



Study of The Prevalence of Cutaneous Leishmaniasis in Yafran City and Its Surrounding Areas

Abdulatem Masoud E. Alkesh¹, Abdulfatah Ramadan Swesi^{2*}, Noureddine Al-Mabrouk Mohammed Issa³, Abobaker Saleh Ibrakaw⁴

^{1,2} Department of Medical Technology, High Institute of Sciences and Technology, Alasabaa, Libya

³ Department of Medical Technology, High Institute of Sciences and Technology, Jadu, Libya

⁴ Libyan Center for Desert Research and Development of Desert Communities, Murzuq, Libya

دراسة معدل إنتشار مرض الليشمانيا الجلدي في مدينة يفرن والمناطق المجاورة لها

عبدالعظيم مسعود الكيش¹، عبدالفتاح رمضان سويس^{2*}، نور الدين المبروك محمد عيسى³، ابوبكر صالح ابريكاو⁴

^{1,2} قسم التقنيات الطبية، المعهد العالي للعلوم والتقنية الأصابعة، ليبيا

² قسم التقنيات الطبية، المعهد العالي للعلوم والتقنية جادو، ليبيا

³ المركز الليبي لأبحاث الصحراء وتنمية المجتمعات الصحراوية مرزق، ليبيا

*Corresponding author: abdulfatahswesi@gmail.com

Received: June 26, 2025

Accepted: August 20, 2025

Published: August 25, 2025

Abstract:

This study was conducted with the aim of determining the prevalence of cutaneous leishmaniasis in the city of Yafran and its neighboring areas. The study included patients who attended the Dermatology clinic at Yafran General Hospital and the Center for Disease Control (Yafran branch), and who were diagnosed with the disease during the years 2022 and 2023. The study results revealed the registration of 165 cases during the mentioned period. The results showed that males were more susceptible to the infection, with 109 cases (66.1%), compared to 56 cases among females (33.9%). As for the age groups, the group under 60 years of age was the most affected, with 86 cases (52.1%), while the group over 60 years of age recorded 79 cases (47.9%). The results also indicated that the infection rate was high during the months of December, February, March, and January, with percentages of 21.2%, 15.7%, 14.5%, and 13.9%, respectively. The most affected area were Yafran (18.2%), Al-Qalaa (12.1%), Kikla (11%), Al-Zawiya (9.1%), and Bir Al-Ghanam (8.5%). Regarding environmental factors, the study results showed that the average temperatures and humidity for 2022 were 20.2°C, and 65% respectively, while the average for 2023 was 19.7°C, and 68.6.

Keywords: Prevalence, Cutaneous Leishmaniasis, Yafran, Libya.

الملخص

أجريت هذه الدراسة بهدف تحديد معدل انتشار مرض الليشمانيا الجلدي في مدينة يفرن والمناطق المجاورة لها. وقد شملت الدراسة المرضى الذين تردوا على عيادة الجلدية بمستشفى يفرن العام ومركز مكافحة الأمراض (فرع يفرن)، والذين تم تشخيص إصابتهم بالمرض خلال عامي 2022 و 2023. كشفت نتائج الدراسة عن تسجيل 165 حالة إصابة خلال الفترة المذكورة. وأظهرت النتائج أن الذكور كانوا أكثر عرضة للإصابة بواقع 109 حالات (66.1%)، مقارنة بـ 56 حالة بين الإناث (33.9%). أما بالنسبة للفئات العمرية، فقد كانت الفئة العمرية الأقل من 60 عامًا هي الأكثر إصابة بـ 86 حالة (52.1%)، بينما سجلت الفئة فوق 60 عامًا 79 حالة (47.9%). كما أوضحت النتائج أن معدل الإصابة كان مرتفعًا خلال أشهر ديسمبر، فبراير، مارس، ويناير، بنسب بلغت 21.2%، 15.7%، 14.5%، و 13.9% على التوالي. وكانت المناطق الأكثر تأثرًا بالمرض هي يفرن (18.2%)، القلعة (12.1%)، ككلة (11%)، الزاوية (9.1%)، وبنر الغنم (8.5%). وفيما يخص العوامل البيئية، أظهرت نتائج الدراسة أن متوسط درجات الحرارة والرطوبة لعام 2022 بلغ 20.2 درجة مئوية و 65% على التوالي، بينما كان المتوسط في عام 2023 هو 19.7 درجة مئوية و 68.6%.

الكلمات المفتاحية: إنتشار، الليشمانيا الجلدية، يفرن، ليبيا.

Introduction:

Leishmaniasis refers to several different diseases caused by infection with organisms called protozoa. Protozoa are the simplest organisms in the animal kingdom, and they are all unicellular [1]. Leishmaniasis is a parasitic disease transmitted by the bite of a sandfly. The sandfly transmits the *Leishmania* parasite by sucking it from the blood of an infected person (human or animal such as dogs and rodents), then transferring it to the blood of another person, who in turn transmits the disease to them. It is widespread in agricultural and rural areas [2], is distributed across four continents, and is considered by the World Health Organization (WHO) to be one of the six most common parasitic diseases affecting humans [3,4].

Scientists [5] have indicated that this disease is endemic in the Middle East, Africa, Asia, and South America, where the number of cutaneous leishmaniasis cases is approximately one to half a million, with approximately half a million cases recorded annually [6,7]. The main forms of leishmaniasis in warm regions: visceral leishmaniasis (VL), cutaneous leishmaniasis (Oriental sore) (CL), and mucocutaneous leishmaniasis (MCL). Various forms of leishmaniasis occur in warmer regions across 88 countries in Asia, Africa, Europe (Mediterranean countries), and Latin America [7,8].

Cutaneous leishmaniasis is the most common disease caused by *Leishmania tropica*, accounting for 50–75% of all cases [6,7]. CL is endemic in the northwestern region of Libya, particularly in the Nafusa Mountains. Among the most important sites where the disease-carrying animals are found are ancient places, such as swamps, pits, and cliffs, as well as what is known as (Damous), and old houses surrounding cities where mosquitoes and other animals live [9,10]. Its life cycle involves humans being infected by the bite of a female sandfly. It feeds on the blood of humans or animals [4,11].

When it sucks the blood of an infected human or animal, the first step occurs: a flagellate stage transforms into the pro flagellate stage, which multiplies in the insect's stomach and then reaches the anterior part of the midgut to settle in its saliva. When it bites a healthy human or animal, it injects these parasites into its body, causing disease [4,12,13]. When macrophages engulf the parasite, it transforms into the flagellate stage within a short period of 12–24 hours and continues to divide inside the phagocytic cells. When the phagocytic cell is filled with the parasite, it bursts, and the flagellate stages are released to infect other phagocytic cells.

When the vector insect takes a blood meal from the infected host, it transfers the flagellate stage to the peripheral blood, thus repeating the life cycle again [4]. Cutaneous leishmaniasis infection leads to the appearance of a skin ulcer on exposed parts of the body, and the ulcer heals on its own within a period ranging from three months to two years. The infection is not accompanied by fever or any side effects and does not leave a mark or scar that disfigures the body aesthetically [6,14]. *Leishmania* parasite belongs to the family Trypanosomatidae, which is within the order of Kinetoplastids, which is attributed to the class Zoomastigophora, which is a branch of the phylum Sarcomastigophora, which is attributed to the kingdom Protista [15,16].

Study Problem:

Cutaneous leishmaniasis (CL) is a neglected tropical infections disease that poses a significant public health challenge in many parts of the world, including Libya. Despite efforts to control the disease, infection rates remain high in some areas, necessitating of the dynamics its spread. The city of Yafran and its surrounding areas lack up-to-date, comprehensive epidemiological studies that shed light on the current status of CL prevalence. Previous studies have been either limited in scope or outdated, failing to provide a clear and detailed picture of the disease's true prevalence rate or the contributing factors, such as environmental and climatic factors, demographic composition, community behaviors, the availability of healthcare, and vector control measures. Therefore, this study addresses this knowledge gap by answering the following central research question: What is the prevalence rate of CL in city of Yafran and its neighboring areas, and what are the most prominent epidemiological and environmental factors that contribute to this spread?

Study objectives:

This study aims to evaluate the epidemiological situation of CL in the city of Yafran and its surrounding areas by achieving the sub- objectives:

- To Measuring the prevalence rate CL in the city of Yafran and its surrounding areas during a specified period.
- To analyze the epidemiological factors influencing the disease's spread by studying the relationship between CL infection and certain demographic variables, such as gender and age.
- To identify the geographic areas with the highest disease incidence among the cities and regions surrounding Yafran, classifying them according to the severity of spread.
- To determine the seasonal pattern of disease transmission by analyzing monthly infection rates and identifying the months that witness a peak in the number of cases.

- To assess the environmental impact of temperature and humidity on the disease's spread by analyzing the relationship between the average temperature and humidity in 2022 and 2023 and the rates of cutaneous leishmaniasis infection.
- The study also aims to collect reliable scientific data that can be used in future research, contributing to collaboration between organizations and the exchange of knowledge and expertise in the field of disease control.

Material and methods:

Sample collection methods:

This study was conducted to determine the prevalence of cutaneous leishmaniasis in Yafran city and its surrounding areas during the years 2022-2023. The cases included patients visiting the dermatology clinic at Yafran General Hospital and the Center for Disease Control, Yafran branch, who were diagnosed with cutaneous leishmaniasis during this period. The diagnosis of cutaneous leishmaniasis is based on clinical symptoms and examination and is confirmed by parasite detection (clinical diagnosis by dermatologists). Dermatologists completed data collection for cutaneous leishmaniasis patients (private records) and submitted them to the National Center for Disease Control in Yafran.

Data on cutaneous leishmaniasis patients (sex, age, geographic area, year, and month) were recorded. Descriptive statistics were used to summarize the data, including frequency distribution and percentages for demographic, geographic, and seasonal variables, to assess statistical significance, such as differences in infection rates between males and females and age groups for the years 2022-2023. This was done using the SPSS software. This was done after obtaining the necessary approvals for data collection from the Yafran Center for Disease Control. Patient data was treated with strict confidentiality and was compiled to ensure anonymity.

Results and discussion:

The results of the study showed a number of (165) cases of leishmaniasis recorded in the records of the National Center for Disease Control Yafran during the period 2022-2023 AD.

Regarding gender:

Table (1) shows the total number of cases for the years 2022-2023 for both sexes and their percentages. The results showed a higher number of infected males than females, with 109 cases (66.1%), while the number of infected females reached 56 cases (33.9%). The results of this study were consistent with many studies, including a study conducted in the central coastal region of northern Libya, which aimed to limit the incidence of infection in the specified area, where 156 cases were recorded. The incidence rate of cutaneous leishmaniasis by gender was higher among males than females by (68%) (32%), respectively [17]. The results of a study conducted in the Yafran region during the period 2012-2018 also showed that the incidence rate among males reached (58%), while the rate among females reached (42%) [10].

Table 1: The total number of cases for both gender and their percentages.

Gender	Number of cases	Percentage
Males	109	66.1%
Females	56	33.9%
Total	165	100%

This is consistent with the study conducted in the Souq Al Khamis region on patients visiting the dermatology clinic at Al Maqarif Hospital, which showed that males are more infected than females by (67.16%) (32.14%) respectively [16]. The convergence between the current study and previous studies is due to several reasons, including that males are more mobile and active outside the home due to the nature of the work they perform, whether herding, commercial activity, or daily services, which allows males to be outside the home for longer periods compared to women.

The higher incidence rate among males than females is due to the exposure of body parts, especially the extremities and face, compared to females, which are usually not exposed due to the nature of women. Despite this general consensus, The results of the current study were not consistent with a study conducted in the city of Tawergha, which examined some epidemiological and clinical aspects of cutaneous leishmaniasis in the city, and showed that females were more affected than males, reaching 51.1% compared to 48.8% [18].

Similarly, a study conducted in Lattakia Governorate on patients visiting the Specialized Center for Leishmaniasis and Parasitic Diseases, where the percentage of females was 51.33% and males 48.66% [19]. This can be attributed to the fact that women in the areas where these studies were conducted bear greater responsibility in terms of assistance with agricultural work or daily services, making them more exposed to the insect than males.

The distribution of sample members based on age groups:

Table (2) and figure (1) shows the age groups and rates of cutaneous leishmaniasis cases for both sexes for the years 2022-2023. The results showed that the number of cases under the age of sixty was 86, representing 52.1%, and the number of cases over the age of sixty was 79, representing 47.9%.

Table 2: The distribution of sample members based on age groups.

Gender Age groups	Number of cases	Percentage
Less than 60 years	86	%52.1
More than 60 years	79	%47.9
Total	165	100%

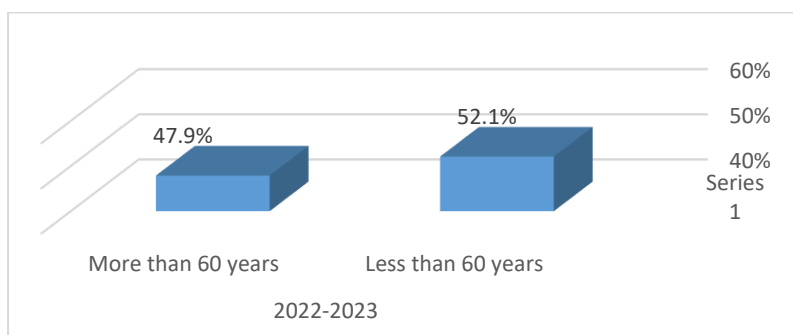


Figure 1: The relationship between age and incidence rate.

This finding is consistent with previous studies that have indicated that younger age groups are most affected, which indicate that age groups under 60 are the most affected. Among these studies is a study conducted in the city of Tawergha, which showed that the highest infection rate was among young people, with children being the most affected [18]. An epidemiological study of the leishmaniasis parasite in the north-central part of Libya also showed that the highest infection rate was among age groups under 60, with the 21-39 age group having the highest infection rate compared to other age groups [17]. Regarding age groups over 60, this study is consistent with several studies, including a study conducted in the southern Zawiya region [20], which showed that those over 60 had a 3% lower infection rate than other age groups. A study conducted to determine the prevalence of leishmaniasis in the Western Mountain, specifically in the Zintan municipality, showed that age groups over 60 years are the least affected by cutaneous leishmaniasis [6]. It also agreed with a study conducted in the Souq Al Khamis area, which indicated that age groups over 60 years were the least affected by cutaneous leishmaniasis, at a rate of 11.2% [16]. This is because age groups under 60 are typically more active and mobile outside the home than older groups.

Relationship between infection and age groups with respect to gender:

Table (3) shows that infection occurred in age groups under 60 years, with males accounting for 62 cases, representing 37.6% of the total number of cases, compared to 24 cases among females, representing 14.5% of the total number of cases during 2022-2023. Similarly, among the age group over 60 years, males had a higher incidence than females, with 47 cases, representing 28.5% of the total number of cases, and 32 cases among females, representing 19.4% of the total number of cases, for the same years.

Table 3: The distribution of sample members based on age groups and gender.

Age groups	Gender			
	Males		Females	
	N	%	N	%
Less than 60 years	62	37.6%	24	14.5%
Over than 60 years	47	28.5%	32	19.4%
Total	109	66.1%	56	33.9%

The prevalence of infection during the months of the year and the percentage:

The study shows through Table (4) that the number of infected people was highest during the months of December, February, March and January at rates 21.2%, 15.7%, 14.5% and 13.9% respectively. The months with the highest incidence, we note that these were the months with the highest rainfall rates compared to other months, resulting in the presence of swamps, ponds, and stagnant water, in addition

to high humidity rates, which can lead to the presence and reproduction of sand flies in these months. The results of the current study are consistent with an epidemiological study of the Leishmania parasite conducted in the north-central part, which showed that the incidence rate in December reached 59.35% [17]. This study also agreed with a study on the endemicity of cutaneous leishmaniasis in the southern Zawiya region, which showed that the peak incidence of the disease was in December, accounting for approximately 48% of the total cases [20].

The current study also agreed with a study conducted in the Zintan municipality in 2019, which showed that the incidence rate was 82.29% in late autumn and early winter (October-November-December) , This correlation is attributed to the favorable climatic conditions for sandfly activity and reproduction during these months, characterized by relatively moderate temperatures and high rates of humidity and rainfall, which leads to the formation of swamps and stagnant water, which are suitable habitats for the vector. In contrast, the results of the current study differ from the study conducted in Tawergha to study some epidemiological and clinical aspects of cutaneous leishmaniasis, which indicated that the highest incidence of cutaneous leishmaniasis was in September and the lowest rate in February at 7.23% and 3%, respectively [18]. This study also differed from the study conducted in Al-Hamza Al-Sharqi district and some of its affiliated areas, as the highest incidence rate was in April at 16% and the lowest rate was in October at 3% [2]. This variation in monthly distribution reflects the differences in climatic and environmental conditions between different regions, in addition to the complex interaction between temperature, humidity, rainfall, and the presence of hosts that store the parasite.

Table 4: The prevalence of infection during the months of the both years 2022-2023.

Months	Number of cases	Percentage
January	23	13.9%
February	26	15.7%
March	24	14.5%
April	3	2%
May	4	2.4%
June	2	1.2%
July	4	2.4%
August	8	4.8%
September	3	2%
October	12	7.2%
November	21	12.7%
December	35	21.2%
Total	165	100%

Geographical distribution of infected people:

Table (5) and Figure (2) illustrates the distribution of cutaneous leishmaniasis cases in the towns surrounding Yafran. The data indicates that Yafran recorded the highest number of infections, accounting for 18.2% of the total cases, followed by Al-Qalaa and Kikla at with 12.1%, 11 respectively. In contrast, Al-Zarqan and Al-Qawalish registered the lowest number of cases, with 0.6% each.

Table 5: The Geographical distribution of cutaneous leishmaniasis.

The region	Frequency	Percentage	The region	Frequency	Percentage
Yafran	30	18.2%	Al-Haraba	5	3%
Al-Qalaa	20	12.1%	Al-Rajban	4	2.4%
Kikla	18	11%	Al-Awiniya	4	2.4%
Zawiya	15	9.1%	Umm Al-Jarsar	4	2.4%
Bir Al-Ghanam	14	8.5%	Al-Rahibat	3	2%
Tagma	10	6.1%	Jadu	2	1.2%
Al-Rayyanah	7	4.2%	Al-Ghanaima	2	1.2%
Al-Khalifa	6	3.6%	Awlad Attia	2	1.2%
Wadi Al-Hay	5	3%	Al-Asabaa	2	1.2%
Zintan	5	3%	Al-Zarqan	1	0.6%
Al-Rabita	5	3%	Al-Qawalish	1	0.6%

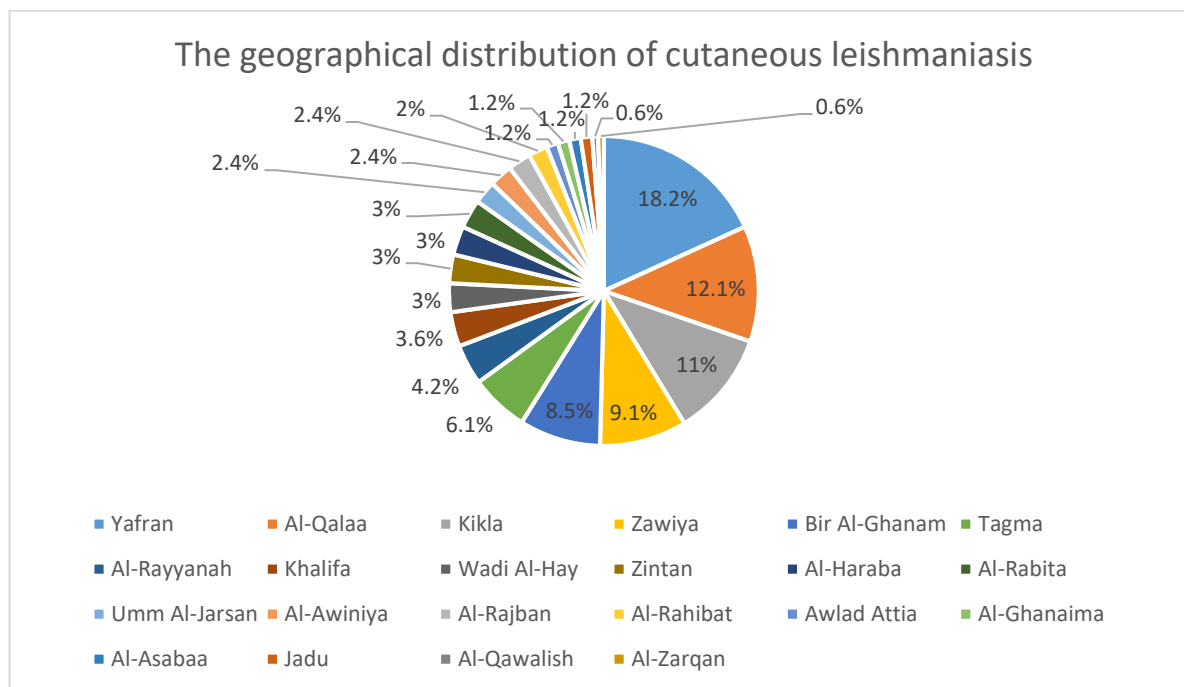


Figure 2: The geographical distribution of cutaneous leishmaniasis.

This geographic distribution suggests that these areas may provide suitable breeding grounds for sand flies and reservoir hosts. The high prevalence in these areas is likely due to the population's low level of health awareness and the lack of effective sand-fly and rodent control programs.

Average temperature and humidity rates for the years 2022-2023:

Average temperature and humidity were obtained from the Libyan National Meteorological Center (LNMC), for the years 2022-2023, as shown in figure (3). It was found that the average temperatures for the years 2022-2023 ranged between 20.2 and 19.7 degrees Celsius, respectively, while the average humidity for the same years ranged between 65% and 68.6%. This climate is suitable for the *Leishmania* parasite, which inhabits hot and temperate regions, and provides sufficient humidity that increases the reproduction of sand flies. This study is consistent with a study on the endemicity of cutaneous leishmaniasis in the southern Zawiya region [20].

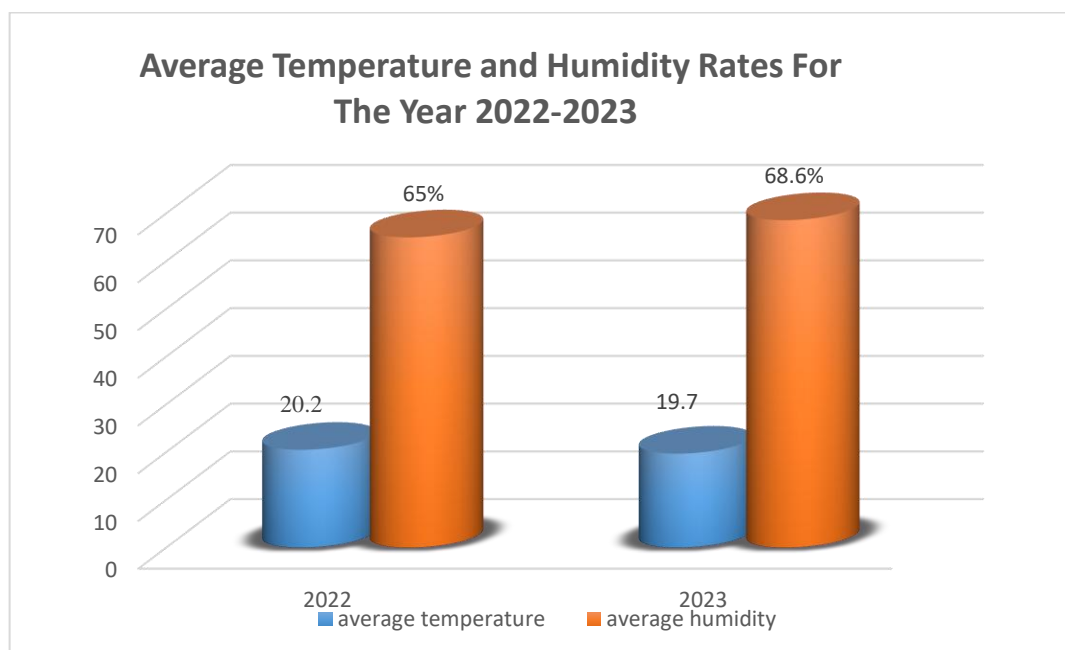


Figure 3: Average temperature and humidity rates for the year 2022-2023.

Conclusion:

Cutaneous leishmaniasis (CL) is a parasitic disease caused by protozoa of the genus *Leishmania* and transmitted to humans through the bite of infected female phlebotomine sandflies. It is recognized as one of the most significant neglected tropical diseases, affecting millions of individuals worldwide, particularly in developing countries. The disease manifests as skin lesions, ulcers, and scars that, although rarely fatal, have profound physical, psychological, and social impacts on affected populations.

The article indicates that most cases are attributed to males, who account for 109 cases (66.1%), while females represent 56 cases (33.9%). This shows that the number of male cases is nearly double that of females, suggesting a gender imbalance in the distribution. Overall, out of the 165 total cases, males constitute the predominant group. The distribution of cases across age groups shows a relatively balanced pattern. Individuals younger than 60 years constitute the majority with 86 cases (52.1%), while those aged 60 years and above account for 79 cases (47.9%). Although the difference is not large, the data suggest a slightly higher prevalence among participants under 60 years of age. The joint distribution of cases by age and gender indicates that males under 60 years form the largest subgroup, with 62 cases (37.6%), followed by males over 60 years with 47 cases (28.5%). Among females, those over 60 years represent 32 cases (19.4%), which is notably higher than females under 60 years (24 cases, 14.5%).

Moreover, the prevalence of infection shows noticeable variation across the months of 2022–2023. The highest number of cases was recorded in December (35 cases; 21.2%), followed by February (26 cases; 15.7%) and March (24 cases; 14.5%). January also showed a considerable prevalence with 23 cases (13.9%), while November contributed 21 cases (12.7%). In contrast, the lowest prevalence was observed in June (2 cases; 1.2%), September (3 cases; 2%), and April (3 cases; 2%). The monthly distribution of infection cases during 2022–2023 reveals a clear seasonal trend. The peak prevalence occurred in December (35 cases; 21.2%), followed by February (26 cases; 15.7%), March (24 cases; 14.5%), and January (23 cases; 13.9%). Together, these months accounted for more than half of all cases, indicating that infections were most common during the winter season. Conversely, the lowest prevalence was recorded in June (2 cases; 1.2%), September (3 cases; 2%), and April (3 cases; 2%), representing the spring and summer months. This suggests that infection rates tend to decline significantly during warmer periods and rise during colder months, highlighting a possible seasonal influence on infection prevalence.

Recommendations:

Based on the study findings, the researchers recommend the following:

- **Strengthening Surveillance and Prevention Programs:** This can be achieved by intensifying health awareness campaigns about the disease's transmission methods and symptoms, with a focus on the most susceptible groups: males and individuals under 60 years of age. These programs should include distributing informational brochures and organizing workshops in schools and local health center.
- **Launching Vector Control Campaigns:** Specific campaigns targeting sand flies, the disease vector, should be initiated, especially in areas with the highest infection rates, such as Yafran, Al-Qalaa, and Kikla. These campaigns could involve spraying insecticides and focusing on regions that serve as fertile breeding grounds for the insects.
- **Improving Diagnosis and Treatment:** This involves providing advanced laboratory diagnostics, such as Polymerase Chain Reaction (PCR), in local hospitals and clinics to ensure accurate and rapid diagnosis. This will help avoid over-reliance on clinical diagnosis alone.
- **Conducting Further Research:** It is essential to carry out comparative studies between different geographical regions to identify the reasons behind the varying infection rates.

References:

- [1] Longe, J. (2002). The Gale Encyclopedia of Medicine Second Edition.
- [2] حسين، غفران مظفر، 2017. انتشار داء اللشمانيا الجلدية في قضاء الحمزة الشرقي وبعض المناطق التابعة له، أطروحة دكتوراه. كلية العلوم، جامعة القادسية.
- [3] World Health Organization WHO. (2010). Communicable Disease Working Group on Emergencies, HQ Division of Communicable Disease Control, EMRO, WHO office, Baghdad. WHO Office.
- [4] الموسوي، اذهار موسى جعفر، 2015. دراسة جزيئية ومناعية لطفي لللشمانيا الجلدية في المحافظات الوسطى والجنوبية، بحث منشور، كلية التربية للعلوم الصرفة، قسم علوم الحياة، جامعة كربلاء، بغداد.
- [5] Zuskrman A. and Lainson R. (1977). parasitic protozoa *Leishmania* Academic press – New York pp: 57-133.
- [6] El-tellawi Ibrahim Mohamed, (2019), Study Outbreak of Cutaneous Leishmaniasis in Municipality of AlZintan, College of Physical Education - Al-Marqab University.
- [7] WHO. (2000) N. *Leishmania* / HIV co-infection. WHO /LEISH/2000 .42. CTDTRX. INHO: 12 PP. Genera

- [8] Kayser, F. H., Bienz, K. A., Eckert, J., & Zinkernagel, R. M. (2005). Medical microbiology. Thieme, Printed in Germany by Appl, Wemding , p :493 499
- [9] النجار، بدر الدين، مجلة فصلية عن المركز الوطني لمكافحة الأمراض السارية، العدد الأول، 2012، ص50-55
- [10] الأشهب إحسان علي. (2020)، التوزيع المكاني لمرض الليشمانيا في منطقة يفرن خلال الفترة من 2012 إلى 2018 (دراسة مقارنة في الجغرافيا الطبية)، مجلة القرطاس، كلية التربية، يفرن، جامعة الزنتان. العدد الحادي عشر نوفمبر 2020.
- [11] Rebollar-Tellez, E.A.; Tun-Ku, E.; Manrique-Saide, P.C.; NdradeNarvaez, F.J. (2005). Relative abundances of sandfly species (Diptera: Phlebotominae) in two villages in the same area of Campeche, in southern Mexico. Ann. Trop. Med. Parasitol., 99(2):193-201.
- [12] Motazedian, M.H.; Mehrabani, D.; Oryan, A.; Asgari, Q.; Karamian, M. and Kalantari, M. (2006) Life cycle of cutaneous leishmaniasis in Larestan, southern Iran. Iran. J. Clin. Infect. Dis1: 137–143.
- [13] Salomon, O. D.; Wilson, M. L.; Munstermann, L. E. and Travi, B.L. (2007). Temporal patterns of Phlebotominae sand flies (Diptera: Psychodidae) in a Cutaneous Leishmaniasis focus in Northern Argentina. J. Med. Entomol., (41): 33-39.
- [14] Bowman, W.C. & Rand, M. J. (1980). Leishmaniasis Text. Book of pharmacology.2ndEdt. pp.21-36; Blackwell Scientific Publication. London
- [15] Berman, J. D. (1988). Chemotherapy for Leishmaniasis Biochemical mechanisms. Clinical efficacy and future Strategies. View.Infect Dis.,10(3),560-581
- [16] الغرياني، علي محمد. (2022)، دراسة معدل انتشار مرض الليشمانيا الجلدية في منطقة سوق الخميس وضواحيها، مجلة القلعة، العدد 19، كلية الآداب والعلوم مسالمة قسم الأحياء جامعة المرقب.
- [17] الأطيرش، سليمان مصطفى. فيدان، امحمد عثمان البسكيني، عبدالرحمن محمود (2024)، دراسة وبائية لطيف الليشمانيا في الجزء الشمالي الأوسط (سرت، الوشكة، زمزم، بوقرين)، مجلة البيان العلمية، جامعة سرت، العدد 17، ISSN:2790-0614
- [18] فتاتيت، نعيمة حسن. الصداقي، خديجة عمر. المدولي، عائشة عبد الباسط. السوسي، حنان عبد الرحمن. هويدي، دنيا مفتاح (2024). دراسة بعض الجوانب الوبائية و السريرية لداء الليشمانيا الجلدية في مدينة تاورغاء. مجلة العلوم، العدد 17، كلية العلوم، جامعة مصراته.
- [19] علي، منال (2014). تنميط أنواع الليشمانية المسؤولة عن الإصابات الجلدية في اللاذقية، قسم الكيمياء الحيوية والأحياء الدقيقة – كلية الصيدلة – جامعة دمشق.
- [20] عمران، هدى محمد (2016). توطن مرض الليشمانيا الجلدية في جنوب منطقة الزاوية، المجلة الجامعة، ال عدد18 – المجلد الثاني، قسم الجغرافيا – كلية الآداب - جامعة الزاوية.