WORLD EPIDEMIOLOGY OF LEISHMANIASIS: A NARRATIVE REVIEW

EPIDEMIOLOGIA MUNDIAL DA LEISHMANIOSE: UMA REVISÃO NARRATIVA

EPIDEMIOLOGÍA MUNDIAL DE LA LEISHMANIASIS: UNA REVISIÓN NARRATIVA

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ABSTRACT

Leishmaniasis is a neglected tropical disease caused by protozoa of the genus Leishmania, transmitted by the bite of infected female sandflies. Endemic in 99 countries, the disease affects more than 12 million people and represents a major global public health challenge, with World Health Organization (WHO) estimates of 30,000 new cases of visceral leishmaniasis (VL) and more than 1 million cases of cutaneous leishmaniasis (CL) annually. This study is a narrative review aimed at synthesizing the global epidemiology of leishmaniasis, with emphasis on patterns of incidence, prevalence, mortality, geographic distribution, and socioeconomic and environmental determinants of transmission. The databases consulted were PubMed, MedLine, LILACS, CAPES, PLOS and SciELO, in addition to official data from WHO and PAHO. In 2024, 85% of global VL cases were concentrated in seven countries: Brazil, Ethiopia, India, Kenya, Somalia, Sudan and South Sudan. For CL, Afghanistan, Algeria, Brazil, Colombia, Iran, Peru and Syria accounted for 83% of global incidence. The geospatial distribution of the disease is determined by ecological, sociodemographic and geopolitical factors, with systematic underreporting compromising the true magnitude of the problem. Elimination initiatives have achieved notable progress, such as Bangladesh's validation as the first country to eliminate VL as a public health problem in 2023.

Keywords: Leishmaniasis. Epidemiology. Incidence. Neglected Tropical Diseases. Sandflies.

RESUMO

A leishmaniose é uma doença tropical negligenciada causada por protozoários do gênero Leishmania, transmitida pela picada de flebotomíneos fêmeas infectados. Endêmica em 99 países, a doença acomete mais de 12 milhões de pessoas e representa um dos principais desafios de saúde pública global, com estimativas da Organização Mundial da Saúde (OMS) de 30.000 novos casos de leishmaniose visceral (LV) e mais de 1 milhão de casos de leishmaniose cutânea (LC) anualmente. Este estudo trata-se de uma revisão narrativa que

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objetivou sintetizar a epidemiologia mundial da leishmaniose, com enfoque nos padrões de incidência, prevalência, mortalidade, distribuição geográfica e determinantes socioeconômicos e ambientais da transmissão. As bases de dados consultadas foram PubMed, MedLine, LILACS, CAPES, PLOS e SciELO, além de dados oficiais da OMS e da Organização Pan-Americana da Saúde (OPAS). Em 2024, 85% dos casos globais de LV concentraram-se em sete países: Brasil, Etiópia, Índia, Quênia, Somália, Sudão e Sudão do Sul. Para a LC, Afeganistão, Argélia, Brasil, Colômbia, Irã, Peru e Síria responderam por 83% da incidência global. A distribuição geoespacial da doença é determinada por fatores ecológicos, sociodemográficos e geopolíticos, com subnotificação sistemática comprometendo a real dimensão do problema. Iniciativas de eliminação têm obtido avanços expressivos, como a validação do Bangladesh como primeiro país a eliminar a LV como problema de saúde pública em 2023.

Palavras-chave: Leishmaniose. Epidemiologia. Incidência. Doenças Tropicais Negligenciadas. Flebotomíneos.

RESUMEN

La Leishmaniasis es una enfermedad tropical desatendida causada por protozoos del género Leishmania, transmitida por la picadura de flebótomos hembra infectados; endémica en 99 países, la enfermedad afecta a más de 12 millones de personas y representa un importante desafío de salud pública global, con estimaciones de la World Health Organization (WHO) de 30.000 nuevos casos de leishmaniasis visceral (LV) y más de 1 millón de casos de leishmaniasis cutánea (LC) anualmente; este estudio es una revisión narrativa cuyo objetivo es sintetizar la epidemiología global de la leishmaniasis, con énfasis en patrones de incidencia, prevalencia, mortalidad, distribución geográfica y determinantes socioeconómicos y ambientales de la transmisión; las bases de datos consultadas fueron PubMed, MedLine, LILACS, CAPES, PLOS y SciELO, además de datos oficiales de la WHO y la Pan American Health Organization (PAHO); en 2024, el 85% de los casos globales de LV se concentraron en siete países: Brasil, Etiopía, India, Kenia, Somalia, Sudán y Sudán del Sur; para la LC, Afganistán, Argelia, Brasil, Colombia, Irán, Perú y Siria representaron el 83% de la incidencia global; la distribución geoespacial de la enfermedad está determinada por factores ecológicos, sociodemográficos y geopolíticos, con un subregistro sistemático que compromete la verdadera magnitud del problema; las iniciativas de eliminación han logrado avances notables, como la validación de Bangladesh como el primer país en eliminar la LV como problema de salud pública en 2023.

Palabras clave: Leishmaniasis. Epidemiología. Incidencia. Enfermedades Tropicales Desatendidas. Flebótomos.

1 INTRODUCTION

Leishmaniasis belongs to the group of neglected tropical diseases (NTDs) and currently represents one of the leading public health problems on a global scale. Caused by several species of intracellular protozoa of the genus Leishmania, belonging to the family Trypanosomatidae, the disease is transmitted to humans and other mammals through the bite of infected female sandflies of the genera *Phlebotomus* (Old World) and *Lutzomyia* (New World) (WHO, 2025; Pace, 2014). The disease is endemic in 99 countries, with CL present in 90 and VL in 80 countries, with 71 countries presenting both forms concomitantly (PAHO, 2025).

In clinical terms, leishmaniasis manifests in three main forms: visceral leishmaniasis (VL), also known as kala-azar, the most severe and potentially fatal if untreated; cutaneous leishmaniasis (CL), the most prevalent form, characterized by ulcerative lesions on exposed areas of the body; and mucocutaneous leishmaniasis (MCL), the most disabling form, associated with progressive destruction of the nasal and oral mucosae (Grifferty et al., 2023; Pace, 2014). Beyond these classical forms, post-kala-azar dermal leishmaniasis (PKDL), a late complication of VL, accounted for 13,515 reported cases between 2012 and 2024, with greater concentration in East Africa and the Indian subcontinent (WHO, 2024).

The magnitude of the disease is considerable, as it is estimated that more than 12 million people are infected worldwide and more than 1 billion live in endemic areas at risk of infection (PAHO, 2025; WHO, 2025). The WHO estimates 30,000 new annual cases of VL and more than 1 million cases of CL per year (WHO, 2025). Analyses from the Global Burden of Disease (GBD) 1990–2021 indicate that leishmaniasis ranked as the fourth NTD in terms of "Disability-Adjusted Life Years" (DALYs) in 2010, with the tegumentary form recording the greatest DALY increase among all NTDs between 1999 and 2023 (GBD, 2021; Ruiz-Postigo et al., 2023). Systematic underreporting, estimated at only 25 to 45% of actual cases reported to the WHO, compromises understanding of the true epidemiological significance of the disease (Awoke et al., 2024; Sunyoto et al., 2018).

The geographic distribution of leishmaniasis is largely determined by the presence and abundance of sandfly vectors, whose survival depends on specific climatic conditions (Aversi-Ferreira et al., 2014; WHO, 2025), especially localities with temperatures between 16 and 44°C, high humidity and low wind speed (Knight et al., 2022). Beyond ecological factors, socioeconomic determinants such as poverty, accelerated urbanization, deforestation, forced migration due to armed conflicts and fragile health systems constitute the complex epidemiological landscape that favors transmission and perpetuates the endemic condition in vulnerable populations (GBD, 2021; Salam; Al-Shaqha; Azzi, 2014).

The present study aimed to synthesize and discuss the global epidemiology of leishmaniasis, with emphasis on incidence and prevalence patterns by region, geographic distribution determinants, and socioenvironmental risk factors that condition the burden of disease at the global and regional level.

2 MATERIALS AND METHODS

This is a narrative literature review. The bibliographic search was carried out in the electronic databases PubMed, MedLine, LILACS, CAPES, PLOS and SciELO, complemented with official epidemiological data from the World Health Organization (WHO), the Pan American Health Organization (PAHO) and the Global Burden of Disease Study (GBD). The descriptors used were: leishmaniasis, visceral leishmaniasis, cutaneous leishmaniasis, mucocutaneous leishmaniasis, sandflies, epidemiology, incidence, prevalence and global burden.

The analytical framework for geographic and environmental variables related to leishmaniasis transmission was grounded in the review chapter by Aversi-Ferreira et al. (2014), which systematized the main evidence on global and regional determinants of disease distribution using the MEDLINE, PubMed, LILACS, CAPES, PLOS, SciELO and Google Scholar databases.

2.1 INCLUSION CRITERIA

Original articles and indexed reviews published between 2014 and 2025 addressing epidemiological aspects, geographic distribution, incidence, prevalence, mortality or DALYs of leishmaniasis were included, as well as technical documents and epidemiological bulletins from WHO and PAHO.

2.2 EXCLUSION CRITERIA

Studies prior to 2014 (except classic references without equivalent subsequent updates), studies focused exclusively on therapeutic, laboratory or molecular aspects without epidemiological interface, and works addressing the same content as more recent references already included were excluded.

3 GLOBAL EPIDEMIOLOGICAL OVERVIEW

Leishmaniasis is endemic in four major eco-epidemiological regions, namely the Americas, East Africa, North Africa, and Western and South Asia (WHO, 2025; PAHO, 2025). In 2024, 52 VL-endemic and 59 CL-endemic countries reported data to the WHO global

program, corresponding to 65% of endemic countries for each form. The 2024 global data confirm that the disease burden remains highly concentrated, i.e., 85% of VL cases were reported in only seven countries, namely Brazil, Ethiopia, India, Kenya, Somalia, Sudan and South Sudan, and 83% of CL cases were recorded in Afghanistan, Algeria, Brazil, Colombia, Iran, Peru and Syria (WHO, 2025).

The GBD 1990–2021 analysis demonstrated that the DALY burden of leishmaniasis is inversely proportional to the Socioeconomic Development Index (SDI), i.e., countries with lower SDI consistently presented the highest age-standardized DALY rates. The ten countries with the highest DALY rates in 2021 were Afghanistan, Suriname, Sudan, Djibouti, Nicaragua, Panama, Turkmenistan, Tunisia, Iraq and Brazil (GBD, 2021). The study also evidenced sexual dimorphism in disease burden: DALY rates for VL were substantially higher in men (7.31 per 100,000) than in women (3.36 per thousand), a difference partially explained by greater occupational exposure of males to sandfly habitats (GBD, 2021).

Underreporting represents a structural obstacle to epidemiological surveillance. Estimates indicate that only 25 to 45% of actual annual VL cases are effectively reported to the WHO, meaning that, in real terms, the burden may be two to four times higher than recorded (Awoke et al., 2024; Sunyoto et al., 2018). For CL in sub-Saharan Africa, the actual number of cases is estimated to be up to six times higher than reported (Sunyoto et al., 2018). In 2024, 133 imported CL cases and 73 imported VL cases were globally recorded, evidencing growing human mobility as a factor in disease dissemination to non-endemic regions (WHO, 2025).

Cutaneous leishmaniasis has shown global incidence growth since 2012, with the tegumentary form recording the greatest DALY increase among NTDs between 1999 and 2023 (Ruiz-Postigo et al., 2023). In contrast, VL showed a declining case trend in several regions following elimination initiatives, with Bangladesh becoming the first country validated by WHO in 2023 as free of VL as a public health problem, the result of an elimination program jointly launched in 2005 with India and Nepal (WHO, 2025). India reduced its VL burden from approximately 33,000 cases in 2005 to fewer than 6,000 in 2016, and from 77,000 cases in 1992 to fewer than 6,000 in 2016, following implementation of integrated indoor residual spraying strategies and active surveillance (Wilson et al., 2020; Dutta et al., 2023).

4 EPIDEMIOLOGY BY GEOGRAPHIC REGION

4.1 THE AMERICAS

In the Americas, leishmaniasis is a vector-borne zoonosis with a complex transmission cycle involving a wide diversity of parasite species, reservoirs and vectors. Of the 22

Leishmania species pathogenic to humans, 15 have been identified in the region, with approximately 54 vector species potentially involved in transmission (PAHO, 2025). Between 2001 and 2018, approximately 55,000 annual CL cases were recorded in 17 countries of the Americas, with 79.4% of cases concentrated in rural areas (Cossio et al., 2021). For VL, between 2001 and 2015, 52,000 cases were reported, with progressive reduction thereafter (Maia-Elkhoury et al., 2017). More than two-thirds of new CL cases in the Americas occur in six countries: Afghanistan, Algeria, Brazil, Colombia, Iran and Syria, with Colombia corresponding to the second highest continental CL incidence (Herrera et al., 2018).

Brazil is the country with the greatest diversity of *Leishmania* species causing CL in the Americas, with six belonging to the subgenus Viannia and prevalence of *L.* (Viannia) *braziliensis* (Saheki et al., 2017). More than 20,000 annual CL cases are recorded in the country, with more than 260 vector sandfly species identified (Meneguzzi et al., 2016). Between 2001 and 2020, 63,966 VL cases were notified, with a mean incidence rate of 1.68 cases per 100,000 inhabitants and a case fatality rate of 6.96% (Bruhn et al., 2024). Brazil accounts for 97% of VL cases in the Americas, with a case fatality rate of approximately 10% (Vieira-Duarte et al., 2024). The GBD 2016 analysis in Brazil demonstrated that the age-standardized incidence rate decreased by 48.5% between 1990 and 2016, but DALYs increased by 83.6% in the same period, reflecting increased case severity and aging of the affected population (Bezerra et al., 2018).

In terms of domestic distribution, the largest VL mortality clusters in Brazil are located in the Northeast and in the states of Tocantins and Roraima (Vieira-Duarte et al., 2024). Maranhão led VL incidence rates in children and adolescents over the past decade, and the impact of the COVID-19 pandemic was identified as a factor that altered incidence trends in several northeastern states between 2020 and 2022 (Fernandes et al., 2025). In Minas Gerais, cities surrounded by coffee plantations have recorded, since the 1960s, significant incidence of TL in rural workers; in Governador Valadares, 191 VL cases were reported between 2008 and 2017, with a case fatality rate of 14.7% (Silva et al., 2017).

In the municipality of Montes Claros, northern Minas Gerais, VL has become a consolidated urban endemic, with cases distributed across the entire urban area recorded between 2001 and 2007, with a reduction in incidence from 2005 onwards, although the disease has remained a serious public health problem in the region (Sousa et al., 2008).

Colombia has the second largest number of documented *Leishmania* species, with cases concentrated in rural and military areas. The prevalence of *L. braziliensis* in military personnel reaches 95.4%, directly related to exposure in vector habitats (Purse et al., 2017).

The Andean region accounts for more than 50% of Colombian CL cases (Posada-López et al., 2023).

The epidemiology of CL is complex, with intra- and interspecific variation in transmission cycles, reservoir hosts, vectors and clinical manifestations (Mubayi; Paredes; Ospina, 2018). In Peru, nearly 6,000 CL and MCL cases were recorded in 2015, with the Madre de Dios region being one of the most endemic in South America, with 4,000 cases between 2010 and 2015 (Zorrilla et al., 2017). Ecuador contributes to the dispersal of L. lainsoni in 21 of 24 provinces (Kato et al., 2016), and Paraguay recorded approximately 3,000 cases between 2006 and 2017, with predominance in San Pedro and Canindeyú (Benítez et al., 2020).

4.2 EAST AFRICA AND SUB-SAHARAN AFRICA

East Africa concentrates the second largest global number of VL cases, with Eritrea, Ethiopia, Kenya, Somalia, Sudan, South Sudan and Uganda as endemic countries (Awoke et al., 2024). An estimated 29,400 to 56,700 VL cases occur annually in the region, with only 8,560 cases effectively reported, evidencing one of the highest underreporting rates in the world (Awoke et al., 2024; Sunyoto et al., 2018). In Ethiopia, the annual VL incidence is estimated between 3,700 and 7,400 cases, with a population of more than 3.2 million people at risk. Approximately 60% of cases are concentrated in the northwestern plains, on the border with Sudan, while CL, caused mainly by *Leishmania aethiopica*, affects between 20,000 and 50,000 people annually, leaving approximately 30 million in a state of susceptibility (Awoke et al., 2024; Yohannes; Abebe; Boelee, 2019).

In Kenya, 900 new VL cases per year are estimated, with coexistence of cutaneous and visceral forms in locations such as the Rift Valley. The sandfly study in the Gilgil region identified Phlebotomus guggisbergi as a confirmed vector of L. tropica and L. major, with high infection rates detected (Owino et al., 2019; Hassaballa et al., 2021). The four forms of leishmaniasis present in Kenya put 1.6 billion people at risk globally, and the country is among the five African nations that bear the greatest proportion of the global VL burden (Grifferty et al., 2023).

In sub-Saharan Africa, the epidemiological burden of CL remains largely underestimated. A systematic review estimated that the actual number of cases may be six times higher than reported, with countries in Central, Western and Eastern Africa recording significant diagnostic gaps (Sunyoto et al., 2018). In Algeria, the largest endemic country in North Africa, 13,599 cases were reported in 2024, corresponding to 78% of all African CL cases notified that year, with incidence that nearly doubled between 2021 and 2024 (WHO,

2025). Case distribution is directly correlated with the distribution of the 24 sandfly species described in the Maghreb region (Benallal et al., 2022).

4.3 MIDDLE EAST AND CENTRAL ASIA

Leishmaniasis is considered the third most important vector-borne disease in the world, with a particularly severe impact in the Middle East (Knight et al., 2022). In 2016, 84% of globally notified CL cases were concentrated in ten countries, including Afghanistan, Algeria, Brazil, Colombia, Iraq, Pakistan, Peru, Syria, Tunisia and Yemen (Knight et al., 2022). Social factors, poverty, intense urbanization and violent conflicts, are critical determinants of the endemic condition in the region (Salam; Al-Shaqha; Azzi, 2014).

In Syria, the impact of war is exemplary: approximately 90,000 leishmaniasis records were notified in 2019, with more than 6,000 cases in the first month of 2020, with Deir-ez-Zor, Aleppo and Idleb as main foci, caused by *L. tropica* and *L. major* (Hussein et al., 2019). In Yemen, migration, the collapse of the health system, poverty and rubble serving as vector breeding sites determined more than 6,000 cases between 2019 and 2020, with MCL as the predominant form (Al-Bajalan et al., 2018). In Iraq, during the 2014–2015 civil war, a CL outbreak mainly affected the north and center of the country, with displacement of populations from endemic to non-endemic areas and deterioration of health services as the main factors (Al-Bajalan et al., 2018).

In India, VL is typically caused by L. donovani, with 90% of cases concentrated in Bihar, in the northwest of the country. National efforts reduced the burden from nearly 33,000 cases in 2005 to fewer than 6,000 in 2016 (Wilson et al., 2020). Saudi Arabia showed a significant decline in CL cases since the 1990s, with only 600 cases notified in 2021, while no VL case was recorded between 2019 and 2021, as a result of effective local epidemiological management (Knight et al., 2023). In Iran, Azerbaijan and Fars are VL foci for *L. infantum* and *L. major* (Adham et al., 2020; Behniafar et al., 2024).

Sri Lanka represents a singular case in Asia: CL caused by *L. donovani*, a species classically associated with the visceral form, is endemic in the country, with 2,217 cases in 2020 and 19,361 cases between 2001 and 2019 (Gunasekara et al., 2023). Projections for 2025 estimate more than 19,000 additional cases, evidencing an ascending trajectory without immediate control prospects (Karunaweera et al., 2021). China figures among the 14 countries with the highest global VL incidence, with distribution data in the northwest of the national territory (Chen et al., 2019).

4.4 EUROPE AND IMPORTED CASES

Southern Europe, especially Spain, Italy, France, Portugal and Mediterranean islands, is endemic for VL caused by *L. infantum*, while the central and eastern portions record cases due to L. martiniquensis (Maia et al., 2023). In 2022, 517 autochthonous cases were notified in metropolitan France and 1,725 imported cases between 1998 and 2020, with VL prevailing among autochthonous and CL among imported cases (Pasquier et al., 2022). The re-emergence of leishmaniasis in Spain between 2009 and 2012 alerted neighboring countries to the risk of expansion (Mubayi; Paredes; Ospina, 2018), and records of asymptomatic individuals for *L. infantum* exist in several European countries, including Italy, Spain, France and the Balearic Islands (Iatta et al., 2021).

In 2024, 133 imported CL cases and 73 imported VL cases were reported globally to WHO, reflecting the growing role of international mobility in disease dissemination (WHO, 2025). Austria recorded a change in the epidemiological profile of human leishmaniasis between 2000 and 2021, including a case of congenital transmission, a rare but documented route of infection (Riebenbauer et al., 2024). Studies in Barcelona demonstrated an increase in autochthonous and imported cases associated with a growing number of immunocompromised individuals and migrants from endemic areas (Knight et al., 2023). Furthermore, the geographic expansion of vector sandflies in the Mediterranean has been attributed to climate change and the geopolitical situation, facilitating parasite dispersal to previously non-endemic regions (Moriconi et al., 2017).

5 EPIDEMIOLOGICAL DETERMINANTS OF TRANSMISSION

5.1 SOCIOENVIRONMENTAL AND ECONOMIC DETERMINANTS

The association between leishmaniasis and poverty is widely documented and represents the main structural determinant of the endemic condition (GBD, 2021; Salam; Al-Shaqha; Azzi, 2014). Countries with lower HDI consistently present higher disease DALY rates, and spatial analyses in northeastern Brazil confirm that high leishmaniasis incidences are directly associated with unfavorable socioeconomic conditions and precarious infrastructure (GBD, 2021). VL is classically associated with malnutrition, a particularly grave risk situation: in Brazil, the highest rates of years of life lost (YLL) due to VL are observed in children under one year of age, with an increase of 131.2% between 1990 and 2016 (Bezerra et al., 2018).

Accelerated urbanization and deforestation with expansion of agricultural frontiers broaden human contact with sandflies (Aversi-Ferreira et al., 2014; Meneguzzi et al., 2016). In Espírito Santo, geographic expansion resulting from economic changes led to growth of

peripheral urban populations, increasing domestic CL reservoirs (Meneguzzi et al., 2016). In Maranhão, the wide spatial distribution of vectors, with a high degree of adaptation to domestic and anthropic environments, ensures transmission to both humans and dogs (Guimarães-e-Silva et al., 2017). Over the past 20 years, territorial expansion of the disease has been attributed to agricultural exploitation and forest destruction, which create favorable habitats for sandflies while simultaneously reducing the habitats of natural predators of these vectors (Glidden et al., 2023; Marinho-Júnior et al., 2023).

Seasonal migration of rural workers and human mobility in general function as disease dispersal vectors. The state of Rio de Janeiro, Brazil's main tourist destination, recorded 1,620 imported TL cases between 2001 and 2015, corresponding to 0.8% of national cases, associated with migratory flows from endemic areas (Miranda et al., 2019). Geopolitical conflict conditions exponentially amplify risk: mass population migration, collapse of health systems, precarious housing and rubble serving as vector breeding sites were identified as the main explanatory factors for outbreaks in Syria and Yemen (Du et al., 2016; Al-Bajalan et al., 2018).

The displacement of manual workers and migrants from rural to urban areas for work-related reasons has been identified as one of the most important risk factors for American tegumentary leishmaniasis (Bamorovat et al., 2021). Outdoor sleeping, proximity to animals and restricted public health systems additionally increase risks for populations living in disadvantaged conditions (Grifferty et al., 2023; Yohannes; Abebe; Boelee, 2019).

5.2 ECOLOGICAL AND CLIMATIC DETERMINANTS

The heterogeneity of leishmaniasis distribution is intrinsically associated with environmental and climatic conditions that determine the life cycle of the vector and the etiological agent (Aversi-Ferreira et al., 2014; Pace, 2014; Glidden et al., 2023). Sandflies survive across a wide temperature range, 16 to 44°C, with ideal activity on warm, clear nights with low wind speed (Knight et al., 2022). In the province of Sétif (Algeria), a correlation was demonstrated between the monthly number of sandflies and temperature, with low association with rainfall and humidity (Posada-López et al., 2023). Different habitat types, including forest areas, peridomicile and plantations, harbor distinct sandfly species compositions, with different ambient volatile chemistries that modulate vector selection (Hassaballa et al., 2021).

Global climate change represents a growing threat for the geographic expansion of sandflies to previously non-endemic regions, particularly at higher latitudes and altitudes (Riebenbauer et al., 2024; Sutrave; Richter, 2021). In the Mediterranean, vector expansion

has been attributed to climate change, and in India, high-altitude areas, classically unfavorable for vector proliferation, have recorded a progressive increase in cases (Thakur et al., 2018). Climate projections indicate that continued global warming should result in territorial expansion of the endemic, with disproportionately greater impact on already vulnerable populations (Riebenbauer et al., 2024).

The availability and variety of reservoir hosts constitutes a determining ecological variable. In the Americas, 60 animal species have been identified as Leishmania reservoirs, a number in continuous growth, including rodents and cats (Kato et al., 2021). Dogs are the main urban VL reservoirs, but other animals, such as hares, rodents, chickens and pigs, also contribute to parasite circulation (Guimarães-e-Silva et al., 2017). Rodents of the species Rattus rattus, present in peridomiciliary environments, maintain high connectivity between rural areas and urban peripheries, sustaining high Leishmania infection rates at these interfaces (Marinho-Júnior et al., 2023). Periurban banana, pineapple and vegetable plantations were associated with higher densities of rodent hosts and, consequently, with higher relative risk of human infection at these sites (Marinho-Júnior et al., 2023; Bustos et al., 2015).

6 UNDERREPORTING, SURVEILLANCE AND CONTROL INITIATIVES

Underreporting is a structural phenomenon in leishmaniasis epidemiology and affects each endemic region differently. Global estimates indicate that only 25 to 45% of actual VL cases are annually reported to WHO (Awoke et al., 2024). For CL in sub-Saharan Africa, the actual number may be up to six times higher than reported (Sunyoto et al., 2018). The causes are multifaceted: fragility of epidemiological surveillance systems, difficult access of rural populations to health services, absence of mandatory reporting in some countries and diagnostic difficulties, especially for atypical forms and coinfections (Grifferty et al., 2023; Al-Bajalan et al., 2018).

International elimination initiatives have demonstrated expressive results when sustained by integrated strategies. The Kala-Azar Elimination Program in Southeast Asia, launched jointly by India, Bangladesh and Nepal in 2005, incorporated indoor residual spraying (IRS), active case detection and treatment, resulting in a reduction from more than 77,000 cases in 1992 to fewer than 6,000 in 2016 (Wilson et al., 2020). In 2023, Bangladesh became the first country in the world validated by WHO as having eliminated VL as a public health problem — a historic milestone demonstrating that elimination is achievable even in resource-limited settings (WHO, 2025).

Saudi Arabia represents an example of effective control in the Middle East: local epidemiological management significantly reduced CL cases since the 1990s (from hundreds per year to 600 cases in 2021), and no VL case was recorded between 2019 and 2021 (Knight et al., 2023). In contrast, conflict-affected countries such as Syria and Yemen illustrate how the disintegration of health systems and forced migration can rapidly reverse years of control progress, with a return to epidemic rates in a short time (Du et al., 2016; Hussein et al., 2019).

PAHO has been implementing since 2023 the Plan of Action for Strengthening Surveillance and Control of Leishmaniasis in the Americas 2023–2030, linked to the Communicable Disease Elimination Initiative and the WHO NTD Road Map (PAHO, 2025). The plan sets targets for incidence reduction, expansion of diagnostic and therapeutic coverage, and strengthening of entomological and reservoir surveillance. In this context, information systems such as SisLeish, a multinational standardized platform for monitoring leishmaniasis in the Americas, play a fundamental role in consolidating comparable epidemiological data among countries (Cossio et al., 2021).

7 CONCLUSION

Leishmaniasis remains one of the greatest global public health challenges, with a distribution that goes far beyond traditional climatic markers to reflect, in its essence, the distribution of poverty, social inequality and fragility of health systems worldwide. The 2024 data confirm that the concentration of disease burden in few countries, with Brazil, India, Ethiopia, Sudan and South Sudan accounting for a disproportionate fraction of global cases, is not a geographic accident, but the result of decades of underinvestment in surveillance, diagnosis and vector control in historically marginalized populations.

Systemic underreporting significantly compromises the formulation of evidence-based public policies. Estimates pointing to fewer than 50% of actual cases being reported to WHO indicate that the magnitude of the problem is substantially greater than official data suggest. Concurrently, the advances achieved in countries such as Bangladesh and India demonstrate that elimination is attainable when integrated, sustained and politically prioritized strategies exist.

The geographic expansion expected as a result of climate change, with displacement of sandfly habitable areas to higher latitudes and altitudes, adds a dimension of urgency to the problem. The combination of global warming, accelerated urbanization, growing human mobility and persistence of adverse socioeconomic conditions suggests that, without robust interventions, the global burden of leishmaniasis is likely to increase in the coming decades.

Full recognition of leishmaniasis as a priority public health problem, integrated with social equity policies, strengthened epidemiological surveillance and translational research in therapeutics and vaccines, is an indispensable condition for reversing this scenario.

REFERENCES

Adham, D., et al. (2020). Spatial autocorrelation and epidemiological survey of visceral leishmaniasis in an endemic area of Azerbaijan region, northwest of Iran. PLOS ONE, 15(8), e0236414. https://doi.org/10.1371/journal.pone.0236414

Al-Bajalan, M. M. M., et al. (2018). An outbreak of Leishmania major from an endemic to a non-endemic region posed a public health threat in Iraq from 2014-2017: epidemiological, molecular and phylogenetic studies. PLOS Neglected Tropical Diseases, 12(3), e0006255. https://doi.org/10.1371/journal.pntd.0006255

Aversi-Ferreira, R. A. G. M. F., Galvão, J. D., Silva, S. F. da, Cavalcante, G. F., Silva, E. V. da, Bhatia-Dey, N., & Aversi-Ferreira, T. A. (2014). Geographical and environmental variables of leishmaniasis transmission. In D. M. Claborn (Ed.), Leishmaniasis: Trends in epidemiology, diagnosis and treatment (pp. 105-124). InTech. https://doi.org/10.5772/57546

Awoke, T., et al. (2024). Assessment of liver function test and associated factors among visceral leishmaniasis patients attending University of Gondar, Northwest Ethiopia. PLOS ONE.

Bamorovat, M., et al. (2021). Major risk factors and histopathological profile of treatment failure, relapse and chronic patients with anthroponotic cutaneous leishmaniasis: A prospective case-control study. PLOS Neglected Tropical Diseases.

Behniafar, H., et al. (2024). Detection and phylogenetic analysis of kinetoplast DNA of Leishmania infantum infected humans, domestic dogs and sandflies in Northwest Iran. PLOS ONE. https://doi.org/10.1371/journal.pone.0296777

Benallal, K. E., et al. (2022). Phlebotomine sand flies (Diptera: Psychodidae) of the Maghreb region: A systematic review of distribution, morphology, and role in the transmission of pathogens. PLOS Neglected Tropical Diseases.

Benítez, I. R., et al. (2020). Análisis de datos basados en evidencia para la caracterización epidemiológica de leishmaniasis en Paraguay: I – Leishmaniasis tegumentaria. Revista del Instituto de Medicina Tropical, Asunción, 15(2), 29-44. https://doi.org/10.18004/imt/2020.15.2.29

Bezerra, J. M. T., et al. (2018). Burden of leishmaniasis in Brazil and federated units, 1990–2016: Findings from Global Burden of Disease Study 2016. PLOS Neglected Tropical Diseases, 12(9), e0006697.

Bruhn, F. R. P., et al. (2024). Spatio-temporal dynamics of visceral leishmaniasis in Brazil: A nonlinear regression analysis. Zoonoses and Public Health, 71(2), 144-156. https://doi.org/10.1111/zph.13092

Bustos, M. F., et al. (2015). Clinical and epidemiological features of leishmaniasis in northwestern-Argentina through a retrospective analysis of recent cases. Acta Tropica, 154, 125-132.

Chen, H., et al. (2019). Multi-locus characterization and phylogenetic inference of Leishmania spp. in snakes from Northwest China. PLOS ONE, 14(4), e0210681.

Cossio, A., et al. (2021). SisLeish: A multi-country standardized information system to monitor the status of Leishmaniasis in the Americas. PLOS Neglected Tropical Diseases.

Du, R., et al. (2016). Old World cutaneous leishmaniasis and refugee crises in the Middle East and North Africa. PLOS Neglected Tropical Diseases, 10(5), e0004545.

Dutta, O., et al. (2023). Burden of dengue, leishmaniasis and lymphatic filariasis in India and its states from 1990–2019: Analysis from the Global Burden of Disease Study (GBD 2019). PLOS ONE, 18(10), e0292723.

Fernandes, G. L., et al. (2025). Impact of COVID-19 on the incidence of visceral leishmaniasis in children and adolescents in the Northeast region, 2007-2022: Time series study. PMC.

GBD Leishmaniasis Collaborators. (2021). Global burden of leishmaniasis, 1990–2021: Systematic analysis of the Global Burden of Disease Study. BMC Infectious Diseases. https://pmc.ncbi.nlm.nih.gov/articles/PMC12648993/

Glidden, C. K., et al. (2023). Phylogenetic and biogeographical traits predict unrecognized hosts of zoonotic leishmaniasis. PLOS Neglected Tropical Diseases, 17(5), e0010879.

Grifferty, G., et al. (2023). The leishmaniases in Kenya: A scoping review. PLOS Neglected Tropical Diseases, 17(6), e0011358.

Guimarães-e-Silva, A. S., et al. (2017). Leishmania infection and blood food sources of phlebotomines in an area of Brazil endemic for visceral and tegumentary leishmaniasis. PLOS ONE.

Hassaballa, I. B., et al. (2021). Exploring the influence of different habitats and their volatile chemistry in modulating sand fly population structure in a leishmaniasis endemic foci, Kenya. PLOS Neglected Tropical Diseases, 15(2), e0009062.

Herrera, G., et al. (2018). Geospatial-temporal distribution of tegumentary leishmaniasis in Colombia (2007–2016). PLOS Neglected Tropical Diseases, 12(4), e0006419.

Hussein, N. R., et al. (2022). Leishmaniasis: Recent epidemiological studies in the Middle East. Frontiers in Microbiology. https://www.frontiersin.org/articles/10.3389/fmicb.2022.1052478

Iatta, R., et al. (2021). Leishmania tarentolae and Leishmania infantum in humans, dogs and cats in the Pelagie archipelago, southern Italy. PLOS Neglected Tropical Diseases.

Kato, H., et al. (2016). First human cases of Leishmania (Viannia) lainsoni infection and a search for the vector sand flies in Ecuador. PLOS Neglected Tropical Diseases, 10(5), e0004728.

Kato, H., et al. (2021). Prevalência de cepas de Leishmania geneticamente complexas com discordância híbrida e mitonuclear. Frontiers in Cellular and Infection Microbiology, 11, 625001.

Karunaweera, N. D., et al. (2021). Spatiotemporal distribution of cutaneous leishmaniasis in Sri Lanka and future case burden estimates. PLOS Neglected Tropical Diseases, 15(4), e0009346.

Knight, G., et al. (2022). Leishmaniasis: Recent epidemiological studies in the Middle East. Clinics.

Knight, G., et al. (2023). Changes in the microbiological diagnosis and epidemiology of cutaneous leishmaniasis in real-time PCR era: A six-year experience in a referral center in Barcelona. PLOS Neglected Tropical Diseases.

Maia, C., et al. (2023). The estimated distribution of autochthonous leishmaniasis by Leishmania infantum in Europe in 2005–2020. PLOS Neglected Tropical Diseases, 17(7), e0011497.

Maia-Elkhouri, A. N. S., et al. (2017). Leishmaniasis visceral en las Américas: Análisis de tendencias (2001-2015). Revista Panamericana de Salud Pública.

Marinho-Júnior, J. F., et al. (2023). High levels of infectiousness of asymptomatic Leishmania (Viannia) braziliensis infections in wild rodents highlights their importance in the epidemiology of American tegumentary leishmaniasis in Brazil. PLOS Neglected Tropical Diseases.

Meneguzzi, V. C., et al. (2016). Environmental niche modelling of phlebotomine sand flies and cutaneous leishmaniasis identifies Lutzomyia intermedia as the main vector species in southeastern Brazil. PLOS ONE.

Miranda, L. E. C., et al. (2019). Geospatial analysis of tegumentary leishmaniasis in Rio de Janeiro state, Brazil from 2000 to 2015. PLOS Neglected Tropical Diseases.

Moriconi, M., et al. (2017). Phlebotomine sand fly–borne pathogens in the Mediterranean Basin: Human leishmaniasis and phlebovirus infections. PLOS Neglected Tropical Diseases, 11(8), e0005660.

Mubayi, A., Paredes, M., & Ospina, J. (2018). Comparative evaluation of epidemiologically different outbreaks of American cutaneous leishmaniasis in Madrid, Spain and Tolima, Colombia. Tropical Medicine & Infectious Disease, 3(2), 43.

Owino, B. O., et al. (2019). Association of Phlebotomus guggisbergi with Leishmania major and Leishmania tropica in a complex transmission setting for cutaneous leishmaniasis in Gilgil, Nakuru county, Kenya. PLOS Neglected Tropical Diseases, 13(10), e0007712.

Pace, D. (2014). Leishmaniasis. Journal of Infection, 69(Suppl 1), S10-S18.

Pan American Health Organization (PAHO/OPAS). (2025). Leishmaniasis. Washington, DC: PAHO. https://www.paho.org/en/topics/leishmaniasis

Pasquier, G., et al. (2022). Leishmaniasis epidemiology in endemic areas of metropolitan France and its overseas territories from 1998 to 2020. PLOS Neglected Tropical Diseases.

Posada-López, L., et al. (2023). Ecological interactions of sand flies, hosts, and Leishmania panamensis in an endemic area of cutaneous leishmaniasis in Colombia. PLOS Neglected Tropical Diseases, 17(5), e0011316.

Purse, B. V., et al. (2017). Ecological niche modelling predicts southward expansion of Lutzomyia (Nyssomyia) flaviscutellata, vector of Leishmania amazonensis in South America, under climate change. PLOS ONE.

Riebenbauer, K., et al. (2024). The changing epidemiology of human leishmaniasis in the non-endemic country of Austria between 2000 and 2021, including a congenital case. PLOS Neglected Tropical Diseases, 18(1), e0011875.

Ruiz-Postigo, J. A., et al. (2023). Global leishmaniasis surveillance updates. Weekly Epidemiological Record, WHO.

Saheki, M. N., et al. (2017). Dynamics of American tegumentary leishmaniasis in a highly endemic region for Leishmania (Viannia) braziliensis infection in northeast Brazil. PLOS Neglected Tropical Diseases, 11(11), e0006015.

Salam, N., Al-Shaqha, W. M., & Azzi, A. (2014). Leishmaniasis in the Middle East: Incidence and epidemiology. PLOS Neglected Tropical Diseases, 8(10), e3208.

Silva, J., et al. (2017). Detection of multiple circulating Leishmania species in Lutzomyia longipalpis in the city of Governador Valadares, southeastern Brazil. PLOS ONE.

Sousa, R. G., Santos, J. F., Rodrigues, H. G., & Aversi-Ferreira, T. A. (2008). Casos de leishmaniose visceral registrados no município de Montes Claros, Estado de Minas Gerais. Acta Scientiarum. Health Sciences, Maringá, 30(2), 155-159.

Sunyoto, T., et al. (2018). Uncharted territory of the epidemiological burden of cutaneous leishmaniasis in sub-Saharan Africa: A systematic review. PLOS Neglected Tropical Diseases, 12(10), e0006914.

Sutrave, S., & Richter, A. (2021). Leishmaniasis: Recent epidemiological studies in developing nations. PLOS ONE.

Thakur, L., et al. (2018). Atypical leishmaniasis: A global perspective with emphasis on the Indian subcontinent. PLOS Neglected Tropical Diseases, 12(9), e0006659.

Vieira-Duarte, R., et al. (2024). Mortality due to visceral leishmaniasis in Brazil by municipalities, 2001–2018: A spatial-temporal analysis of estimates from the Global Burden of Disease study. Public Health, 234, 58-63. https://doi.org/10.1016/j.puhe.2024.06.003

Wilson, A. L., et al. (2020). The importance of vector control for the control and elimination of vector-borne diseases. PLOS Neglected Tropical Diseases, 14(1), e0007831.

World Health Organization (WHO/OMS). (2025). Global leishmaniasis surveillance updates 2024: Consolidating gains and new initiatives. Weekly Epidemiological Record, 45, 535-552.

World Health Organization (WHO/OMS). (2025). The global epidemiology of leishmaniasis. Geneva: WHO. https://www.who.int/data/gho/data/themes/topics/gho-ntd-leishmaniasis

Yohannes, M., Abebe, Z., & Boelee, E. (2019). Prevalence and environmental determinants of cutaneous leishmaniasis in rural communities in Tigray, northern Ethiopia. PLOS Neglected Tropical Diseases, 13(9), e0007722.

Zorrilla, V., et al. (2017). Distribution and identification of sand flies naturally infected with Leishmania from the Southeastern Peruvian Amazon. PLOS Neglected Tropical Diseases, 11(11), e0006029.