Review Article

Social Determinants of Health Influencing Leishmaniasis Worldwide: A Systematic Review

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Abstract

Background: Leishmaniasis is a neglected tropical disease influenced by a complex interplay of biological, environmental, and social factors. This study aimed to review the evidence on social determinants of health SDH associated with leishmaniasis worldwide.

Methods: This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. A search was carried out in national databases (IranMedex and Magiran), the Google Scholar search engine, as well as international databases (PubMed, Scopus and Web of Science). The quality of the studies was assessed using the Newcastle–Ottawa Scale (NOS).

Results: Out of 5538 retrieved articles, 36 studies met the inclusion criteria. The findings indicated that poverty, inadequate housing conditions, residence in rural or marginalized areas, low educational attainment, and limited access to healthcare services were among the influential SDH associated with a risk of leishmaniasis. Analysis within the WHO SDH framework revealed that social determinants, particularly those at the structural level (socioeconomic status) and intermediary level (housing conditions, health behaviors, and access to services), played a critical role in shaping the incidence and spatial distribution of leishmaniasis in the studied populations.

Conclusion: The available evidence underscores that leishmaniasis is not solely an infectious disease but also a condition deeply rooted in social and economic inequalities. Strengthening health equity policies, improving living conditions, enhancing educational opportunities, and expanding access to healthcare services can substantially contribute to the global prevention and control of leishmaniasis.

Keywords: Leishmaniasis; Social determinants of health; Health inequality; Poverty; Neglected diseases

Introduction

Leishmaniasis is a parasitic disease caused by protozoa of the genus *Leishmania* and transmitted to mammals, including humans, through the bite of infected phlebotomine sand flies. Depending on the *Leishmania* species, the transmission cycle may be zoonotic (involving animal reservoirs, for example, *L. major*) or anthroponotic (human-to-sand fly-to-human, for example, *L. donovani* and *L. tropica*). The disease is endemic in both the Old World (parts of

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Asia, Africa, the Middle East and Southern Europe) and the New World (Central and South America) (1–3). Consequently, the disease now affects more than 98 countries, with an estimated 12 million cases worldwide (4). Approximately 1.5 million new cases of cutaneous and mucocutaneous leishmaniasis occur annually, 90% of which are concentrated in Afghanistan, Brazil, Bolivia, Iran, Peru, Saudi Arabia and Syria (5). Visceral leishmaniasis, the most severe form, is associated with a high fatality rate if left untreated and affects approximately 70,000 individuals each year (4). Leishmaniasis disproportionately affects the poorest populations and perpetuates a vicious cycle of poverty (6–8). Understanding the poverty-driven conditions that reinforce the transmission cycle is essential for planning effective disease elimination strategies (8, 9). Substandard housing and poor living conditions create environmental conditions that favor sand fly breeding and increase the risk of disease transmission (6, 10). Moreover, the burden of leishmaniasis has been linked to various environmental factors, including deforestation, dam construction and irrigation projects, climate change, rapid urbanization, migration of non-immune populations into endemic areas, malnutrition and the breakdown of public health systems (5). Within this context, the social determinants of health (SDH) have emerged as a critical framework for understanding the transmission and persistence of leishmaniasis in vulnerable communities. Living conditions and socioeconomic factors, collectively known as SDH, are closely associated with the sustained transmission of leishmaniasis in low- and middle-income countries (11). Social determinants of health are generally defined as the conditions in which people are born, grow, live, work and age and they exert powerful effects on disease incidence, prevalence and health inequalities (12). The multifactorial nature of leishmaniasis reflects the complex interplay of social, environmental, economic, ecological and public health factors (13–16). Factors such as increased trade and travel, civil unrest, migration, low socioeconomic status, settlement in peri-urban areas, ecological changes and climate change all play substantial roles in shaping disease risk. Inadequate infrastructure and disruptions in health systems further contribute directly to the occurrence of leishmaniasis in vulnerable populations (16). Accordingly, the sustainable reduction of leishmaniasis prevalence at the global level requires addressing the SDH, including improving environmental and sanitary conditions, enhancing nutritional status and investing in equitable opportunities for marginalized populations living in endemic regions (17). This perspective is grounded in the principle that sustainable control of leishmaniasis cannot be achieved solely through biomedical interventions, but rather necessitates targeting the underlying social and economic factors that perpetuate transmission cycles across diverse geographical settings.

Given the existing knowledge gap regarding a systematic examination of these determinants within a comprehensive review framework, this study aims to provide an integrated overview of all social determinants of health associated with leishmaniasis globally, while examining the SDH influencing the disease.

Materials and Methods

Study design

The review protocol was not registered in the International Prospective Register of Systematic Reviews (PROSPERO) or any other prospective registry. However, this systematic review adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines for reporting.

Search strategy

A systematic search was performed in reputable national databases, including IranMedex, Magiran and the Persian Google Scholar search engine, as well as international databases such as PubMed/MEDLINE, Scopus, Web of Sci-

ence (ISI) and Google Scholar search engine to identify relevant studies published from January 1, 2000, to March 31, 2025. A combination of disease-related keywords (zoonotic cutaneous leishmaniasis (ZCL), anthroponotic cutaneous leishmaniasis (ACL), anthroponotic visceral leishmaniasis (AVL), zoonotic visceral leishmaniasis (ZVL), mucocutaneous leishmaniasis) and SDH-related terms ("Social Determinants of Health," "Socioeconomic Factors," "Poverty," "Education," "Housing," "Employment") was used with appropriate Boolean operators (AND, OR) for each database.

Inclusion and exclusion criteria

Inclusion criteria: 1-Human studies with various study designs (cohort, case–control, cross-sectional), 2-Studies explicitly examining the association between at least one SDH factor and the incidence, prevalence, or severity of leishmaniasis and 3-Articles published in English or Persian.

Exclusion criteria: 1-Animal studies, purely qualitative studies, case reports, review articles, editorials and conference abstracts and 2-studies for which full-text access was not available.

Study selection and screening process

Following the initial search, all records were imported into EndNote reference management software, and duplicates were removed. The screening process was performed in two stages by two independent reviewers ("Sh.R." and "B.P."): 1. Title and abstract screening: Articles were screened based on the preliminary inclusion and exclusion criteria. 2. Full-text review: Articles that passed the first stage were reviewed in full to assess their relevance and alignment with the study objectives. Any discrepancies between reviewers were resolved through discussion or consultation with a third reviewer.

Data extraction

Data from eligible studies were extracted using a standardized data extraction form developed before the study's initiation. Extracted information included: 1-Study identification details: article title, first author, year of publication and the country. 2-Methodological characteristics: study design. 3-SDH-related data: Social Determinants of Health were categorized according to the WHO's conceptual framework (2010) (18), which classifies determinants into two levels: structural determinants, encompassing socioeconomic–political context and axes of inequality; and intermediary determinants, including material conditions, behavioral and psychosocial factors, and health system characteristics.

Quality assessment

The methodological quality of the included studies was assessed using appropriate tools. The Newcastle–Ottawa Scale (NOS) was used for cohort and case–control studies (19, 20). For cross-sectional studies, an adapted version of the NOS was used. Studies were categorized based on NOS scores as high quality (7–9 stars), moderate quality (4–6 stars), or low quality (0–3 stars). For ecological studies, due to the lack of a specific standard tool, a checklist based on key methodological criteria was developed and used by researchers (21). Quality assessment was performed independently by two reviewers, with disagreements resolved by a third reviewer. The results of the quality assessment are presented in Table 1.

Data analysis

After finalizing the eligible studies (n= 36), a thematic synthesis approach was used to analyze the extracted data. The following steps were undertaken:

Codebook development: A preliminary codebook was developed a priori based on the WHO conceptual framework for SDH (18). This initial codebook included predefined codes corresponding to structural and intermediary determinants.

Coding process: Two independent reviewers (Sh.R. and B.P.) performed line-by-line

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coding of the extracted findings from each included study. The coding was iterative, allowing new codes to emerge inductively from the data. Codes that were not covered by the initial framework were discussed and added to the codebook.

Inter-rater reliability: To ensure coding consistency, inter-rater reliability was assessed using Cohen's kappa on a random sample of 20% of the studies. The kappa value was 0.85, indicating almost perfect agreement.

Disagreement resolution: Any disagreements between the two reviewers were resolved through discussion. When consensus could not be reached, a third reviewer (A.H.) was consulted.

Theme development: Codes with similar meanings and characteristics were grouped into broader categories. Through an iterative process of review and refinement, these categories were synthesized into five overarching thematic domains, which are presented in the Results section.

This process ensured a transparent, reproducible and rigorous qualitative synthesis of the extracted SDH factors.

Results

Due to significant heterogeneity in study designs, populations, and measured outcomes across the included studies, a meta-analysis was not feasible. Findings are therefore presented as a narrative and thematic synthesis.

A total of 5,538 articles were retrieved from the databases. After removing duplicates, 1,974 unique records remained. These records were then forwarded to the title-screening stage. During title screening, 982 articles were deemed irrelevant and excluded, leaving 992 records for abstract screening. In the abstract screening stage, an additional 694 articles were excluded. Consequently, 298 articles were selected for full-text assessment, of which 36 met the inclusion criteria and were included in the final synthesis. The overall selection process is illustrated in Fig. 1. Also, quality assessment of the 36 included studies revealed that 23 studies (63.9%) were of high quality. Common limitations included a lack of adjustment for confounding variables in case-control studies and insufficient reporting of exposure assessment in cross-sectional studies.

Social determinants of health influencing leishmaniasis

Table 2 summarizes the included studies by country, study design and the most prominent SDH factor reported. For a more detailed description, including all extracted SDH factors and complete study characteristics, please see Supplementary Table S1.

Frequency of social determinants of health factors extracted from the included studies

According to the present systematic review, the most frequently reported factors were poverty, poor housing conditions, personal protective measures, low educational attainment, limited access to healthcare services and residence in rural areas. These were clearly identified as the primary social determinants of health influencing the incidence of leishmaniasis (Table 3).

As shown in Table 3, economic factors such as low income were the most frequently reported SDH (n=27 studies), underscoring their central role in leishmaniasis risk. Housing conditions (n=13), low awareness of disease and prevention (n=11) and limited access to health services (n=10) were also prevalent determinants.

Interestingly, some factors such as "wealth" or "disease awareness" were unexpectedly associated with a higher risk of disease, reflecting the complexity of causal relationships and the potential presence of mediating and confounding variables. As illustrated in Table 3, these factors are interconnected within a network. For instance, poverty can lead to inadequate housing, malnutrition and reduced access to healthcare and education, all of which contribute to an increased risk of leishmaniasis.

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Framework for assessing social determinants of health influencing leishmaniasis

Connecting the frequency analysis (Table 3) to the WHO conceptual framework (Table 4) reveals that the most frequently reported SDH factors, such as low income (n=27), poor housing conditions (n=13), low awareness of disease and prevention (n=11), and limited access to healthcare services (n=10), align predominantly with the structural (socioeconomic position) and intermediary (material conditions, behavioral factors and health system) levels of the WHO framework. This alignment empirically validates the relevance of the WHO model for understanding leishmaniasis and demonstrates how structural inequalities translate into immediate risk factors at the individual level.

Data analysis within the framework of the SDH model (WHO, 2010) indicates that the incidence and distribution of leishmaniasis in the studied population are a function of complex interactions between structural and intermediary factors.

At the structural level, socioeconomic positions are the main determinants of individuals' risk exposure. For example, residence in marginalized areas, deteriorated urban neighborhoods, or proximity to mountains and barren lands, where lower-income populations are often concentrated, was directly associated with higher disease incidence. Additionally, occupations such as agriculture increased the likelihood of exposure to the disease vector. Inequality-related variables, such as educational attainment, played a key role in shaping awareness levels and consequently, preventive behaviors.

At the intermediary level, living conditions contributed most significantly to the formation of disease hotspots. Inadequate building materials, the presence of construction debris, open waste and sewage created an ideal physical environment for sand fly breeding and biting (the disease vector). Simultaneously, behavioral and psychosocial factors, such as misconceptions about the disease (for example, perceiving lesions as simple pimples) and delays in seeking treatment, directly affected disease outcomes. Finally, access to healthcare, particularly the financial ability to cover treatment costs and the distance to the nearest health facility, served as a key determinant of individuals' ability to utilize diagnostic and treatment services (Table 4).

Table 1. Methodological quality assessment of included studies

Author (year)	Selection (out of 4)	Comparability (out of 2)	Outcome/Exposure (out of 3)	Total score (/9)	Quality level*
Kassiri H (2019)	3	2	3	8	High
Fernando S (2010)	3	1	3	7	High
Arroub H (2012)	3	0	3	6	Moderate
Sheets D (2010)	3	0	2	5	Moderate
Talbi FZ (2010)	3	1	3	7	High
Ramezankhani R (2017)	4	1	3	8	High
Kumar N (2017)	3	2	3	8	High
Boelaert M (2009)	3	1	2	6	Moderate
Ximenes R (2009)	3	2	2	7	High
Younis LG (2020)	3	2	2	7	High
Sudarshani K (2019)	3	1	2	6	Moderate
Moya-Salazar J (2021)	3	2	3	8	High
Ahmad S (2022)	2	1	3	6	Moderate
Shahryari A (2023)	4	2	3	9	High
Nayakarathna N (2022)	3	2	3	8	High
Silva DM (2022)	4	2	3	9	High

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Table 1. Continued ...

De Carvalho AG (2020)	3	1	2	6	Moderate
Gonçalves AFLdS (2020)	2	1	3	6	Moderate
Carvalho CDP (2023)	2	1	3	6	Moderate
Shaheen R (2025)	2	1	2	5	Moderate
El Omari H (2020)	3	1	2	6	Moderate
Mashayekhi-Ghoyonlo V (2015)	3	2	2	7	High
Heidari A (2025)	3	2	2	7	High
Wijerathna T (2020)	4	1	3	8	High
Dos Reis ES (2022)	4	1	3	8	High
Salomón OD (2022)	2	1	3	6	Moderate
Kaya K (2024)	2	1	2	5	Moderate
dos Santos LR (2025)	2	1	2	5	Moderate

*Quality levels based on NOS scores: 7–9= High quality, 4–6= Moderate quality, 0–3= Low quality

Ecological studies

Author	Score (out of 100)	Quality level (based on proportion)
Rodrigues MGdA (2019)	86/100	High
Nunes BEBR (2019)	76/100	High
Gutierrez JD (2017)	76/100	High
Hernández AM (2019)	75/100	High
Valero NNH (2021)	80/100	High
Maia-Elkhoury AN (2021)	78/100	High
de Freitas NDA (2024)	76/100	High
Tapias Rivera J (2025)	78/100	High

Table 2. Summary of included studies: country, study design, and the most important social determinants of health factors associated with leishmaniasis

Author (year)	Country	Study design	Most important SDH factor(s) identified
Ramezankhani R (2017)	Iran	Cross-sectional (spatial)	Temperature, humidity, vegetation density
Shahryari A (2023)	Iran	Population-based case-control	Housing roof type, animal contact
Younis LG (2020)	Nepal	Case-control	Bamboo walls, cracks in walls, and outdoor toilets
Moya-Salazar J (2021)	Peru	Retrospective	Poverty level
Boelaert M (2009)	India (Bihar)	Cross-sectional	Severe poverty, caste discrimination
Ahmad S (2022)	Pakistan	Cross-sectional	Low education, low income, poor housing
Ximenes R (2009)	Brazil	Case-control	Low income, poor housing, proximity to forest
Kassiri H (2019)	Iran	Descriptive-analytical	Agricultural occupation, rural residence, lack of access to healthcare
dos Santos LR (2025)	Brazil	Descriptive-analytical	Low education, mixed race, geographic region
Sudarshani K (2019)	Sri Lanka	Cross-sectional	Rural residence, poor housing, lack of awareness
Kaya K (2024)	Turkey	Prospective	Low income, lack of access to healthcare
Kumar N (2017)	India	Case-control	Grain storage inside the house, poor drainage
Fernando S (2010)	Sri Lanka	Descriptive-observational	Delay in seeking treatment, inability to pay, stigma
Arroub H (2012)	Morocco	Cross-sectional	Poor waste management, poor housing, and

Table 2. Continued ...

			unsanitary toilets
Sheets D (2010)	India (Bihar)	Cross-sectional	Low education, poor housing, and population density
Lu C (2024)	Pakistan	Cross-sectional (spatial)	Clay houses, Afghan refugees, large households
Talbi FZ (2020)	Morocco	Cross-sectional	Rural residence, poverty, population density
Nayakarathna N (2022)	Sri Lanka	Cross-sectional	Low awareness, bush/forest areas
De Carvalho AG (2021)	Brazil	Cross-sectional	Low SES, low knowledge among dog owners
Gonçalves AFLdS (2020)	Brazil	Cross-sectional and ecological	Poverty index, infrastructure index
Rodrigues MGdA (2019)	Brazil (Amazonas)	Ecological	Deforestation, unplanned urbanization
Carvalho CDP (2023)	Brazil	Cross-sectional	Low income, treatment costs
Shaheen R (2025)	Pakistan	Cross-sectional	Mud houses, livestock inside the home, delay in care
El Omari H (2020)	Morocco	Cross-sectional	Urbanization, population density
Mashayekhi-Ghoyonlo V (2015)	Iran	Prospective cohort	Low SES, poor housing, limited healthcare access
Heidari A (2025)	Iran	Case-control	Outdoor sleeping, low SES, animal proximity
Gutierrez JD (2017)	Colombia	Ecological	Forest cover, agricultural areas
Wijerathna T (2020)	Sri Lanka	Cross-sectional with case-control	Being a housewife, low income, low awareness
Hernández AM (2019)	Colombia	Ecological	Deforestation, distance to cities, and armed conflict
Valero NNH (2021)	Brazil	Cross-sectional-longitudinal ecological	Poor housing, lack of waste/sewage services
Maia-Elkhoury AN (2021)	Multi-country (Latin America)	Ecological	Illiteracy, crowded housing, and agricultural activities
Dos Reis ES (2022)	Brazil	Retrospective spatio-temporal	Inadequate housing, low income, low education
Nunes BEBR (2020)	Brazil	Ecological	Low income, low education, fragile housing, unemployment
Salomón OD (2022)	Americas	Cross-sectional	Poverty, inadequate housing, and environmental changes
de Freitas NDA (2024)	Brazil	Ecological	Open sewage, trees around the house
Tapias Rivera J (2025)	Colombia	Ecological	Multidimensional Poverty Index, housing deficits, mi

Table 3. Frequency of social determinants of health (SDH) factors for leishmaniasis in the included studies

Dimensions of SDH	SDH Factors	Frequency
Socio-economic factors	Income status	27
	Educational level	14
	Employment status	15
	Marginalized ethnicity/race	3
Housing and living environment factors	Poor housing conditions (lack of window/door screens)	13
	Inadequate personal protection (sleeping outdoors, not using bed nets, etc.)	9
	Type of building materials (mud, thatch,	8

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Table 3. Continued ...

	cracked walls)	
	Presence of and contact with animals inside or around the house	7
	Lack of access to safe drinking water	5
	Inadequate sewage and drainage system	5
	Insufficient household lighting	3
	Indoor grain storage	2
	Use of solid fuels (wood/dung)	2
	Asbestos-cement roofing	1
	Outdoor latrines with dirt floors	1
Access to health services	Lack of / delay in accessing to health services	10
	Delay in diagnosis and treatment	4
	Treatment and transportation costs	3
	Low satisfaction with health services	2
	Visiting traditional healers	1
Demographic factors	Residence in rural areas	9
	Gender (male)	8
	Age (children and youth)	8
	High population density / large households	6
	Residence in urban areas	4
	Migration and population mobility	5
	Age (middle-aged and elderly)	2
Environmental and geographical factors*	General environmental factors (temperature, wind, humidity, etc.)	8
	Vegetation cover (trees, bushes, forests)	7
	Agricultural and farming areas	5
	Altitude above sea level	4
	Living in endemic areas	3
	Deforestation	6
	Wet and water-logged soils	3
	Termite mounds	2
	Decaying waste / improper waste management	2
	Proximity to forests	1
Knowledge, awareness, and behavioral factors	Low awareness of the disease and prevention	11
	Contact with infected individuals/family members	4
	Not using protective measures (bed nets, etc.)	3
	Misinterpretation of lesions (considering them pimples)	2
	Outdoor activities (night-time, recreational)	2
Disease outcome-related factors	Psychological impact and social stigma	3
	Catastrophic treatment costs	2
	Malnutrition and comorbidities	2

*Note: Factors such as temperature, humidity, and vegetation cover are primarily biophysical/environmental variables, not social determinants of health (SDH) according to the WHO definition. They are included here only because some original studies reported them alongside SDH factors. They should not be interpreted as SDH in the conceptual framework.

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Table 4. Classification of social determinants of health (SDH) influencing leishmaniasis based on the WHO conceptual framework

Main theme	Sub-theme	Extracted Factor	Leishmaniasis-related Explanation/Justification
Structural factors	Socio-economic and political context	Monthly household income / per capita income Employment status of household head (farmer, laborer, housewife, unemployed) Ownership of basic assets (car, refrigerator,…) Recipients of social assistance	These factors determine the overall socio-economic position of the household, which shapes inequalities in exposure to the disease (e.g., living in high-risk neighborhoods) and access to preventive resources.
	Social inequality axes	Educational level of the household head and the infected individual Age and gender of the infected person Ethnicity Nationality Place of residence (urban, rural, peri-urban/slum) History of migration or residence in endemic areas	These variables define the social position of individuals and expose them to varying levels of risk (e.g., certain occupations or ethnic groups are predominantly located in endemic regions).
Intermediary factors	Financial circumstances	Building materials (type of walls, roof, floor) Physical condition of the house (use of screens on doors/windows, cracks or holes in walls) Environmental hygiene (presence of waste, open sewage, abandoned lands) Keeping livestock and poultry near the house Presence of animals inside the house	These conditions directly create a physical environment favorable for the breeding and biting activity of sandflies (vectors of leishmaniasis).
	Behavioral and psychosocial factors	Personal protection practices (sleeping outdoors, not using bed nets) Knowledge about the disease (transmission, prevention, symptoms) Awareness of the time and place of sand fly biting Misconceptions about the disease (perceiving lesions as simple pimples) Main source of health information Delay in seeking treatment after symptom onset	This knowledge and these beliefs directly influence protective behaviors (such as using insecticide-treated bed nets) and the decision to seek timely care.
	Health system	Financial ability to afford treatment costs (direct and indirect) Distance to the nearest health facility Access barriers (need for male accompaniment, mobility constraints for women) Satisfaction with received services (staff attitude, quality of care)	These factors determine the ability to benefit from prevention, diagnosis, and treatment services, which are directly linked to disease outcomes.
	Social-demographic factors (as background)	Household size and crowding per room Duration of residence History of infection among other family members	These factors create conditions that either facilitate or intensify exposure to the vector and disease transmission.

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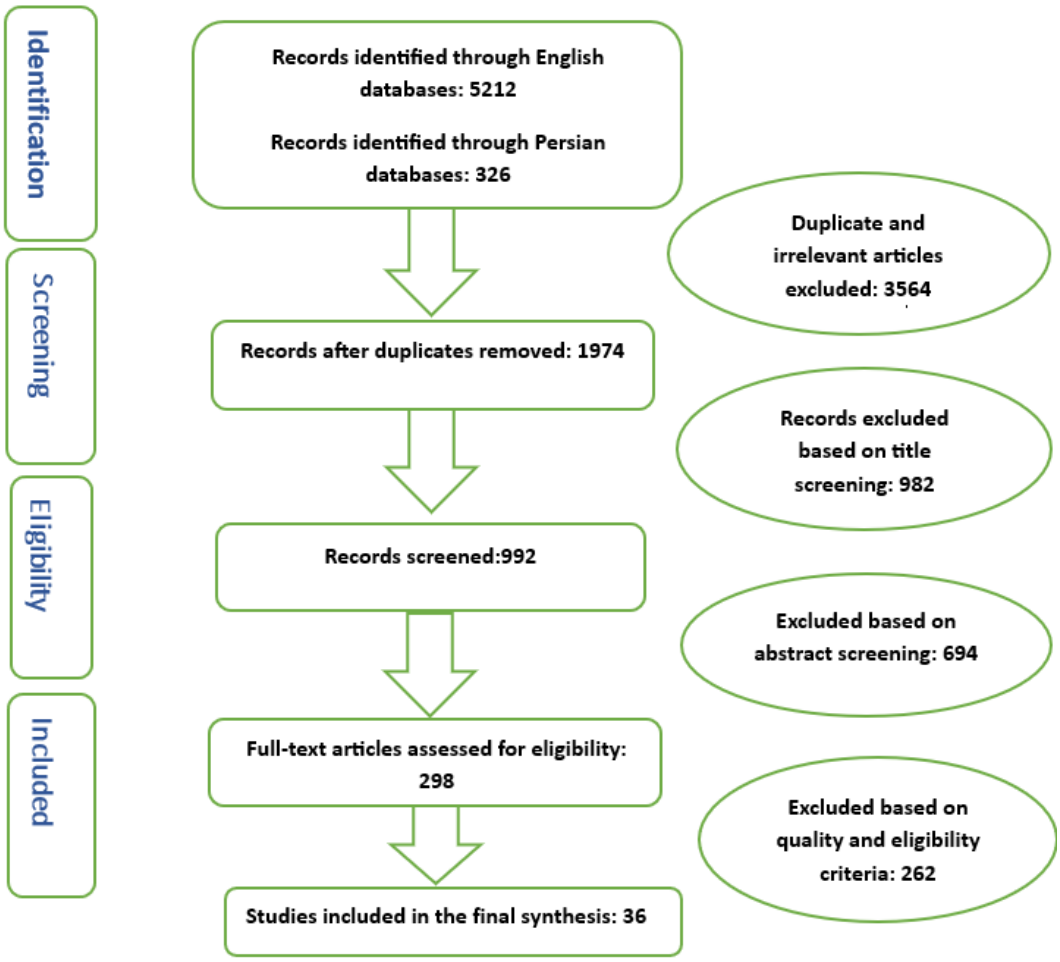

Fig. 1. Study selection process based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol

Discussion

The findings of this systematic review indicate that leishmaniasis is strongly influenced by SDH, which can act as both structural drivers and mediators in disease transmission. Consistent with global literature, the present study highlights poverty, inadequate housing, low educational attainment, residence in rural or marginalized areas, and limited access to healthcare services as key factors associated with an increased risk of leishmaniasis.

Multiple studies have demonstrated that poverty increases disease risk through various mechanisms, including reduced financial capacity to improve housing conditions, limited access to diagnostic and treatment services, malnutrition and increased exposure to vectors (sand flies), resulting in a disproportionate burden of leishmaniasis among low-income populations (8, 22–24).

This finding has important implications for intervention design. The cyclical relationship between poverty and leishmaniasis suggests that biomedical interventions alone (for example, free diagnosis and treatment) are insufficient. Sustainable control requires breaking the poverty-disease cycle through economic empowerment programs, conditional cash transfers and livelihood support for affected households. Without addressing the economic vulnerabilities that force families to live in high-

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risk environments, reinfection and persistent transmission are likely to occur.

Poor housing conditions emerged as another critical determinant. Dwellings lacking proper roofing, with wall cracks, high humidity, or proximity to vector breeding sites provide ideal environments for sand fly proliferation and shelter (23, 24). Research in Brazil and Iran has similarly shown that low construction quality and the absence of protective measures (for example, window screens) are directly associated with higher disease incidence (11, 25).

This suggests that vector control programs focused solely on insecticide spraying may have limited success if the fundamental architecture of human dwellings provides refuge for sand flies. Therefore, integrating housing improvement subsidies or material support (for example, provision of window screens, plaster for wall cracks) into public health programs could yield synergistic benefits. Such structural interventions address the root causes of exposure rather than merely mitigating vector populations.

Low educational attainment and limited health literacy were also identified as important risk factors, as insufficient education may limit awareness of preventive measures, protective behaviors and timely health-seeking. Evidence suggests that enhancing health literacy may serve as a key tool in controlling disease transmission (24, 26).

The implication is clear: educational interventions should not be an afterthought but a core component of leishmaniasis control programs. School-based health education, community awareness campaigns using local languages, and integration of leishmaniasis prevention into routine primary health education can empower at-risk populations. Moreover, addressing gender-specific barriers to education (particularly in regions where women have lower literacy rates) could have cascading effects on household-level prevention behaviors.

This limitation leads to delayed diagnosis. In anthroponotic forms of leishmaniasis (for example, ACL and AVL), where humans serve as the main reservoir, delayed diagnosis can expand the human reservoir and consequently increase transmission. In zoonotic forms (ZCL and ZVL), although delayed diagnosis does not expand a human reservoir, it still contributes to individual disease burden and may delay timely public health interventions (24, 27–29).

From a health systems perspective, these findings highlight the need for decentralized diagnostic services. In many endemic regions, the distance to the nearest health facility (often >10 km) and the direct and indirect costs of treatment (transport, lost wages, medication) are prohibitive for low-income households. Therefore, interventions such as mobile clinics, community health worker training for early case detection, and elimination of user fees for leishmaniasis treatment could dramatically reduce diagnostic delays and interrupt transmission cycles, particularly for anthroponotic forms.

Socio-demographic factors, such as age, sex, employment status and daily activities, were also considered in the included studies. For example, men engaged in agricultural or construction work outdoors are more exposed to sand fly bites than others (30–32). Additionally, seasonal or forced migration can expose individuals to endemic areas or place them in temporary settlements with inadequate living conditions (24, 30).

The WHO framework (Table 4) provides a powerful analytical lens for understanding why isolated interventions often fail. As shown in Table 4, structural determinants (for example, low income, low education) do not act directly on disease risk. Instead, they manifest through intermediary determinants, material conditions (inadequate housing, lack of screens), behavioral and psychosocial factors (misconceptions about lesions, low awareness) and health system barriers (distance to facilities, treatment costs).

For example, poverty (a structural determinant) increases leishmaniasis risk not through

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a direct biological pathway, but because it forces families into poorly constructed housing (material condition), limits their ability to afford bed nets or screens (material condition), reduces health literacy (psychosocial factor), and constrains their ability to pay for transportation to health facilities (health system barrier). This explains why providing free treatment alone without addressing transportation costs, housing conditions, or misconceptions that lesions are "just pimples," will not interrupt the transmission cycle. Effective interventions must simultaneously target multiple intermediary pathways through which structural inequalities operate.

The findings indicate that controlling leishmaniasis without addressing the underlying social determinants, such as improving living conditions, alleviating poverty, enhancing education and strengthening healthcare systems, will neither be sustainable nor effective.

Finally, this study underscores the necessity of inter-sectoral approaches and equity-oriented health policies. Leishmaniasis control programs should combine health interventions, such as vector control and patient treatment, with social and structural measures. Future research in this area could focus on multilevel studies, advanced ecological analyses and evaluations of health policy interventions aimed at reducing inequalities and controlling disease.

Interpretation of counterintuitive findings

A notable finding of this review was that some studies reported unexpected associations, where factors such as higher wealth or greater disease awareness were paradoxically linked to increased leishmaniasis risk (Table 3). Several explanations may account for this.

First, detection bias may play a role: greater healthcare access and awareness among wealthier individuals can lead to higher diagnosis and reporting rates, which may not correspond to a genuine increase in disease risk. Second, confounding by occupation or behavior is plausible in some settings; higher education or awareness may be associated with outdoor occupations (for example, farmers, construction workers, military personnel) that increase exposure to sand fly bites, as observed in studies from Iran and Colombia. Third, reverse causality cannot be ruled out: individuals who develop leishmaniasis may become more aware of the disease through their illness experience, creating a spurious association between awareness and disease.

Regarding education, the relationship appears context-dependent. While low educational attainment was associated with higher risk in most studies (n=14), a few studies reported that higher education increased risk, likely due to confounding by outdoor occupational activities rather than education itself being a risk factor. This highlights the importance of considering local social and occupational contexts when interpreting SDH factors.

These nuanced findings underscore the complexity of causal pathways in leishmaniasis epidemiology and the need for longitudinal studies to disentangle true risk factors from biases and confounders.

Limitations

This systematic review has several limitations. First, the included studies exhibited considerable heterogeneity in study designs (cross-sectional, case-control, cohort, ecological), populations, geographic settings and outcome measurements. This heterogeneity limits the direct comparability of findings and precludes a meta-analysis. Second, most studies were cross-sectional in design, which precludes establishing causal relationships between SDH factors and leishmaniasis. Third, the majority of studies were conducted in Brazil, Iran, and India, which may limit the generalizability of findings to other endemic regions. Fourth, publication bias may exist, as studies reporting significant associations are more likely to be published. Finally, the quality assessment revealed that some studies had methodological

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limitations, particularly in adjusting for confounding variables.

Additionally, although we searched both English and Persian databases, the inclusion of only these two languages may have introduced language bias, potentially excluding relevant studies published in Spanish, Portuguese, French, or other languages, particularly from Latin American and African endemic regions. Furthermore, social determinants of health can change over time (for example, income, housing conditions and educational attainment) and the predominance of cross-sectional designs cannot account for such temporal dynamics. Despite these limitations, the consistency of findings across diverse settings strengthens confidence in the key conclusions of this review.

Conclusion

The results of this systematic review indicate that the incidence and spread of leishmaniasis are substantially influenced by a range of social determinants of health. Factors related to poverty, poor housing conditions, residence in rural or marginalized areas, low literacy and educational attainment, and limited access to healthcare were identified as the most frequently reported variables associated with an increased risk of infection. Beyond these, demographic and occupational factors, including male gender, young age (children and young adults) and high-risk occupations such as farming, construction work, and military service, also consistently shaped disease risk across studies.

However, the relationships between SDH and leishmaniasis are not always linear or deterministic. Notably, a small number of studies reported counterintuitive findings, where higher wealth or greater educational attainment were paradoxically associated with increased risk. These unexpected associations may reflect complex causality, confounding by outdoor occupational activities (for example, educated individuals may work in agriculture or field-based jobs), or surveillance/detection bias (wealthier individuals have better access to diagnosis and reporting). This nuance underscores that poverty reduction alone, while essential, may not be sufficient and that context-specific pathways must be understood.

Analysis of the existing studies highlights that leishmaniasis control and prevention cannot rely solely on biomedical and medical interventions but require serious attention to structural and social determinants of health. Accordingly, the adoption of inter-sectoral policies aimed at reducing social inequalities, improving living conditions, enhancing health literacy and strengthening healthcare delivery systems can play a critical role in reducing the global burden of this disease. Furthermore, the conceptual framework presented in this study can serve as a guide for future research and for designing interventions based on social determinants of health, while recognizing that local occupational, demographic and behavioral contexts must be carefully considered.

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Ethical considerations

All ethical principles, including avoidance of plagiarism, data falsification, and duplicate publication, were fully observed in this study. This systematic review was conducted based on previously published literature and did not involve direct participation of human subjects or animals. The study protocol was approved by the Ethics Committee of Kurdistan University of Medical Sciences, with the ethical approval code IR.MUK.REC.1404.288.

Conflict of interest statement

The authors declare there is no conflict of interest.

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