Investigating the Prevalence of Cutaneous Leishmaniasis in Tripoli, Libya (2020-2024)

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دراسة انتشار داء الليشمانيات الجلدي في طرابلس، ليبيا (2020-2024)

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Abstract:
Cutaneous leishmaniasis (CL) is a parasitic disease caused by leishmaniasis species; it is widespread in northwestern of Libya. It is normally transmitted to humans by the bite of infected female sand flies, and it is endemic in many places around the world. In Libya, it has become a growing public health concern in recent years. This study investigates the prevalence of CL, its seasonal trends and diagnostic methods employed over a five-year period from 2020 to 2024 in Tripoli, Libya. A total of 913 CL cases were in this study, and the results showed that the number of cases increased significantly in 2020 and 2022 due to internal migration and displacement as a result of local conflicts. The study also highlighted the highest prevalence of CL was reported in Jan, Feb, and Mar among individuals between the ages of 16 - 47. To detect leishmaniasis, microscopy was used to visualize parasites to detect leishmania, and polymerase chain reaction (PCR) as they proved to be a reliable technique. These findings underscore the need to improve vector control, improve diagnostic tools and to raise the public awareness to combat the ongoing leishmaniasis endemic in Libya.

Keywords: Cutaneous Leishmaniasis, Tripoli, Libya, epidemiology, seasonal patterns, diagnostic methods, public health, vector control.

الملخص:
داء الليشمانيات الجلدي هو مرض طفيلي تسببه أنواع من الليشمانيات، وهو منتشر على نطاق واسع في شمال غرب ليبيا. ينتقل عادةً إلى البشر عن طريق لدغة ذباب الرمل الأنثوي المصاب، وهو متوطن في العديد من الأماكن حول العالم. في ليبيا، أصبح مصدر قلق متزايد للصحة العامة في السنوات الأخيرة. تبحث هذه الدراسة في انتشار داء الليشمانيات الجلدي، واتجاهاته الموسمية، وطرق التشخيص المستخدمة على مدى خمس سنوات من 2020 إلى 2024 في طرابلس، ليبيا. بلغ إجمالي حالات داء الليشمانيات الجلدي في هذه الدراسة 913 حالة، وأظهرت النتائج أن عدد الحالات قد زاد بشكل ملحوظ في عامي 2020 و2022 بسبب الهجرة الداخلية والنزوح نتيجة للصراعات المحلية. كما أشارت الدراسة إلى أن أعلى معدل انتشار لداء الليشمانيات الجلدي كان في يناير وفبراير ومارس بين الأفراد الذين تتراوح أعمارهم بين 16 و47 عامًا. للكشف عن داء الليشمانيات، يتم استُخدام المجهر لتصوير الطفيليات، كما يتم استخدام تفاعل البوليميراز المتسلسل، حيث أثبتت هذه التقنية موثوقيتها. وتُؤكد هذه النتائج على ضرورة تحسين مكافحة النواقل، وتطوير أدوات التشخيص، ورفع مستوى الوعي العام لمكافحة هذا المرض المتوطن في ليبيا.

الكلمات المفتاحية: داء الليشمانيات الجلدي، طرابلس، ليبيا، علم الأوبئة، الأنماط الموسمية، طرق التشخيص، الصحة العامة، مكافحة النواقل.

Introduction

Leishmaniasis is a group of neglected complex infectious diseases caused by flagellated protozoan parasites belonging to *Trypanosomatida* subfamily, genus *Leishmania* which include over 20 *Leishmania* species and transmitted by the bite and blood suckling of infected phlebotomine female sand fly vectors (around 42 species of *Phlebotomus* in the Old World, and 56 species of *Lutzomyia* in the New World) to humans or many other mammalian species reservoirs to maintain the parasite life cycle [1,2]. Leishmaniasis is the second death cause parasitic disease after malaria worldwide, and it has become an opportunistic pathogen since immunocompromised patients can serve as human reservoirs for it [3,4]. It is an endemic infection in 98 tropical and subtropical countries in Europe, Africa, Asia, and Americas with 350 million people are at the risk of getting infected each year, and an estimated 1.5 to 2 million new cases, and around 70,000 deaths yearly [5]. In North Africa, leishmaniasis is a

common chronic disease that affects all ages, and it is linked to poverty, malnutrition, poor housing, lack of health resources, and population migration [2,6]. The disease is classified into three categories: Cutaneous Leishmaniasis (CL), Mucocutaneous Leishmaniasis (ML), and Visceral Leishmaniasis (VL) [7,8]. Cutaneous leishmaniasis (CL) is the most common form of the disease, which did not reach epidemic levels until seventies where more than 50.000 cases have been recorded, and about 600,000 to 1 million new cases reported annually worldwide according to WHO/2023 [9,10,11]. Cutaneous Leishmaniasis causes non-life-threatening ulcerative lesions on all exposed body parts which leave permanent wounds and lead to significant disability or social stigma [12] In the Northwest of Libya Cutaneous leishmaniasis (CL) created a serious public health problem for decades, and the first two cases were recorded back in 1930 [13]. Since then, cases have been spread to 49 new foci throughout the northwestern of Libya including Misrata, Tawergha, Sirte, and Zlitten to add to Tripoli, and Jabal Nafusa [10, 14]. CL causative agents in Libyan northwest are *Leishmania major* and *Leishmania tropica* parasites, *Phlebotomus* female sand flies are vectors, human and *Meriones spp* rodents serve as reservoirs [14]. Transmission cycles of CL in Libya are considered as zoonotic transmission for *L. major* where the parasites are transmitted by *Phlebotomus* sand flies from *Meriones sp* rodent reservoir to humans [15]. On the other hand, *L. tropica* is considered as an anthroponotic where the disease is transmissible from human to human, and humans are required to maintain the life cycle [16]. Cutaneous leishmaniasis incubation period is vary and only few studies has been approached about it, according to Aoun, K., *et al* 2020 they found that for CL caused by *L. major* from the bitten of the infected sandfly until the skin lesions appearance is 2 weeks to 6 months and it needs around 2–6 months to heal, while the incubation period for CL cases caused by *L. tropica* is less than 4 months and it needs approximately 6–15 months to heal, but both lesions can lead to lifelong psychological burden [4, 6, 17, 18, 19, 20]. The number of Cutaneous leishmaniasis cases in Libya have progressively decreased from 7180 in 2006 [21], 3884 in 2007, 1800 in 2008, to 1503 in 2009 [10]. The Libyan National Centre for Diseases Control/2010 (LNCDC/2010) reported that around 981 new infected cases occur yearly [22]. The peak of seasonal distribution of CL in Libya 1995 to 2012 due to *L. major* were in January, while *L. tropica* were distributed all over the year which is similar to the southeastern Tunisia [23]. In Libya 2023, the number of cutaneous leishmaniasis cases were 448, out of them were 148 cases in Tawergha which can be due to the recent return of displaced populations to their city [10]. These high levels of CL cases in the Libya confirm the urgent need for the *Leishmania* control programme, and an urgent attention to know the risk factors that contributed to the CL infection.

The objective of this study is twofold, first to assess the epidemiological features ad prevalence of CL from 2020 to 2024 in Tripoli, Libya, and second to estimate the infection rates among males and females, with the most affected age group and seasonal change rates

Materials and Methods

The study was conducted 2020 - 2024 in Tripoli, Libya to estimate the prevalence of leishmaniasis pathogens. Specimen reports were collected from the Libyan National Centre for Diseases and Control (LNCDC) and Tripoli Dermatology Hospital. A total of 913 cases were screened with Cutaneous leishmaniasis (CL). Various diagnostic methods were used such as the parasitological techniques, including microscopy to visualize *Leishmania* parasites in Giemsa-stained smears or culture, and polymerase chain reactions (PCR) which used for detecting *Leishmania* DNA. However, the gold standard technique for CL diagnosis remains the direct to visualize *Leishmania* parasites using microscopy.

Statistical Analysis

The data obtained were statistically analyzed using frequency distribution, descriptive analysis & conceptual statistics, and T-test in order to find out the trends and correlations between different demographic factors (age, gender, and season) and the incidence of CL. Differences were considered significant at p-value ≤ 0.05.

Results

The epidemiology of the current study of Cutaneous Leishmaniasis in Tripoli included 913 CL cases between 2020 – 2024. The highest peak reached 349 cases (38.23%) in 2020, and 246 cases (26.94%) in 2022. On the other hand, the incidence of CL declined reaching 104 cases (11.39%), 116 cases (12.71%), and 98 cases (10.73%) in 2021, 2023, and 2024 respectively. Statistically, the number of CL cases in 2020/2022 (595 infected cases) has been found significantly different compared with the number of CL cases in 2021, 2023, and 2024 (318 infected cases).

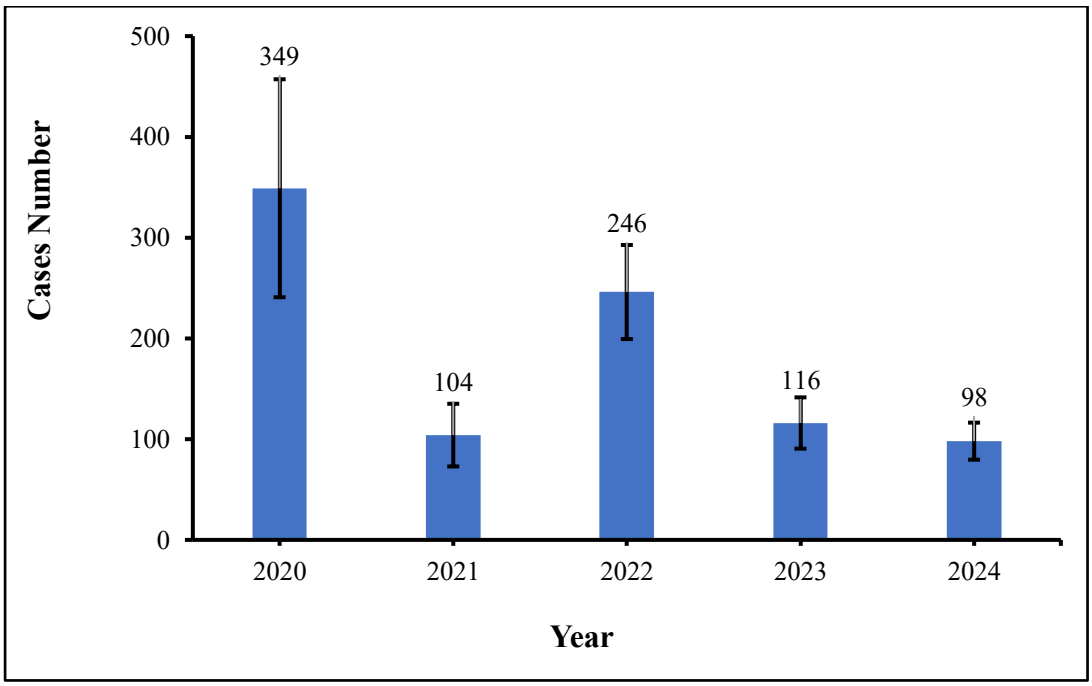


Figure 1: Evolution of the annual cases of CL in Tripoli, Libya 2020–2024.

For the 5 years gender distribution (2020 – 2024) in Tripoli, Libya, among the 913 total CL patients there were significantly more males infected (67.79%) than females (32.20%). The highest CL male cases were reported in 2020 with 251 cases, followed by 2022 with 156 cases; but the cases declined in 2021, 2023, and 2024 to 74 cases, 76 cases, and 62 cases respectively. On the other hand, the highest CL female cases were reported in 2020 with 98 cases, followed by 2022 with 90 cases; however, in 2021, 2023, and 2024 the cases declined to 30 cases, 40 cases, and 36 cases in row.

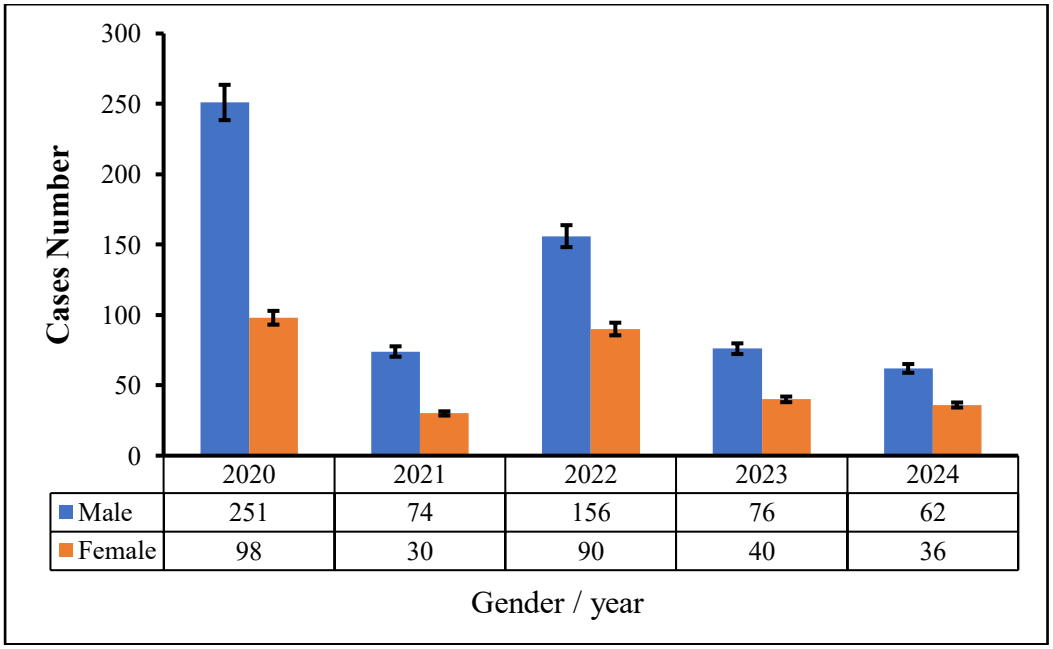


Figure 2: Evolution of the annual cases of CL Male and Female in Tripoli, Libya 2020–2024.

Distribution of Cutaneous Leishmaniasis infection in the current study on age indicated that all age groups ranged from 01 days to 90 years were affected. This finding revealed that the Median age was 27.5 years, and the majority CL infection rate was found among 32-47 age groups with 332 cases (36,36%), followed by 16-31 age group with 241cases (26.39%), then under 16 years old with 156 cases (17.08%). On the other hand, the cases number dropped down to 119 cases (13.03%) in age group 48-63, and 65 cases (7.11%) over 63 years old.

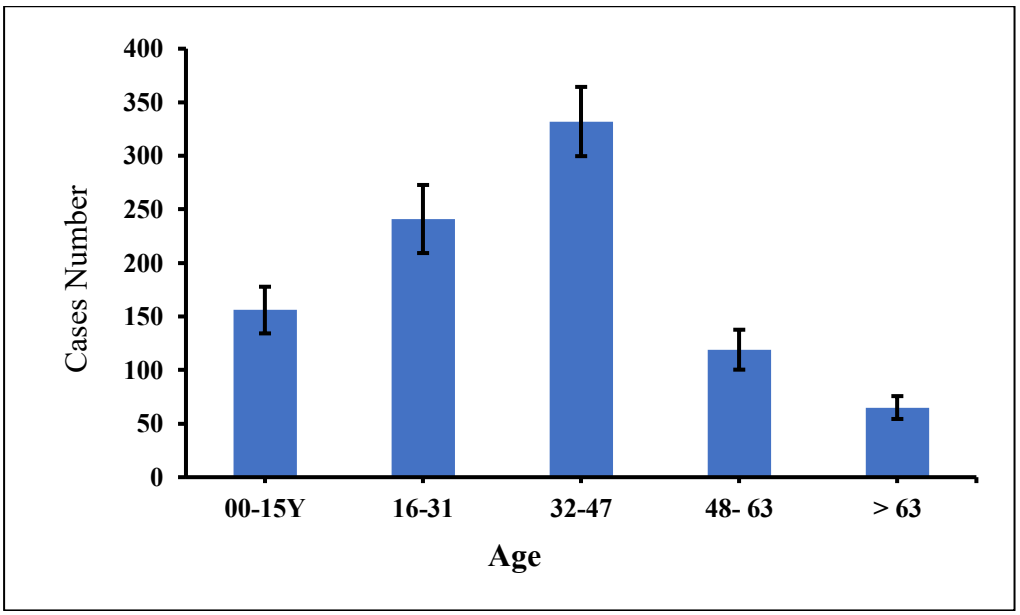
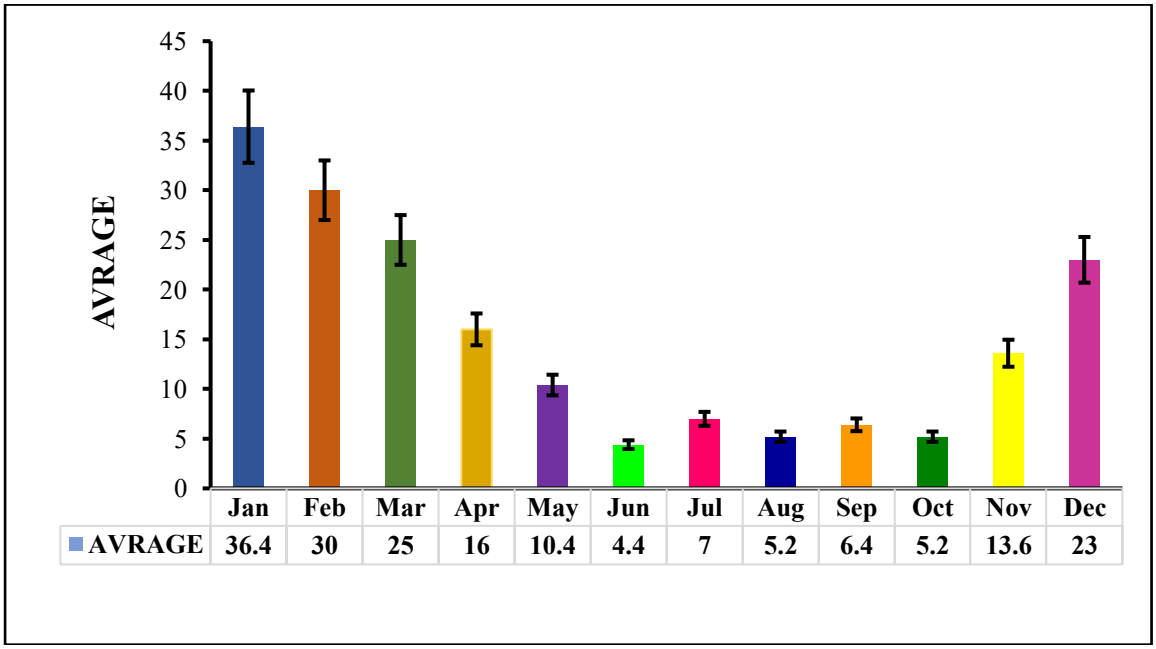


Figure 3: Overall Age group distribution of CL Cases between ages in Tripoli, Libya

Another interesting result during these 5 years (2020–2024) was the seasonal distribution. The highest total number of CL infection was recorded during November to March with highest peak being in January with 182 cases (19.93%), followed by 150 cases (16.43%), and 125 cases (13.71%) in February, and March respectively. Then the total patients number start to declined sharply in April with 80 cases (8.76%), and got very low in Jun with 22 cases (2.41%). This seasonal increase of CL is noteworthy as the peak of leishmaniasis occurs during the colder months when sandfly activity is generally reduced. The finding of this study clearly show that CL cases started in late autumn or early winter with a long parasite incubation period of 4-6 months as the symptoms and lesions of CL started to appear later in December, Jan, Feb, and March.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AVRAGE	36.4	30	25	16	10.4	4.4	7	5.2	6.4	5.2	13.6	23

Figure 4: The overall seasonal distribution of the CL cases in Tripoli, Libya (2020-2024).

Discussion

Leishmaniasis is a widespread disease that results in serious health problems to humans in many parts of the world including Libya, especially in the western areas of the country. The number of infected people was reported to increase until 2023, which triggered researchers to conduct some studies to better understand the disease. As Bsrat, A., *et al* (2015) mentioned that the prevalence of CL is significantly variable between men and women as well as from place to place depending on the sand flies vector habitats, human activities and where they live, environmental factors, and the reservoir distributions [24].

This study data was collected from the Libyan National Center for Disease Control and Dermatology Hospital, Tripoli indicating some significant trends. This research highlighted that during the study period 2020 - 2024, the scale of infection reached the peak in 2020 and 2022 with 349 case (38.2%) and 246 case (26.94%) infected cases of CL reported respectively, in which they were significantly different with *p-value 0.047* compared with 2021, 2023, and 2024 of CL cases which were 104 cases (11.39%), 116 cases (12.71%), 98 cases (10.73) in row, these cases number for 2020, 2021 is consistent with Mustafa R *et al*. (2024) [25]. This dramatic rise in CL infection in 2020 could be most likely attributed to the civil war which struck the country apart at that time resulting in collapse of the health system leaving many people without health care, and absence of vector control programs which increased the risk factors for CL infection, add to this, in 2022, the high cases number could be due to the breakdown of many hospitals and difficulties of navigating to reach. On the other hand, the lowest CL infection rates were reported in 2021 with 11.39% cases, which due to the health care system breakdown immediately after the war ends. Again in 2023 and 2024, the low CL infection rates were reported with 12.70% and with 10.73% cases respectively. All of these results indicated a decline in the number of CL cases over these 3 years because of the control measures taken such as health campaigns, vectors and reservoirs control programs and better diagnosis methods which reduced the spread of the disease. These finding agreed with many CL studies under war conditions as a study by Croft A *et al*. (2008) which confirmed that during 2000s in Iraq war, CL infection spread as an endemic [26]; add to that, in Afghani civil war, Ahmad K. (2002) reported that during 1990s there was an outbreak of CL infection [27]; furthermore, Rowland M *et al*. (1999) found that there were thousands of CL cases among Afghanistanian refugee populations in Pakistan [28]. All of these studies show that several virulence factors and marks characterize the cutaneous leishmaniasis epidemiology all over the world.

Second, gender distribution rates of this study results for the 5 years (2020 – 2024) revealed consistently disparity in CL infection rates between males and females. Overall, males were predominance with 67.79% compared to females with 32.20% which is statistically significant with *P-value 0.036*. These results of the gender disparity are consistent with numerous studies as Abdellatif *et al.* (2013), Amro *et al.* (2017), Arshah, T.M., and Arshah, A.A.M., (2020), and Manal *et al*. (2013) that all showed more men were affected by CL than women [23, 29, 30, 31]. This higher rate of male infection can be attributed to the engagement of Libyan males outdoor lifestyle activities such as hiking and camping and hanging out in the evening outdoor times for coffee time during hot nights rendering them more susceptible to the sand fly bites infection compared to women as the latter normally tend to spend less time outside their homes.

This study found that all age groups were infected with cutaneous leishmaniasis (CL), but the highest affected age groups were individuals aged 16-31 and 32-47, with no significant differences found between them. Therefore, it can be deduced that these individuals were at risk of sandfly bites due to their increased exposure. Despite the higher incidence rates in adults, the results indicated that younger age groups (under 16) and elderly groups (48-63 and >63) experienced lower infection rates of 17.08%, 13.03%, and 7.11%, respectively. This disparity could be attributed to the wartime situation, where the 16-31 and 32-47 age groups were more likely to interact with the environment and engage in outdoor work in endemic areas of Tripoli, thereby increasing their exposure to sandflies. Conversely, children and the elderly were more likely to stay indoors, reducing their exposure. Consequently, the middle age group was disproportionately affected. Based on these findings, we can confirm that CL is a significant health concern among all age groups in Tripoli, Libya. This trend has been reported in other parts of the world, where adults are most at risk due to increased exposure to sandflies in the environment. Our study results agreed with Messaoudene, F., *et al*. (2023) in Algeria, where they reported that 34.87% of CL cases occurred in the 20-44 age group [32]; Lemma, W., *et al*. (2015) in northwest Ethiopia, who found that 79.9% of leishmaniasis cases were in the 15-24 and 25-34 age groups [33]; and Arshah, T.M., and Arshah, A.A.M. (2020) in Libya, who found that patients under 40 years old, with a median age of 25, were the most affected [30], Collis, S., *et al.* (2019) in Sudan, they illustrated that the majority of cases were an age group 19 to 30 and 31 to 45 years old with 27.4% and 25.6% respectively [34]. However, our results disagreed with Amro, A., *et al*. (2021) in Libya, which reported that all age groups were infected with no significant differences among them [35], and Anwar, M., *et al*. (2007) in Pakistan, who found that the most affected age group was individuals aged 10-14 years [36]. In light of this discussion, we can confirm that while certain age groups may be more exposed, age is not a determining factor for CL infection

In this study which conducted in Libya from 2020 to 2024, total CL cases monthly distribution showed seasonal variations with remarkable peak incidence most notably in January (19.94%), February (16.43%), followed by March (13.69%) where sandfly activity is generally reduced because of the cold; then the cases number decreased to a minimum during summer (2.41% in June), these findings are similar to those reported in Tunisia by Bousslimi *et al*. (2010) [37], in Sudan by Collis, S *et al*. (2019) [34], in Algeria by Messaoudene, F *et al*. (2023) [32], and in Libya by Amro A, *et al.* (2012) [21], as well as by Arshah, T.M. (2023) [4]; where they all found that the highest numbers of new cases were in the winter months and the lowest in the summer months. This can be explained by the fact that the long incubation period of *Leishmania* after infection could last on average 1 - 6 months [4, 21], making the diagnosis of the symptoms completed during autumn and winter not during summer time. The seasonal

pattern of the CL disease in the Mediterranean Basin is correlates with the sand fly activity (May - October), where there is a lag time between the sand fly bite and the skin lesions development until the patients recognize the need for medical tension, which extend after that until February, March of the next year [23, 38].

These findings confirmed that CL leishmaniasis is a major problem in Libya and the number of infections is influenced by a combination of many factors such as climate change, migration and sandflies behavior, environmental factors and the massive displacement of people from and to Tripoli without any controlling measures for the vectors and reservoirs in the city were considered as a risk factor assisting the spread of Cutaneous Leishmaniasis in Libya.

Overall, this study highlights that the Libyan ministry of health should adopt strict vector and reservoir control measures particular in the state of wars and natural catastrophes. The Libyan ministry of health should continually raise the public awareness about the danger of sand-fly bites and how to get access to health care when bitten by a sand-fly and to as a raise peoples' understanding of weather patterns that are critical to combat the disease and limit its spread.

Conclusion

This study on Cutaneous leishmaniasis in Tripoli, Libya was conducted over the past five years will hopefully provide valuable insights into current knowledge on the CL epidemiology of the disease in Tripoli, Libya. The peak of Cutaneous leishmaniasis cases in Libya reported in 2020, 2022 indicated that the Libyan civil war and internal migration of people to Tripoli seeking for secure places played a major role in increasing the spread of the disease in Tripoli. Furthermore, the decline in the cases of CL in 2021, 2023 and 2024 proved that vector and reservoir host control measures, health interventions and the disease control management had a vital role in reducing the spread of Cutaneous leishmaniasis in Tripoli. Moreover, the results clearly indicated that males were more likely infected with CL than females due to their social outdoor activities where sandfly vectors thrive. In addition, the results showed that the age group between 16– 47 years old was the most affected by CL, in which was associated with other work and social outdoor activities in this age. The seasonal distribution of CL cases, which recorded the highest rate in the first quarter of the year highlighted the impact of environmental and climatic factors on the disease transmission

Overall, the number of CL cases has declined over the last three years of the study reflecting the impact of public health interventions, the increasing awareness of the danger of the disease among people and early diagnosis strategies, but more research is needed to ensure surveillance and long-term control of the disease in Libya

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