SAGE Open Medicine

SAGE Open Medicine
Volume 10: 1–9

DOI: 10.1177/20503121221129720
journals.sagepub.com/home/smo
SAGE

Epidemiological and clinical characteristics of cutaneous leishmaniasis among patients attending at Tefera Hailu Memorial Hospital, Sekota, Northeast Ethiopia: A five-year trend analysis (2016–2020)

Habtu Debash, Hussen Ebrahim and Habtye Bisetegn

Abstract

Objective: This study was designed to determine the epidemiological and clinical characteristics of cutaneous leishmaniasis among patients attending at Tefera Hailu Memorial Hospital, Sekota, Northeast Ethiopia over the last 5 years.

Methods: A 5-year retrospective study was conducted at Tefera Hailu Memorial Hospital, Northeast Ethiopia. Data were summarized and analysed using Microsoft Excel and SPSS 26 version software, respectively. To present the data and evaluate the patterns in cutaneous leishmaniasis cases across the 5 years, months, and seasons, descriptive statistics were utilized. In multivariable logistic regression analysis of determinants in relation to cutaneous leishmaniasis positivity, *p*-value less than 0.05 was considered as statistically significant.

Result: The overall positivity rate of cutaneous leishmaniasis was 31.1% (452 out of 1455) over the last 5 years at Tefera Hailu Memorial Hospital. The result showed a fluctuating yet declining trend in cutaneous leishmaniasis infections. The highest number of cases was registered in 2016, while the lowest was in 2020. Males and the age group of 15–49 years, accounted 78.5% and 79.9% of the patients, respectively, were the hardest hit by cutaneous leishmaniasis in the area. Similarly, the highest number of cases was observed in Dehana district (268). From all registered confirmed cases, 54 (10.7%) were previously treated cases. Moreover, the majority of cases, 423 (93.6%) were localized cutaneous leishmaniasis and most of the lesions were on the face.

Conclusion: Although the results indicate a fluctuating yet declining trend, the positivity rate of confirmed cutaneous leishmaniasis cases in the area remains alarming and indicates a major public health burden. Therefore, efforts are required to reduce the disease burden through continuous monitoring and evaluation of control measures in the study area.

Keywords

Cutaneous leishmaniasis, trend, positivity rate, Sekota, Ethiopia

Date received: 14 May 2022; accepted: 13 September 2022

Introduction

Leishmaniasis is a vector-borne neglected tropical disease (NTD) caused by a protozoan parasite of the genus Leishmania.[1] The disease is transmitted by the bite of an infected female sand fly of the genera *Phlebotomus* in the old world and *Lutzomyia* in the new world.[2,3] Globally, about 350 million people are at risk of cutaneous leishmaniasis (CL) infection and 220,000 cases per year.[4,5] CL is the most common form of leishmaniasis. It causes disfiguring skin lesions that can leave lifelong scars and lead to severe social stigma, less education, and economic loss.[6–8]

CL is endemic in different regions of Ethiopia like Dessie, Amhara region,[9] Saesie Tsaeda-emba district Eastern Tigray,[10] Ochollo, Southern Nations and Nationalities people's regional state in southern Ethiopia.[11] Risk mapping using environmental parameters of CL in Ethiopia indicates

Department of Medical Laboratory Sciences, College of Medicine and Health Sciences, Wollo University, Dessie, Ethiopia

Corresponding author:
Habtu Debash, Department of Medical Laboratory Sciences, College of Medicine and Health Sciences, Wollo University, Dessie, Ethiopia.
Email: habtudebash@gmail.com

that high prevalence of the disease more commonly occurs in the highland, which constitutes 19.5% of the land mass. In Ethiopia, a total of 30 million of its population are at risk of CL infection with 20,000 to 50,000 estimated annual cases.[5,12]

The disease most commonly affects those people who do not have access to treatment because of poor health service structure. As a result, most affected individuals use traditional medicine for the treatment of CL. For example, application of fire, mud with wholly water, and different plant extracts on the affected areas in some parts of Ethiopia.[13] Other factors such as socio-demographic, environmental, socioeconomic factors and knowledge, attitude and practice of the community contribute for the occurrence of the disease.[14]

The strategies for the prevention and control of CL include managing of the environment, sand fly control, avoiding of the reservoir, and early detection and treatment of the infected individuals are the main methods.[15,16] The prevention and control of CL is challenging due to social stigma, negative perceptions and attitudes towards treatment options, the complexity of its vector control and the existence of many reservoir hosts.[17] Therefore, the disease transmission has stayed steady for a long time.

Despite, the country developing a management guideline for the disease in 2013, only a few hospitals in Ethiopia offer the diagnosis and treatment services for CL. The majority of them are accessible in locations far from where the actual patients are living.[18] CL has been diagnosed using both clinical evaluation and microscopic study of the parasite from skin lesion. In lowland areas where CL is also endemic, the provision of insecticide-treated nets (ITNs) and pesticide spraying for malaria control may have some effect on phlebotomies.[19] However, there is no effective CL vector control effort of CL in the country and remains neglected even among the NTDs.[20] As a result, significant efforts are required to prevent and control CL.

Hence, despite few studies have been conducted in Ethiopia, there is lack of empirical evidences in the study area on the level of CL epidemiological, clinical characteristics and its associated factors. Therefore, this study aimed to determine the epidemiological and clinical characteristics of CL patients attending at Tefera Hailu Memorial Hospital, Northeast Ethiopia in the last 5 years' period from 2016 to 2020. This study helps to understand the dynamics of disease transmission, geographical distribution, and the determinant factors. Such information is vital to develop evidence-based and area-specific interventions.

Materials and methods

Study design, area, and period

A cross-sectional retrospective study was conducted at the Tefera Hailu Memorial Hospital Leishmaniasis Diagnostic and Treatment Center. The hospital is found in Sekota Town, which is the capital of Wag Hemra Zone, Amhara Regional State, Northeast Ethiopia. The area is located 720 km far from Addis Ababa, the capital city of Ethiopia. It has latitude and longitude of 12°38′ N39°02′E and an elevation of 2266 m above sea level (Figure 1). CL suspected patients, whose laboratory result (skin slit test) with complete information were included in the study. Five-year (2016–2020) CL secondary data were collected from April to June 2021.

Inclusion criteria

CL data with complete registration including the result, age, sex, residence, and date of examination were included in the study

Exclusion criteria

Four data were excluded from this record review due to the incompleteness of characteristics such as age, gender, and residence. When duplicate names with the same result found, only one was included, whereas the remaining were excluded. Moreover, previously treated or relapse cases were not used for positivity rate statistics.

Data collection and laboratory method

Five years (2016–2020) laboratory registered data regarding CL were extracted. CL was confirmed by skin slit microscopy from CL suspected patients. Socio-demographic characteristics such as age, sex, month, year of examination, and patient residence as well as the clinical characteristics including new and repeated CL cases, clinical forms, and site of the infection were collected using a predesigned data collection sheet from their medical records. Skin slit test for the diagnosis of CL in the hospital was performed according to a standard operating procedure (SOP).[21]

Data quality control

The completeness of the CL patients' medical records and registration books in the hospital was first assessed to ensure the quality of data. Then, data collection format sheet was prepared and used for data recording. Prior to data extraction, data collectors were adequately trained for 2 days. The overall process of data extraction was followed up by the principal investigator and data were checked for accuracy, completeness, and consistency before analysis. Any data that were not properly documented and not completely registered were excluded from analysis.

Statistical analysis

Data were extracted from laboratory registration logbooks and medical records, and summarized using Microsoft

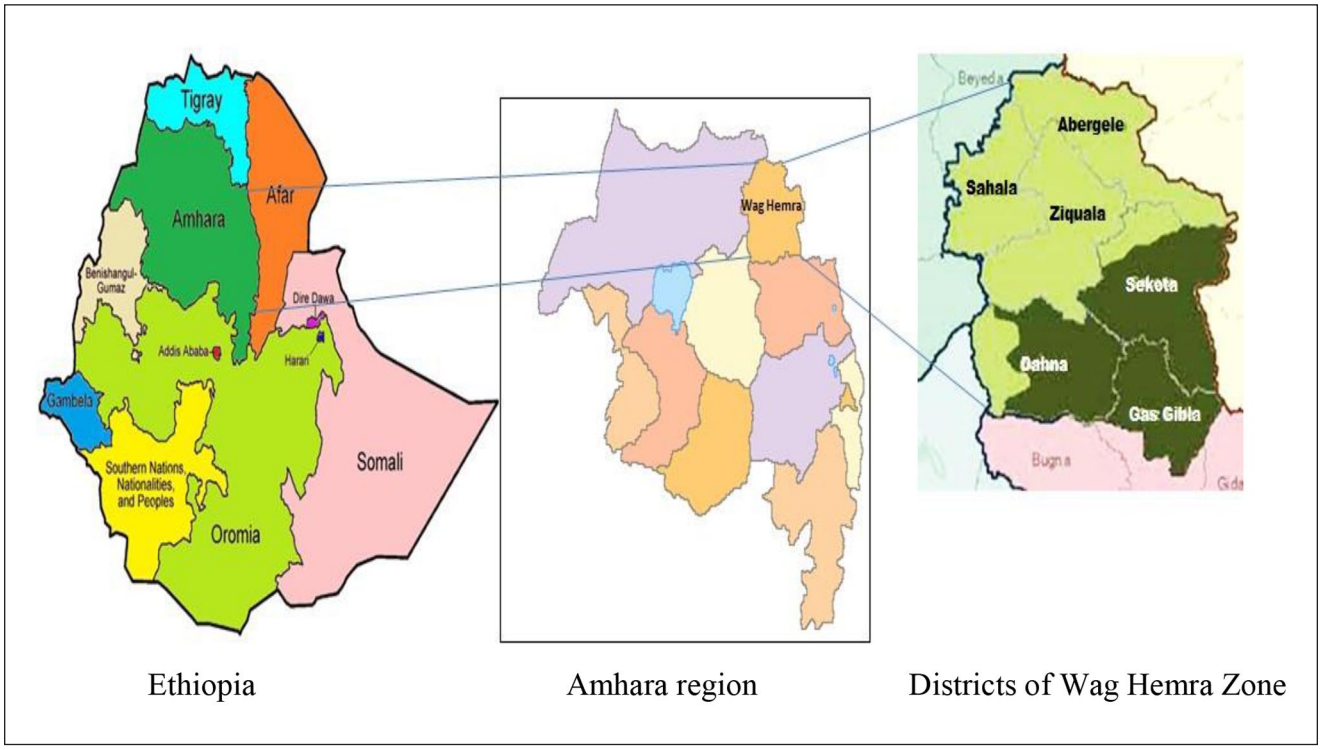


Figure 1. Map of Ethiopia, Amhara Region, and Wag Hemra Zone Districts from where cutaneous leishmaniasis patients of Tefera Hailu Memorial Hospital originated.

Excel. All data were checked for its completeness, then the data were entered into and analysed using SPSS 26 version software. Descriptive statistics were used to present the data and to evaluate CL trends over the years, months, and seasons. Logistic regression analysis was carried out to identify independent predictors of CL. The retrospective total CL case in the past 5 year (2016–2020) was summarized using figures and tables. In bivariable logistic regression analysis, variables with a p-value < 0.25 were included in multivariable logistic regression. In the case of multivariable logistic regression, p-value less than 0.05 was considered as statistically significant.

Result

Overall positivity rate and annual trend of CL

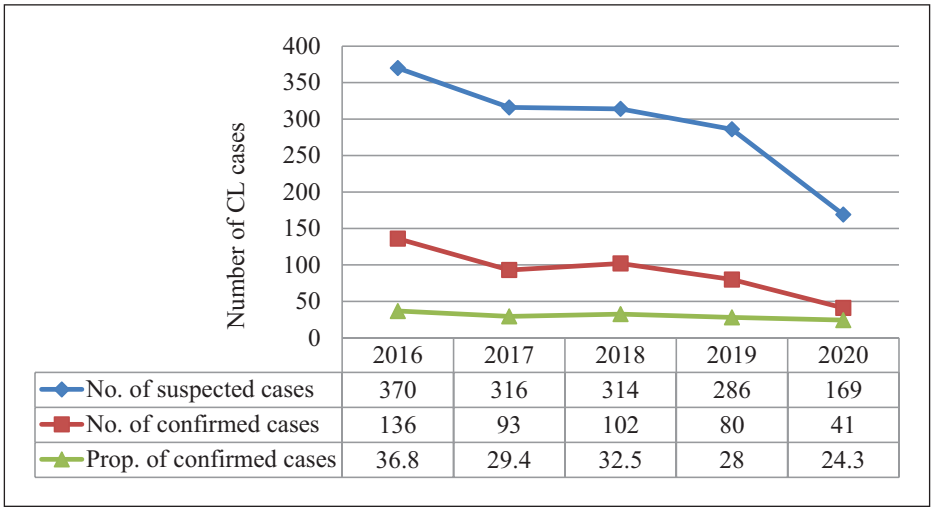
A total of 1455 skin slit tests were requested from CL suspected patients over the last 5 years from 2016 to 2020 at Tefera Hailu Memorial Hospital. Among these, 452 (31.1%) were microscopically confirmed CL cases. An average of 291 suspected and 90 CL-confirmed cases was recorded annually. In 2016, the highest number of CL suspected patients (370) were examined, of which 136 (36.8%) of them were microscopically confirmed cases. On the contrary, the least numbers of confirmed cases, 41 (24.3%) were recorded in 2020. Overall, CL cases were declined from 2016 to 2020 with the exception of 2018 (Figure 2).

Monthly and seasonal patterns of CL over the last 5 years

CL cases occurred throughout the months despite variation in a 5-year period. CL cases showed sharp increasing trend from July to September. In this study, the highest number of CL cases was reported in September (62), followed by December (55), and May (42), while least cases were reported in July (24). Even though CL occurred in all seasons, the positivity rate had fluctuating trend across the four seasons over the last 5 years. Regarding the seasonal distribution, the highest and the lowest cases of CL cases were observed during autumn (September–November; 148) and summer (June–August; 79), respectively (Figure 3).

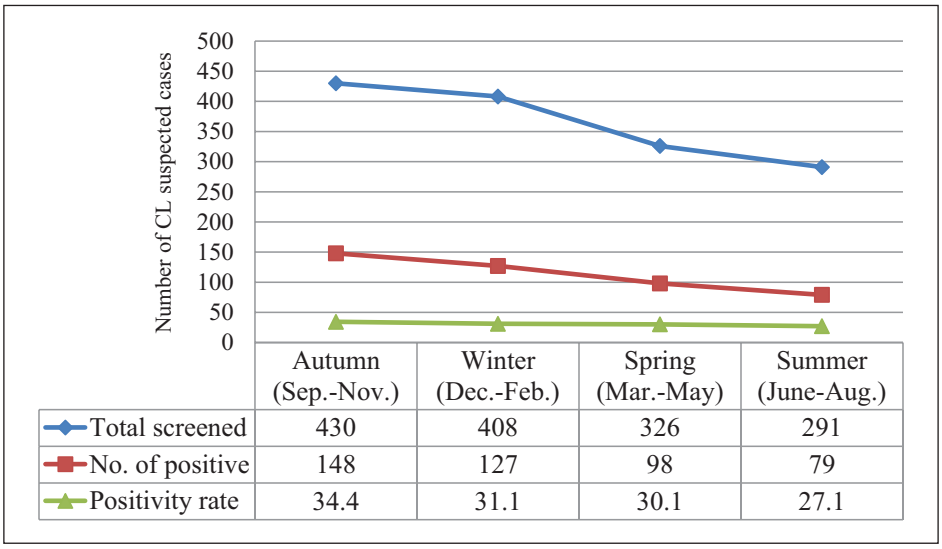
Socio-demographic characteristics of CL cases

In the past 5 years (2016–2020), a total of 452 CL-confirmed cases were reported in Tefera Hailu Memorial Hospital. Of these, 355 were males and 97 were females (male to female ratio 4:1). Moreover, the number of cases was the highest among the age group of 15–49 years old (79.9%) followed by 49 years old and above (14.6%). Regarding residence, 320 (70.8%) and 132 (29.2%) of CL-confirmed patients



	2016	2017	2018	2019	2020
No. of suspected cases	370	316	314	286	169
No. of confirmed cases	136	93	102	80	41
Prop. of confirmed cases	36.8	29.4	32.5	28	24.3

Figure 2. Trend of CL suspected and confirmed cases at Tefera Hailu Memorial Hospital, Northeast Ethiopia, from 2016–2020.



	Autumn (Sep.-Nov.)	Winter (Dec.-Feb.)	Spring (Mar.-May)	Summer (June-Aug.)
Total screened	430	408	326	291
No. of positive	148	127	98	79
Positivity rate	34.4	31.1	30.1	27.1

Figure 3. Distribution of CL suspected and confirmed cases among different seasons at Tefera Hailu Memorial Hospital, Northeast, Ethiopia, 2016–2020.

were from rural and urban resident, respectively. Furthermore, the highest proportion of CL-confirmed patients were come from Dehana district (59.3%) followed by Sekota town (20.4%) and Gazgibla (16.4%; Table 1).

CL cases and its clinical characteristics

A total of 452 (89.3%) new and 54 (10.7%) previously treated confirmed CL cases were detected in this record review study. The number and proportion of new and previously treated (relapse) cases in the hospital had showed variation with the year of examination (Table 2). From a total of 452 new CL-confirmed patients, 423 (93.6%) were localized CL (LCL), 5 (1.1%) diffuse CL (DCL), and 24 (5.3%) were muco-cutaneous leishmaniasis (MCL). Furthermore, cheek, nose, and lips were the most affected body sites with the proportion of 37.6%, 24.8%, and 17.3%, respectively (Table 3).

Bivariable and multivariable analysis of determinants of CL

In bivariable logistic regression analysis, independent variables such as sex, age, residence, and occupation were found to be candidates for multivariable logistic regression analysis. After performing multivariable logistic analysis, living in Dehana district (adjusted odds ratio (AOR) 3.6, 95% confidence interval (CI): 2.04–11.01, $p=0.01$) remained as independent predictor of CL infections (Table 4).

Table 1. Cutaneous leishmaniasis cases by age, gender, residence, and occupation at Tefera Hailu Memorial Hospital, Northeast, Ethiopia, 2016–2020.

Variables	Alternatives	Total skin slit smear examined	Confirmed CL cases	Percentage of positives (%)
Age	<15	151	25	5.5
	15–49	1056	361	79.9
	>49	248	66	14.6
	Total	1455	452	100
Sex	Male	952	355	78.5
	Female	503	97	21.5
	Total	1455	452	100
Residence	Rural	949	320	70.8
	Urban	506	132	29.2
	Total	1455	452	100
Geographical distribution (Districts)	Dehana	734	268	59.3
	Sekota town	286	92	20.4
	Gazgibla	246	74	16.4
	Sekota zuria	121	12	2.7
	Other Waghimra districts	42	4	0.9
	Waghimra border areas	26	2	0.4
	Total	1455	452	100
Occupation	Farmer	826	302	66.8
	Student	334	95	21.0
	Merchant	241	47	10.4
	Civil servant	54	8	1.8
		1455	452	100

CL: cutaneous leishmaniasis.

Table 2. New and previously treated CL cases among patients who were treated at Tefera Hailu Memorial Hospital, Sekota, Northeast Ethiopia, 2016–2020.

CL cases	Year of examination					
	2016	2017	2018	2019	2020	Overall
Repeated	12 (8.1%)	9 (8.8%)	14 (12.1%)	12 (13.0%)	7 (14.6%)	54 (10.7%)
New	136 (91.9%)	93 (91.2%)	102 (87.9%)	80 (87.0%)	41 (85.4%)	452 (89.3%)
Total	148	102	116	92	48	506

CL: cutaneous leishmaniasis.

Discussion

The overall positivity rate of microscopically confirmed CL cases was 31.1% (452out of 1455) from 2016 to 2020. This result was lower than similar studies done in Gondar, Northwest Ethiopia (55.4%)[22] and Sri Lanka (86.4%).[23] This could be explained by differences in study location, study time, laboratory personnel performance in parasite detection, difference in prevalence of other skin conditions, and therefore difference in pre-test probability. The lower positivity rate of CL in our study compared to a study done in Sri Lanka might be also due to the use of the less sensitive skin slit smear microscopy, which was only 56% sensitive in Ethiopia.[24]

In contrast, it was higher than similar health facility-based studies in Ethiopia such as Addis Ababa (14.2%),[25] Dessie town (1.5%),[26] and Larstan, South of Iran (26.6%).[27] This disparity could be due to a variety of reasons, including environmental and ecological factors that may play a significant influence in sand fly vector reproduction, host factors such as bed net use and early diagnosis and treatment, and reservoir host dispersion. CL trend in this study seems non-fluctuating as microscopically confirmed cases showed a steady decrease from 2016 (136) to 2020 (41) with the exception of 2018 (102), which showed slight increment relative to 2017 (93). Despite the fact that the trend showed a decline, the positivity rate of CL cases remained high in comparison to a meta-analysis and

Table 3. Clinical characteristics of CL cases among patients who were treated at Tefera Hailu Memorial Hospital, Sekota, Northeast Ethiopia, 2016–2020.

Variables	Alternatives	Frequency (N)	Percentage (%)
Types of CL	LCL cases	423	93.6
	DCL cases	5	1.1
	MCL cases	24	5.3
	Total	452	100
Site of lesion on the body	Cheek	170	37.6
	Nose	112	24.8
	Lips	78	17.3
	Hand	48	10.6
	Leg	23	5.1
	Whole body	12	2.7
	Neck	6	1.3
	Ear	3	0.7
	Total	452	100

CL: cutaneous leishmaniasis; LCL: localized cutaneous leishmaniasis; DCL: diffuse cutaneous leishmaniasis; MCL: muco-cutaneous leishmaniasis.

Table 4. Univariable and multivariable logistic regression analysis of determinants in relation to CL positivity at Tefera Hailu Memorial Hospital, Northeast Ethiopia, from 2016–2020.

Variables	Alternatives	Positive n (%)	Negative n (%)	COR (95% CI) *p*-value	AOR (95% CI) *p*-value
Sex	Male	355 (37.3)	597 (62.7)	2.49 (1.08–6.57) 0.03	1.4 (0.81–8.76) 0.071
	Female	97 (19.3)	406 (80.7)	1	1
Age in years	< 15	25 (16.6)	126 (83.4)	1	1
	15-49	361 (34.2)	695 (65.8)	2.62 (1.65–9.74) 0.02	1.64 (0.83–8.76) 0.067
	> 49	66 (26.6)	182 (73.4)	1.8 (1.02–7.93) 0.22	0.96 (0.72–5.49) 0.28
Residence	Rural	320 (33.7)	629 (66.3)	1.44 (1.06–9.72) 0.24	1.06 (0.71–8.03) 0.086
	Urban	132 (26.1)	374 (73.9)	1	1
District					
Dehana		268 (36.5)	466 (63.5)	6.90 (2.82–11.06) 0.012	3.58 (2.04–11.01) 0.001*
Sekota town		92 (32.2)	194 (67.8)	5.81 (2.97–10.62) 0.017	2.12 (0.96–6.53) 0.061
Gazgibla		74 (30.1)	172 (69.9)	5.16 (3.82–11.69) 0.04	1.67 (0.97–5.03) 0.071
Sekota zuria		12 (9.9)	109 (90.1)	1.32 (1.03–6.15) 0.23	0.85 (0.67–5.35) 0.47
Other Waghimra areas		4 (9.5)	38 (90.5)	1.26 (0.89–5.72) 0.38	0.65 (0.41–6.79) 0.75
Waghimra border areas		2 (7.7)	24 (92.3)	1	1
Occupation	Farmer	302(36.6)	524 (63.4)	3.31 (2.53–11.28) 0.04	1.96 (0.87–10.42) 0.068
	Student	95(28.4)	239 (71.6)	2.29 (1.91–10.02) 0.14	1.4 (0.58–6.72) 0.091
	Merchant	47 (19.5)	194 (80.5)	1.39 (1.03–7.34) 0.23	0.82 (0.32–6.46) 0.18
	Civil servant	8 (14.8)	46 (85.2)	1	1

COR: crude odds ratio; CI: confidence interval; AOR: adjusted odds ratio.
*Indicates statistically significant.

systemic review reported in Ethiopia (19.0%).[28] As a result, this finding may call for careful consideration on the part of the government and other stakeholders.

This study demonstrated that CL cases fluctuated annually with the highest and lowest numbers recorded in 2016 and 2020, respectively. According to the information obtained from the hospital, the increment of CL suspected and confirmed cases in 2016 were due to the fact that Leishmaniasis Diagnostic and Treatment Center was established in the beginning of this year in this hospital. So, in this year, government and non-government organizations participated in human capacity development. There was also a campaign by health extension workers and other stake holders to create awareness to increase health-seeking behaviour of the people to diagnose and treat in this centre.

Environmental, climatic and seasonal factors play a large role in CL transmission.[29] In the study area, CL was observed in almost every month of the year, although there was significant fluctuation in the number of CL cases. The number of CL cases in this study peaked in September, followed by December. Similarly, during the autumn and winter seasons, the relative dominance of CL cases was also seen. In Ethiopia, particularly in the study catchment areas, agricultural activities are done in summer season (June–August) of every year and also autumn (September–November) is the harvesting season. Therefore, farmers may be vulnerable to sand fly attacks during these seasons. Since *Leishmania aethiopica* requires 1–9 months for clinical incubation time,[30] infected people might have gone to health facilities for screening between September and December. This was comparable with a study done in Gondar Northwest Ethiopia.[22] Therefore, knowing the seasonal pattern of disease transmission is helpful in planning disease surveillance and control measures.

Regarding the age group distributions, those aged 15 to 49 years and men had the highest rates of CL morbidity. This result is in line with those studies done in Gondar[22] and Tigray,[10] Ethiopia; Sri Lanka;[31] and Saudi Arabia.[32] These groups are especially vulnerable to CL because they are of working age and have family responsibilities that expose them to mobilizations in various places. Furthermore, majority of them are from rural areas and work in agricultural activities that are frequently done outside, making them more vulnerable to sand fly bites.

From a total of 506 CL-confirmed cases recorded in registration books, 452 (89.3%) were new cases and 54 (10.7%) were previously treated cases. In this study, the proportion of previously treated cases becomes steady increasing from the year 2016 to 2020. This might be due to substandard treatment[13] and immunological variables[33] are anticipated to play a significant role in the clinical presentation and therapy response of CL.

In this study, majority (93.6%) of the CL-confirmed cases were localized CL while diffuse and muco-cutaneous only accounted for 1.1% and 5.3%, respectively. This was comparable with a report from a study done in Dessie town[25] and Gondar,[22] Ethiopia. Regarding the locations of the lesion or scars, most wounds were seen on the face, such as cheek, nose, and lips with the proportion of 37.6%, 24.8%, and 17.3%, respectively. A similar pattern of distribution was observed in studies done from Tigray, Northern Ethiopia;[34] Dessie, Northeast Ethiopia;[35] and Gondar, North-West Ethiopia.[13] This is due to the fact that these parts of the body are unprotected and sand flies are capable of sucking the blood.

This record review data indicated that there was a greater variation of CL positivity rate among the different districts of Wag Hemra Zone and its border areas. The highest CL cases were recorded from Dehana district followed by Sekota town with the positivity rate of 59.3% and 20.4%, respectively. Hence, those districts are all located above 2000 m above sea level. This is due to the fact that, CL is mostly seen at high and mid altitudes, between 1400 and 2700 m above sea level, where the proven vector sand fly species thrive.[28]

On the contrary, the second highest CL case reported in this study was Sekota town. Because a large number of merchants travel to Dehana district for trade every week, they might be more vulnerable to sand fly bites. Therefore, travelling spread leishmaniasis in people which are living in non-endemic areas.[36] In general, this study indicated the transmission hotspot districts in Wag Hemra zone, Northeast Ethiopia over time from 2016 to 2020. Mapping of CL risk areas could be useful to identify priority regions or areas to establish CL diagnostic and treatment services, to conduct clinical trials and take prevention and control measures in these areas.

This study showed that Dehana district residence was strongly associated with CL infections. Hence, patients who came from Dehana district residence were four times more likely to be infected with CL as compared to those who came from other districts. This, supported by a study done in Ethiopia,[37] increased slope values that produced higher CL correlations, which were substantially associated with an altitudinal range between 810 and 3563 m above mean sea level.

Limitations of the study

Because this was a retrospective study, additional important variables such as environmental conditions, socioeconomic, demographics, and human behaviours could not be collected. Moreover, the sample size calculation was not done. As a result, the outcome was interpreted by considering the limitations.

Conclusion

In a 5-year period, the overall positivity rate of CL was 31.1% (452). According to our findings, the prevalence of CL positive was variable but declining during the following years. The figure, however, suggests that CL is a major public health problem in the research area, affecting the productive portions of the population, and that its occurrence coincides with the major harvesting seasons. Of CL hot spot areas in Wag Hemra zone, Dehana district had the highest CL cases. Identifying hot spot areas will allow local and national government and other stakeholders to take area-specific control and prevention measures. The proportion of patients treated more than once or relapse was increased from 2016 to 2020. This indicated the need of further clinical trial studies on the efficacy of the anti-leishmanial drugs. In addition, molecular and entomological studies needed to identify the Leishmania and Phlebotomus species. Furthermore, awareness creation and other prevention and control measures required for better control of the disease.

Acknowledgements

The authors acknowledge Wollo University for its ethical approval. The authors also thank Wag Hemra Zone health department and Tefera Hailu Memorial Hospital administrators and data collectors.

Author contributions

H.D. devised the study, designed it, supervised data collection, analysed and interpreted the results, and wrote the article. H.B. and H.E. assisted in the design of the study, data collection, data analysis, and interpretation. H.E. critically reviewed the article. All authors read and approved the final article.

Data availability

The article includes all datasets on which the article's conclusions are based. The original data supporting this finding will be available at any time upon request of the corresponding author.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

Ethical clearance was obtained from the ethical review committee of College of Medicine and Health Sciences, Wollo University on 18 March 2021 with a protocol number of CMHS/830/2021. Letter of permission to conduct the study was obtained from Wag Hemra Zone health department and Tefera Hailu Memorial Hospital.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Informed consent

Written informed consent prior to study was not obtained from study subjects. This requirement was waived by the Ethical Review Committee of College of Medicine and Health Sciences, Wollo University. After discussing the purpose and method of the study, verbal consent was sought from the Head of Leishmaniasis Diagnostic and Treatment Center before data collection. Only patient identifiable codes were used to maintain the confidentiality of individuals' identity and the data were analysed only for the intended purpose.

ORCID iD

Habtu Debash https://orcid.org/0000-0003-2512-4897

Supplemental material

Supplemental material for this article is available online.

References

1. Steverding D. The history of leishmaniasis. *Parasit Vectors* 2017; 10(1): 82.
2. Maroli M, Feliciangeli MD, Bichaud L, et al. Phlebotomine sandflies and the spreading of leishmaniases and other diseases of public health. *Med Vet Entomol* 2013; 27(2): 123–147.
3. Postigo JAR. Leishmaniasis in the World Health Organization eastern Mediterranean region. *Int J Antimicrob Agents* 2010; 36(Suppl. 1): S62–S65.
4. Bailey MS and Lockwood DN. Cutaneous leishmaniasis. *Clin Dermatol* 2007; 25(2): 203–211.
5. Alvar J, Vélez ID, Bern C, et al. Leishmaniasis worldwide and global estimates of its incidence. *PLoS ONE* 2012; 7(5): e35671.
6. Owino BO, Matoke-Muhia D, Alraey Y, et al. Association of Phlebotomus guggisbergi with Leishmania major and Leishmania tropica in a complex transmission setting for cutaneous leishmaniasis in Gilgil, Nakuru county, Kenya. *PLoS Negl Trop Dis* 2019; 13(10): e0007712.
7. Bennis I, De Brouwere V, Belrhiti Z, et al. Psychosocial burden of localised cutaneous leishmaniasis: a scoping review. *BMC Public Health* 2018; 18(1): 358.
8. Bezerra JMT, de Araújo VEM, Barbosa DS, et al. Burden of leishmaniasis in Brazil and federated units, 1990-2016: findings from Global Burden of Disease Study 2016. *PLoS Negl Trop Dis* 2018; 12(9): e0006697.
9. Van Henten S, Adriaensen W, Fikre H, et al. Cutaneous leishmaniasis due to Leishmania aethiopica. *eClinicalMedicine* 2018; 1(6): 69–81.
10. Bsrat A, Berhe N, Balkew M, et al. Epidemiological study of cutaneous leishmaniasis in Saesie Tsaeda-emba district, eastern Tigray, northern Ethiopia. *Parasit Vectors* 2015; 8(1): 1–9.
11. Pareyn M, Van den Bosch E, Girma N, et al. Ecology and seasonality of sandflies and potential reservoirs of cutaneous leishmaniasis in Ochollo, a hotspot in southern Ethiopia. *PLoS Negl Trop Dis* 2019; 13(8): e0007667.
12. World Health Organization. *Global leishmaniasis surveillance: 2019-2020, a baseline for the 2030 roadmap*. Geneva: World Health Organization, 2021.
13. Fikre H, Mohammed R, Atinafu S, et al. Clinical features and treatment response of cutaneous leishmaniasis in North-West Ethiopia. *Trop Med Int Health* 2017; 22(10): 1293–1301.
14. Gurel MS, Tekin B and Uzun S. Cutaneous leishmaniasis: a great imitator. *Clin Dermatol* 2020; 38(2): 140–151.
15. Lemma W, Tekie H, Yared S, et al. Sero-prevalence of Leishmania donovani infection in labour migrants and entomological risk factors in extra-domestic habitats of Kafta-Humera lowlands-kala-azar endemic areas in the northwest Ethiopia. *BMC Infect Dis* 2015; 15(1): 1–8.
16. Kassahun A, Sadlova J, Benda P, et al. Natural infection of bats with Leishmania in Ethiopia. *Acta Trop* 2015; 150: 166–170.
17. Alidadi S and Oryan A. Cutaneous leishmaniasis and the strategies for its prevention and control. *Trop Med Surg* 2014; 2: 2.
18. Tamiru HF, Mashalla YJ, Mohammed R, et al. Cutaneous leishmaniasis a neglected tropical disease: community knowledge, attitude and practices in an endemic area, Northwest Ethiopia. *BMC Infect Dis* 2019; 19(1): 855.
19. Solomon Y, Kebede D and Asrat H. Risk factors of visceral leishmaniasis: a case control study in north-western Ethiopia. *BMC Parasit Vectors* 2014; 7(470): 1–11.
20. Negera E, Gadisa E, Yamuah L, et al. Outbreak of cutaneous leishmaniasis in Silti woreda, Ethiopia: risk factor assessment and causative agent identification. *Trans R Soc Trop Med Hyg* 2008; 102(9): 883–890.

21. Federal Ministry of Health. *Guidelines for diagnosis, treatment and prevention of leishmaniasis in Ethiopia*. 2nd ed. Addis Ababa, Ethiopia: Federal Ministry of Health, 2013, pp. 33–34.
22. Zeleke AJ, Derso A, Yeshanew A, et al. A ten-year trend of cutaneous leishmaniasis at University of Gondar Hospital, Northwest Ethiopia: 2009-2018. *J Parasitol Res* 2021; 2021: 8860056.
23. Siriwardana Y, Zhou G, Deepachandi B, et al. Trends in recently emerged Leishmania donovani induced cutaneous leishmaniasis, Sri Lanka, for the first 13 years. *Biomed Res Int* 2019; 2019(1): 1–12.
24. Van Henten S, Fikre H, Melkamu R, et al. Evaluation of the CL detect rapid test in Ethiopian patients suspected for cutaneous leishmaniasis. *PLoS Negl Trop Dis* 2022; 16(1): e0010143.
25. Bekele S, Bekele Y, Mulatu F, et al. Recent trends of cutaneous leishmaniasis in Alert Hospital, Addis Ababa. *Ethiop Med J* 2014; 2014(1): 1–11.
26. Eshetu B and Mamo H. Cutaneous leishmaniasis in north-central Ethiopia: trend, clinical forms, geographic distribution, and determinants. *Trop Med Health* 2020; 48: 39–10.
27. Abolghazi A, Ebrahimzadeh F, Sharafi F, et al. A declining trend of leishmaniasis based on previous data in Larstan, South of Iran 2007–2017. *Ann Glob Health* 2019; 85(27): 1–5.
28. Assefa A. Leishmaniasis in Ethiopia: a systematic review and meta-analysis of prevalence in animals and humans. *Heliyon* 2018; 4(8): e00723.
29. Oryan A and Akbari M. Worldwide risk factors in leishmaniasis. *Asian Pac J Trop Med* 2016; 9(10): 925–932.
30. Akilov OE, Khachemoune A and Hasan T. Clinical manifestations and classification of Old World cutaneous leishmaniasis. *Int J Dermatol* 2007; 46(2): 132–142.
31. Galgamuwa LS, Sumanasena B, Yatawara L, et al. Clinico-epidemiological patterns of cutaneous leishmaniasis patients attending the Anuradhapura Teaching Hospital, Sri Lanka. *Korean J Parasitol* 2017; 55(1): 1–7.
32. Alanazi AD, Alyousif MS, Saifi MA, et al. Epidemiological studies on cutaneous leishmaniasis in Ad-Dawadimi District, Saudi Arabia. *Trop J Pharmaceut Res* 2016; 15(12): 2709–2712.
33. El-On J. Current status and perspectives of the immunotherapy of leishmaniasis. *Isr Med Assoc J* 2009; 11(10): 623–628.
34. Yohannes M, Abebe Z and Boelee E. Prevalence and environmental determinants of cutaneous leishmaniasis in rural communities in Tigray, northern Ethiopia. *PLoS Negl Trop Dis* 2019; 13(9): e0007722.
35. Bisetegn H, Zeleke AJ, Gadisa E, et al. Clinical, parasitological and molecular profiles of Cutaneous Leishmaniasis and its associated factors among clinically suspected patients attending Borumeda Hospital, North-East Ethiopia. *PLoS Negl Trop Dis* 2020; 14(8): e0008507.
36. Ghazanfar M and Malik MF. Sand fly and leishmaniasis: a review. *J Ecosyst Ecograph* 2016; 6(3): 1–5.
37. Seid A, Gadisa E, Tsegaw T, et al. Risk map for cutaneous leishmaniasis in Ethiopia based on environmental factors as revealed by geographical information systems and statistics. *Geospat Health* 2014; 8(2): 377–387.