Prevalence of Some Parasitic Infections in Iraq from 2019 to 2020

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Abstract
Parasitic infections are associated with low education, wars and migration, absence of animal control and poor sanitation. Infections like visceral and cutaneous leishmaniasis (VL and CL), trichomoniasis, toxoplasmosis, malaria, echinococcosis and schistosomiasis are all spread worldwide and have harmful effects on individuals and societies. The aim of this survey was to identify the possible association of these infections with spatial distribution (province/governorate) and patient demographics (age and gender). According to the data collected from the Iraqi National CDC from 2019 to 2020, the predominant parasitic infections in both years were trichomoniasis and CL, followed by echinococcosis, VL and toxoplasmosis. Iraq is malaria and schistosomiasis free. The highest incidence rate of trichomoniasis was in Duhouk (2019) and Al-Dewaniya (2020) and majority of CL cases were in Diala in both 2019 and 2020. The number of echinococcosis cases was the highest in Thi-Qar (2019) and in Nineveh (2020). VL mostly affected Al-Dewaniya (2019) and Thi-Qar (2020). Toxoplasmosis scored the highest incidence rate in Basra in 2019 and 2020. All infections were higher in 2019 than in 2020, except for CL. As for age groups: echinococcosis, toxoplasmosis and trichomoniasis were higher in age group 15 – 44 years, while VL and CL was most common in 0-14 years juveniles in both years. Females were more affected than males by echinococcosis, toxoplasmosis, and trichomoniasis, while VL and CL affected males more often in the years included in this study.

Keywords: Epidemiology, Parasites, Iraq, Leishmania, Trichomonas, Echinococcus, Toxoplasma

الانتشار الوبائي لبعض الأمراض الطفيلية في العراق من عام 2019 الى عام 2020

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الخلاصة
ترتبط الإصابات الطفيلية باختلاف مستوى التعليم، العوامل والحروب والهجرة وغياب السيطرة على الحيوانات، بالإضافة إلى النقص في النظافة، العادات والتقاليد، القوارض، العادات والتقاليد، وللإضاقة يمكن أن تنتشر هذه الأمراض على الأفراد والمجتمعات. إن هذه الإصابات أيضاً تؤثر عادةً على الأطفال والمراهقين خاصةً في العراق.

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1. Introduction

The spread of contagious diseases and animal-born parasitic infections is facilitated by unsatisfactory sanitary conditions. About 50% of Iraqi people living in cities and 33% living in rural areas don’t have access to clean drinking water supplies [1]. Since poverty limits the access to good healthcare conditions, most parasitic infections occur in developing countries [2]. Leishmaniasis is a poverty-related disease, caused by flagellated, intracellular protozoan parasites of the genus *Leishmania*. [3] The disease is vector-borne, so the parasites are transmitted by the bite of infected *Phlebotomus* and *Lutzomyia* sand flies [4]. The major species that cause human diseases in Iraq are *L. tropica*, *L. major*, *L. infantum* and *L. donovani* [3, 5]. Three distinct clinical syndromes have been identified; visceral leishmaniasis (VL), cutaneous leishmaniasis (CL) and mucocutaneous leishmaniasis (ML) [6]. Visceral leishmaniasis (also known as Kala-azar black fever) is caused by the parasite *Leishmania donovani* and is characterized by symptoms such as fever, weight loss, hepatomegaly, splenomegaly, and pancytopenia [7]. There are probably thirty species of *Leishmania* that may cause cutaneous leishmaniasis (CL) [8]. The disease is distributed extensively worldwide in the Americas, Asia, Europe and Africa with its epidemiology being affected by climatic, environmental and migratory factors [9, 10]. About 1 million cases of leishmaniasis are reported from 100 endemic countries every year [11]. Iraq reported 17001 cases of CL from 2008 to 2015 [12].

Toxoplasmosis is a global animal-born disease caused by *Toxoplasma gondii*, a single-celled, eukaryotic parasite of the Phylum Apicomplexa [13]. This parasite has a complex life cycle where humans serve as intermediate hosts and felids are the definitive hosts [14]. Relatively high percentages of infection with toxoplasmosis (40 – 45%) have been reported in different provinces of Iraq [15, 16].

Trichomoniasis is probably the most common non-viral sexually transmitted infection (STI), with prevalence higher than *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infections combined [17]. It is a genital tract disease caused by a flagellated protozoan parasite named *Trichomonas vaginalis* that affects an estimated 3.7 million people in the United States and 276.4 million cases per year worldwide [18, 19]. With few exceptions, transmission mostly occurs via sexual contact [20].
Malaria caused by *Plasmodium* parasites, is one of the most life-threatening infectious diseases around the world. It is transmitted by infected female *Anopheles* mosquitoes bites [2]. Symptoms may include fever, fatigue, digestive tract problems and chills. In severe cases, these symptoms may develop into coma, seizures, cerebral malaria and death [21]. Iraq has been free of malaria for almost 40 years [22, 23].

Echinococcosis (Hydatid disease) is a zoonotic infection caused by a helminth named *Echinococcus granulosus* [24]. It requires two mammalian hosts for the completion of its life cycle. Dogs and other canids are the definitive hosts, while herbivores (sheep or cattle) are the intermediate hosts, and humans act as an accidental intermediate host (dead end) [25]. Schistosomiasis (Bilharziasis) is caused by trematode blood flukes named schistosomes [26]. Three species are responsible for causing dangerous diseases to human; *Schistosoma, haematobium, S. mansoni* and *S. japonicum* [27]. Parasitic diseases are a major cause of global morbidity and mortality, mostly affecting people in the poorest regions of the world [28].

2. Materials and Methods

The data presented in this study was available surveillance database collected from the Iraqi National Communicable Diseases Control Center (CDC). It consisted of spatial and temporal analysis of protozoan and helminthic infections. The data was arranged according to the geographical distribution of all provinces of Iraq (n=18). Total number of patients during study analysis from 2019 to 2020 was 26,038. Each infection was arranged according to age group and gender of patients. The studied parasites were divided into two categories: Protozoa: (*Leishmania, Plasmodium, Toxoplasma* and *Trichomonas*), and Helminths (Cestoda tapeworm: *Echinococcus* and Trematoda blood fluke: *Schistosoma*).

Statistical Analysis:

The Statistical Analysis System (SAS 2012) software was used to analyze data concerning the effects of different parameters in this study [29]. Chi-square test was used to compare between percentages in this study with 0.05 and 0.01 probabilities.

3. Results

Five protozoan and two helminthic infections were reported in 18 provinces of Iraq. The total number of infected individuals in 2019 was 13649, while 12389 were infected in 2020. In 2019 the highest reported cases were trichomoniasis (with a total of 6977 infections), followed by cutaneous leishmaniasis (total 6199 infections). Trichomoniasis was more dominant than CL in Baghdad (917, 13.14%), Basrah (206, 2.95%), Al-Dewaniya (1003, 14.37%), Al-Anbar (927, 13.28%), Al-Muthanna (686, 9.8%), Erbil (918, 13.16%) and Duhok (1309, 18.76%). Whereas CL was the most common parasitic infection in Nineveh (605, 9.7%), Maysan (137, 2.2%), Diala (2405, 38.79%), Babylon (158, 2.54%), Kerbela (171, 2.76%), Kirkuk (485, 7.82%), Wasit (278, 4.48%), Thi-Qar (115, 1.85%), Salah Al-Deen (451, 7.27%), Al-Najaf (150, 2.42%) and Al- Sulaimaniya (108, 1.74%). The highest incidence rate of Echinococcosis (total 230 infections) was in Thi-Qar which harbored 59 infections (25.65%), while there were no infections in Baghdad, Al- Dewaniya, Babylon, Kirkuk, Wasit, Salah Al-Deen, Erbil and Al- Sulaimaniya. Visceral leishmaniasis (total 150) was most dominant in Al- Dewaniya with 29 infections (19.33%), while the highest incidence rate of toxoplasmosis (total 93) was in Basrah which was 35 (37.63%), as shown in (Table 1) where infections with (P value ≤ 0.01) were considered significant while those with (P value > 0.01) being non-significant.

In 2020 the most dominant parasitic infection was CL (with a total of 7957), followed by trichomoniasis with total 4337 infections. As for incidence rates in the Iraqi governorates, Diala had the highest number of CL (3768 infection, 47.35%) followed by Salah Al-Deen (846
infection, 10.63%), whereas infection with trichomoniasis was the highest in Al-Dewaniya (910 infection, 11.43%) followed by Al-Muthanna (852 infection, 10.7%). A total of 46 infected individuals had VL, the governorate with highest incidence rate was Thi-Qar (12 infection, 26.08%). Echinococcosis showed a total of 41 infections, with 29 of them (70.73%) in Nineveh. Only 8 infections were diagnosed with toxoplasmosis, while Basrah harbored 5 of them (62.5%). No infections with malaria or schistosomiasis were reported in any governorate in both years and VL was absent in the north. (Table 1). All parasitic infections included in this study were higher in 2019 than in 2020, except CL which showed a percentage of 45.41% in 2019 and 64.22% in 2020. (Figure 1)

Cutaneous leishmaniasis and trichomoniasis infections were the most dominant parasitic infections in Iraq in both years, followed by echinococcosis, VL and toxoplasmosis, (Figure 1)

### Table 1: Parasitic infections in all Iraqi Governorates, 2019 and 2020

<table>
<thead>
<tr>
<th>Governorate</th>
<th>Echinococcosis</th>
<th>Toxoplasmosis</th>
<th>Visceral Leishmaniasis</th>
<th>Cutaneous Leishmaniasis</th>
<th>Trichomoniasis</th>
<th>Malaria</th>
<th>Schistosomiasis</th>
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<td>35</td>
<td>5</td>
<td>11</td>
<td>1</td>
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<tr>
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<td>3</td>
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<tr>
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<td>150</td>
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<td>0.0016</td>
<td>0.0001</td>
<td>0.0022</td>
<td>0.0001</td>
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</table>

** (P<0.01).

The data was further analyzed to compare between age groups and sexes. The study detected that the same age groups were affected in both 2019 and 2020; as echinococcosis infections were higher in 15-44 years age group, with 66.08% of infections in 2019 and 48.78% in 2020. Toxoplasmosis highly affected the same age group. 89.24% of infections were in age group 15-
44 years age group in 2019 and 100% in 2020. Trichomoniasis was higher in the same age group as well, 63.56% in 2019 and 76.25% in 2020. On the other hand, leishmaniasis infections were more dominant in younger ages, (0-14 years); VL scored 93.33% in 2019 in this age group and 100% in 2020, whereas CL showed 62.99% in 2019 and 57.28% in 2020. There was a significant difference (p<0.05) among age groups regarding infections with these parasites, (Figure 2)

![Graph showing parasitic infection representation in 2019 and 2020](image1)

**Figure 1:** Total parasitic infection representation in 2019 and 2020

![Graph showing relationship between age groups and parasitic infections](image2)

**Figure 2:** Relationship between age groups and parasitic infections

As for gender, Females were more affected than males by echinococcosis: 61.73% in 2019 and 75.6% in 2020, toxoplasmosis 92.47% in 2019 and 100% in 2020, and trichomoniasis 97.69% in 2019 and 98.1% in 2020, while VL and CL had more effects on males, with ratios of 51.33% and 54.70% in 2019, and 54.3% and 55.5% in 2020, respectively, (Figure 3)
Figure 3: Relationship between genders and parasitic infections

4. Discussion

This study indicated high occurrence of protozoan and helminthic parasites in Iraq. The most common parasitic infections were cutaneous leishmaniasis, trichomoniasis, echinococcosis, visceral leishmaniasis and toxoplasmosis. The number of infections within survey years showed that total cases exceeded 12000. Epidemiological information on parasitic infections and associated factors is very important to develop new prevention methods and appropriate control, as well as monitoring existing programs [30].

Leishmaniasis is a vector-borne disease affecting millions of people worldwide, yet it is a neglected tropical disease which is affected by climate changes, including temperature, rainfall and humidity [31]. The results of this study showed that only CL infections rose in 2020 which agreed with the World Health Organization (WHO) reports in 2022 that over 85% of new CL cases occurred in 10 countries including Iraq during 2020 [32]. VL cases are mostly found in central Iraq, as well as in the capital of the country as a result of the increased number of sand flies and unsatisfactory health condition, whereas CL mostly occurred in Baghdad and Mosul where the sanitary conditions were unsatisfactory [1, 22]. The number of reported VL cases has decreased substantially in the past 10 years as a result of better diagnosis and treatment, in addition to vector control and elimination [11]. In the current study, the highest reported cases of CL were noticed in the provinces of Diala and Salah Al-Deen, while there were no infections in VL in Dahok, Erbil and Sulimania. These results are in line with Al-Obaidi et al. (2016) study which showed the highest prevalence of CL were also noticed in Salah Al-Deen as a mean of 8 years from 2008 to 2015 [12]. Moreover, our results also agree with Saheb’s study in 2018 which reported no cases of VL in provinces of North of Iraq, although Diala harbored the highest rate of VL infection [23]. This may be explained by the variation in studies due the relationship of the size of individuals under study. The population prevalence of both types of leishmaniasis are often associated with migration and movement of non-immune people into areas with sandfly vectors and mammalian reservoirs [33]. This study also reported that both CL and VL infections were higher in males than in females. Moreover, the main age group of individuals infected was from 0-14 years. These results were supported by other previous studies [12, 23, 34]. This may be explained due to the fact that CL is an age, sex, seasonal and geographical dependent disease [12].
Despite the fact that Iraq is a Muslim country with specific religious and social prohibitions, sexually transmitted infections are still prevalent. In the year 2000, trichomoniasis infection in Iraq was only 9% [1]. However, it increased greatly and reached 51.1% and 35% in 2019 and 2020 as recorded in our study. Another study between 2018 and 2019 showed results almost similar to ours, indicating that 40.3% of tested Iraqi women were indeed infected with trichomoniasis [35]. This increase raises serious concerns since trichomoniasis is considered a public health threat to pregnant women and infants because it causes lower abdominal pain, pre-term labors and even abortions [36]. The reason why women are the most affected gender is the asymptomatic nature of the infection in men where they show no symptoms while women may suffer from itching and abnormal vaginal discharge [37]. It is noticed that 15-44 years age group was most affected, since this is the sexually active age of most individuals. Our results agree with 2016 estimates published by the WHO in 2019 about the prevalence and incidence of the four most common curable STIs in men and women aged between 15–49 years, including trichomoniasis [38, 39].

Echinococcosis is one of the most important parasitic infections in the under developed and developing countries [40]. In this study, infections with echinococcosis significantly decreased between the two years. The disease is endemic in rural areas with wide livestock breeding activities, where close contact may occur between humans and the domestic dogs and livestock. This explains its high prevalence in rural localities than urban areas [40, 41]. Additionally, the results proved that the number of infected females was higher than males, probably because they have more contact with raw meat while cooking and dog feces while farming. The high prevalence rate within the adults’ age group may be due to the fact that hepatic cysts may exist for 20 years before becoming large enough to cause problems such as pain, cirrhosis, nausea and liver disease. Pulmonary cysts also grow for many years before causing cough, dyspnea and hemoptysis [42]. A recent Iraqi study reported that the incidence rate of echinococcosis started decreasing between 2011-2015. Moreover, these results agree with ours about gender and age group [40, 42]. Our results also agree with another study that included Echinococcosis where Thi-Qar had the highest incidence rate of hydatid disease [43].

Toxoplasmosis is a globally distributed parasitic zoonosis, affecting approximately 35% of the human population [44]. In Iraq, the frequency of infection has elevated more than 40% compared to the eighties where infected women did not exceed 2% of the Iraqi population [15]. This is due to many risk factors such as female age, number of deliveries, contact with cats and uncooked meat, drinking unpasteurized milk, low health education and series of wars in the attacked country [15]. According to this study, Basrah and Thi-Qar showed the highest incidence rates of toxoplasmosis (35 and 29/ 93) respectively, whereas Diayla governorate did not record any Toxoplasma gondii infection neither in 2019 nor 2020. Our results disagree with another Iraqi study which reported that Najaf, Misan and Erbil governorates (67, 67 and 55/ 335) showed the highest rates of prevalence in 2016 [23]. Additionally, there was an incidence rate of 205/ 500 of toxoplasmosis in Baquba City, Diyala in 2018 [45]. The prevalence of toxoplasmosis varies among countries as well as regions within one country. These variations are a result of climatic, geographic and cultural differences. However, over the past decades, the number of positive individuals has decreased globally [46]. Our results, regarding age group and gender, are in line with a study which recorded that women of childbearing age were at higher risk of acquiring toxoplasmosis than older women [44]. Schistosomiasis (Bilharziasis) was eliminated from Iran, Oman, Lebanon and Tunisia, and was greatly reduced in Egypt, Saudi Arabia, Morocco, Syria, Jordan and Iraq. However, it is still considered a major health problem in Yemen [47]. A paper that focused on the effects of climatic changes on tropical diseases including schistosomiasis in the Eastern Mediterranean
Region, showed an alteration of neglected diseases related to climate change, in addition to the expectation of more effects on vectors and reservoir, and even the survival of adult worms in the coming years [31]. According to retrospective survey that included all Iraqi governorates, no infections with schistosomiasis were recorded in Iraq from 2011 to 2015 [43]. For the last several years, due to the planned action of drying wet soil which led to the death of the Bulinus truncatus snail (the intermediate host for S. haematobium) in both of the rivers in the country, Iraq has been free from schistosomiasis [48]. Additionally, due to the national control programs, the current study ensured schistosomiasis elimination from all Iraqi governorates in 2020. Although, a study was carried out in Babylon province from 2016 to 2017 which indicated that only 2 (0.4%) patients were infected. This study detected prevalence of S. haematobium and enrolled of 592 patients [49]. The contradiction in results between these studies is likely due to big differences in sample size.

Reduction of mortality and morbidity caused by malarial infections require sensitive diagnostic tools, the use of anti-malarial drugs, improved personal and community protection, in addition to mosquito control. The goal is to eliminate mosquitoes through spraying with insecticides to control malaria as well as the tracking of human illnesses [50]. About 600,000 cases of malaria were treated yearly in health service centers from 26 to 266 cases for every 1000 citizens, mostly in Karbala [1]. Cases of malaria caused by P. falciparum last occurred in Iraq in the 1980s [22, 51]. The current study ensured malaria removal from all Iraqi provinces in 2020. These results are exactly consistent with [23] who carried out to provide information on the prevalence of this parasite in Iraq in 2016.

Conclusions:
Since Iraq is free of malaria and schistosomiasis, it is very important to focus on how to reduce infection rates with leishmaniasis, trichomoniasis, echinococcosis toxoplasmosis, and any other parasitic infections by animal control and spread of safe sexual contact awareness.

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References