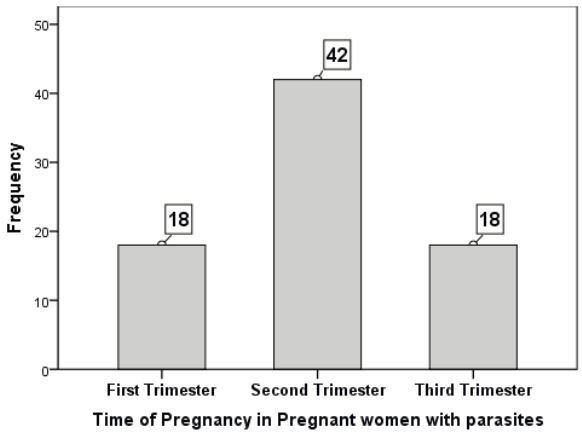

FIG. 4.
Percentage of intestinal protozoan parasites infection among pregnant women according to gestational age

The findings revealed that the highest incidence of intestinal parasites were *Entamoeba histolytica*, followed by *Entamoeba coli*, then *Cryptosporidium parvum*, and the least of it was *Giardia lamblia*, while the lowest infection was of the *Blantidium coli*. This study is similar to other studies conducted by [11].

Recent data suggest that *Entamoeba histolytica* infections remain a health concern among pregnant women in several low- and middle-income countries. In a cross-sectional study conducted in Yemen, approximately 7.4 % of the participants tested positive for *E. histolytica/dispar*, while the total prevalence of intestinal parasites reached 36.6 % [12]. Another large-scale meta-analysis covering South and Southeast Asia estimated the prevalence among pregnant women to be nearly 7 % [13] This relatively high rate has been linked to limited access to clean water, poor sanitation infrastructure, and low levels of health education. Additionally, the physiological immune changes that occur during pregnancy may increase susceptibility to such infections, which have been associated with complications such as dehydration and, in some cases, preterm birth. These findings emphasize the importance of preventive measures, including improved access to safe water and routine parasitological screening during antenatal care [14].

Entamoeba coli is generally considered a non-pathogenic protozoan that lives in the human intestine without causing harm. It does not invade tissues or lead to clinical symptoms in healthy individuals. However, its presence in stool samples is often regarded as a marker of fecal contamination and inadequate sanitary conditions. A higher detection rate of *E. coli* among pregnant women may not indicate direct health effects, but it does suggest increased exposure to potentially contaminated environments. This, in turn, raises concern for the possible presence of more harmful parasites, such as *Entamoeba histolytica*. Therefore, while *E. coli* itself is not a cause of disease, its identification may reflect broader public health and hygiene challenges [15].

Cryptosporidium parvum is a zoonotic protozoan parasite that infects both humans and animals. It causes cryptosporidiosis, a diarrheal disease that can be severe in immunocompromised individuals, including pregnant women [16]. Although it primarily infects livestock, human infection occurs through ingestion of contaminated water or food. In pregnant women, the infection may lead to dehydration and potential complications. Its public health significance lies in its high resistance to chlorine and its role in waterborne outbreaks [17, 18].

Giardia lamblia, a protozoan parasite, is a significant cause of gastrointestinal infections worldwide. Pregnant women, particularly in low-resource settings, are at increased risk due to immunological changes during pregnancy and environmental factors [19].

Balantidium coli is a ciliated protozoan parasite known to cause intestinal and, in rare cases, extraintestinal infections in humans. Transmission typically occurs via the fecal-oral route through ingestion of contaminated food or water. While human infections are uncommon, certain populations, including pregnant women, may be at increased risk due to immunosuppression associated with pregnancy [20].

Several factor, like consumption of raw vegetables and fruit, environmental cleanliness, and water supply have all been linked to the exposure of pregnant women to parasite diseases [21, 22].

In this study, the highest percentage of intestinal protozoan parasite infections among pregnant women observed in to age groups 25–30 years (34.6 %). This finding might to be the fact that older women are generally more knowledgeable about personal and environmental hygiene practices than younger pregnant women [23] such as preterm low birth weight (PTLBW. However, another study did not find a significant correlation between intestinal parasite infections and age groups in pregnant women [24].

Scientific evidence supporting the relevance of investigating the relationship between blood group types and susceptibility to intestinal parasitic infections (IPIs). Several studies have explored how blood group antigens may influence an individual's vulnerability to various infections, including those caused by intestinal parasites. The result showed the incidence of infection among pregnant women according to blood groups, that blood group A had the highest infection rate, while the blood group O had the lowest infection rate this result same result with study conducted by Ai L. and his colleagues [25]. Varying regional, racial, and socioeconomic groupings have varying distributions of ABO blood groups [26], These differences could affect the incidence of some infectious diseases, such parasites [27]. Uncertainty exists regarding the mechanism underlying the varied susceptibility of parasites in humans with various ABO blood groups [28].

The study showed percentage of intestinal protozoan parasites infection among pregnant women according to gestational age. The result showed that the highest infection rate was in second trimester in pregnant women, this result same to other study conducted by [19, 29]. In contrast to these results, a study conducted by Espinosa Aranzales et al., 2018 found that gestational age had no association with IPIs [9, 30]. Second Trimester (fetal growth phase) the immune system shifts toward anti-inflammatory / Th2-dominant state, this is the phase of relative immune suppression, because the fetus is rapidly growing and the body prioritizes tolerance [31].

Intestinal parasitic infections are a high burden for pregnant women in Thi-qar province. Infections with intestinal parasites were found to be relatively common in pregnant women. Early medical action that would influence pregnant women and their unborn children requires routine stool analysis and the dissemination of health information.

CONCLUSION

Intestinal parasitic infections are a high burden for pregnant women in Thi-qar province. Infections with intestinal parasites found to be relatively common

in pregnant women. Early medical action that would influence pregnant women and their unborn children requires routine stool analysis and the dissemination of health information.

Acknowledgements

The authors extend sincere thanks and appreciation to the staff of Bint Al-Huda Teaching Hospital for their cooperation and support during the course of this study. Gratitude also expressed to the College of Science, Department of Biology, University of Thi-Qar, for providing the necessary resources and academic guidance that contributed to the success of this research.

Conflict of interest

The authors declare that they have no conflicts of interest.

Ethical standards

The Human Research Ethics Committee (HREC) at the Biology Department, College of Science, Thi-Qar University-Thi-Qar has approved the study as ethical, According to the book of Dhi Qar University, No. 6558, in 5-January 2024.

REFERENCES

1. Wang Y, Li X-M, Yang X, Wang X-Y, Wei Y-J, Cai Y, et al. Global prevalence and risk factors of Enterocytozoon bieneusi infection in humans: a systematic review and meta-analysis. *Parasite*. 2024; 31: 9. doi: 10.1051/parasite/2024007

2. Naveed A, Abdullah S. Impact of parasitic infection on human gut ecology and immune regulations. *Transl Med Commun*. 2021; 6(1): 11. doi: 10.1186/s41231-021-00091-4

3. Ahmed M. Intestinal Parasitic Infections in 2023. *Gastroenterol Res.* 2023; 16(3): 127-140. doi: 10.14740/gr1622

4. Makinde OA, Uthman OA, Mgbachi IC, Ichegbo NK, Sule FA, Olamijuwon EO, et al. Vulnerability in maternal, new-born, and child health in low-and middle-income countries: Findings from a scoping review. *PLoS One*. 2022; 17(11): e0276747. doi: 10.1371/journal.pone.0276747

5. Mohan S, Halle-Ekane G, Konje JC. Intestinal parasitic infections in pregnancy – A review. *Eur J Obstet Gynecol Reprod Biol*. 2020; 254: 59–63. doi: 10.1016/j.ejogrb.2020.09.007

6. Animaw Z, Melese A, Demelash H, Seyoum G, Abebe A. Intestinal parasitic infections and associated factors among pregnant women in Ethiopia: a systematic review and meta-analysis. *BMC Pregnancy Childbirth*. 2021; 21(1): 474. doi: 10.1186/s12884-021-03908-0

7. Tuli L, Singh DK, Gulati AK, Sundar S, Mohapatra TM. A multiattribute utility evaluation of different methods for the detection of enteric protozoa causing diarrhea in AIDS patients. *BMC Microbiol*. 2010; 10: 11. doi: 10.1186/1471-2180-10-11

8. Ignatius R, Lehmann M, Miksits K, Regnath T, Arvand M, Engelmann E, et al. A new acid-fast trichrome stain for simultaneous detection of *Cryptosporidium parvum* and microsporidial species in stool specimens. *J Clin Microbiol*. 1997; 35(2): 446–9. doi: 10.1128/jcm.35.2.446-449.1997

9. Alula GA, Munshea A, Nibret E. Prevalence of Intestinal Parasitic Infections and Associated Risk Factors among Pregnant Women Attending Prenatal Care in the Northwestern Ethiopia. *Biomed Res Int*. 2021; 2021: 3387742. doi: 10.1155/2021/3387742

10. Al-Yousofi A, Yan Y, Al_Mekhlafi AM, Hezam K, Abouelnazar FA, Al-Rateb B, et al. Prevalence of intestinal parasites among immunocompromised patients, children, and adults in sana'a, Yemen. *J Trop Med*. 2022; 2022: 5976640. doi: 10.1155/2022/5976640

11. Ismael SS, Abdullah BH, Sadiq AJ, Ajaj JS, Ali NS, Omer DM, et al. Prevalence of intestinal protozoan parasites among children attending the Hevi Pediatric Hospital in Duhok Province, Kurdistan Region, Iraq. *Arch Razi Inst*. 2024; 79(3): 507-512. doi: 10.32592/ARI.2024.79.3.507

12. Alharazi T. Prevalence and risk factors of intestinal parasitic infections among pregnant women in Taiz Governorate, Yemen: A hospital-based study. *Helminthologia*. 2023; 60(3): 201–7. doi: 10.2478/helm-2023-0022

13. Garg S, Garg A, Ravishankar N, Garg V. Prevalence of intestinal parasitic infections among the pregnant women in South and South East Asian countries: A systematic review and meta-analysis. *Trop Parasitol*. 2024; 14(2): 71–83. doi: 10.4103/tp.tp_7_23

14. Mor G, Cardenas I. The immune system in pregnancy: a unique complexity. *Am J Reprod Immunol*. 2010; 63(6): 425–33. doi: 10.1111/j.1600-0897.2010.00836.x

15. Mahamat O, Nchuikieh MJ, Eyong EEJ. Entamoeba coli and Entamoeba histolytica infections as risk of allergic reactions: a case study of population of Bamenda, Cameroon. *Blood*. 2020; 9: 10. doi: 10.15761/JMT.1000145

16. Helmy YA, Hafez HM. Cryptosporidiosis: From Prevention to Treatment, a Narrative Review. *Microorganisms*. 2022; 10(12): 2456. doi: 10.3390/microorganisms10122456

17. Pumipuntu N, Piratae S. Cryptosporidiosis: A zoonotic disease concern. *Vet world*. 2018; 11(5): 681–6. doi: 10.14202/vetworld.2018.681-686

18. Zahedi A, Paparini A, Jian F, Robertson I, Ryan U. Public health significance of zoonotic Cryptosporidium species in wildlife: Critical insights into better drinking water management. *Int J Parasitol Parasites Wildl*. 2016; 5(1): 88–109. doi: 10.1016/j.ijppaw.2015.12.001

19. Derso A, Nibret E, Munshea A. Prevalence of intestinal parasitic infections and associated risk factors among pregnant women attending antenatal care center at Felege Hiwot Referral Hospital, northwest Ethiopia. *BMC Infect Dis*. 2016; 16(1): 530. doi: 10.1186/s12879-016-1859-6

20. Almaw A, Berhan A, Solomon Y, Malkamu B, Eyayu T, Workineh L, et al. Balantidium coli; rare and accidental finding in the urine of pregnant woman: case report. *Int Med Case Rep J*. 2022; 105–9. doi: 10.2147/IMCRJ.S355536

21. Animaw Z, Melese A, Bedane D, Tadesse B, Degarege D, Admasu F, et al. Prevalence, pattern and predictors of clinically important parasites contaminating raw vegetables and fruits in Ethiopia: a systematic review and meta-analysis. *BMC Infect Dis*. 2024; 24(1): 1146. doi: 10.1186/s12879-024-10034-7

22. Gemechu T, Bona J, Aliyo A, Dedecha W, Ashenafi G. Assessment of intestinal parasites and its associated factors among fruits and vegetables collected from local markets of Bule Hora town, southeast Ethiopia. *J Trop Med*. 2023; 2023: 1861919. doi: 10.1155/2023/1861919

23. Bushehab NME, Sreedharan J, Reddy S, D'souza J, Abdelmagyd H. Oral Hygiene Practices and Awareness of Pregnant Women about the Effects of Periodontal Disease on Pregnancy Outcomes. *Int J Dent*. 2022; 2022: 5195278. doi: 10.1155/2022/5195278

24. Espinosa Aranzales AF, Radon K, Froeschl G, Pinzón Rondón ÁM, Delius M. Prevalence and risk factors for intestinal parasitic infections in pregnant women residing in three districts of Bogotá, Colombia. *BMC Public Health*. 2018; 18(1): 1071. doi: 10.1186/s12889-018-5978-4

25. Ai L, Li J, Wang W, Li Y. ABO blood group and risk of malaria during pregnancy: a systematic review and meta-analysis. *Epidemiol Infect*. 2022;150: e25. doi: 10.1017/S095026882200005X

26. Kumar N, Kapoor A, Kalwar A, Narayan S, Singhal MK, Kumar A, et al. Allele frequency of ABO blood group antigen and the risk of esophageal cancer. *Biomed Res Int*. 2014; 2014: 286810. doi: 10.1155/2014/286810

27. Degarege A, Gebrezgi MT, Ibanez G, Wahlgren M, Madhivanan P. Effect of the ABO blood group on susceptibility to severe malaria: A systematic review and meta-analysis. *Blood Rev*. 2019; 33: 53–62. doi: 10.1016/j.blre.2018.07.002

28. Abegaz SB. Human ABO blood groups and their associations with different diseases. *Biomed Res Int*. 2021; 2021(1): 6629060. doi: 10.1155/2021/6629060

29. Atakorah EA, Afranie BO, Addy KD, Sarfo AD, Okyere BA. Assessment of intestinal and blood protozoan infections among pregnant women visiting ante-natal care at Tafo Hospital, Ghana. *Heliyon*. 2022; 8(8): e09968. doi: 10.1016/j.heliyon.2022.e09968

30. Abaka-Yawson A, Sosu SQ, Kwadzokpui PK, Afari S, Adusei S, Arko-Mensah J. Prevalence and determinants of intestinal parasitic infections among pregnant women receiving antenatal care in Kasoa Polyclinic, Ghana. *J Environ Public Health*. 2020; 2020(1): 9315025. doi: 10.1155/2020/9315025

31. Reinhard G, Noll A, Schlebusch H, Mallmann P, Ruecker AV. Shifts in the TH1/TH2 balance during human pregnancy correlate with apoptotic changes. *Biochem Biophys Res Commun*. 1998; 245(3): 933–8. doi: 10.1006/bbrc.1998.8549

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