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## Retrospective Study

**Five-year retrospective hospital-based study on epidemiological data regarding human leishmaniasis in West Kordofan state, Sudan**

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**Abstract****BACKGROUND**

Leishmaniasis is a neglected zoonotic disease, endemic in Sudan. Estimating this disease is very important to inform the health care policymakers and the governments to apply proper health and economic policies.

**AIM**

To find out the frequency and distribution of human leishmaniasis based on sex and age for 5 years in the West Kordofan state, Sudan.

**METHODS**

A 5-year retrospective study from 2016 through 2020 was carried out using local hospital records of leishmaniasis patients. The positive results were recorded after

performing at least one of the following leishmaniasis standard tests: direct agglutination test, enzyme-linked immunosorbent assay and leishmania skin test. The sex and age of each patient were recorded. The collected data were analyzed using STATA package version 16.

## RESULTS

A total of 162443 patient records from 2016 to 2020 were retrieved. Of these, 4.39% were found to be positive for leishmaniasis. The disease has been more common in males (65.3%) than in females (34.7%). The highest reported prevalence (6.58%) was in patients 15-44 years, and the lowest prevalence (1.95%) was among patients  $\geq 65$  years.

## CONCLUSION

The results of the current study indicate that leishmaniasis is endemic in the study area even though the numbers of patients in the 5 consecutive years were varying. In addition, the disease was common in males and adults. The interpretation of these findings should take into consideration the absence of information about some important confounding factors.

**Key Words:** Epidemiology; Human Leishmaniasis; West Kordofan; Sudan; Endemicity

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**Core Tip:** A 5-year retrospective study was conducted to find the frequency and distribution of human leishmaniasis in the West Kordofan state and was based on sex and age. A total of 162443 patient records were retrieved. Of these, 4.39% were found to be positive for leishmaniasis. The disease has been more common in males than in females. The highest reported prevalence was in patients 15-44 years, and the lowest prevalence was among patients  $\geq 65$  years. The current study indicates that leishmaniasis is endemic in the study area even though the numbers of patients in the 5 consecutive years were varying.

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## INTRODUCTION

Leishmaniasis is a parasitic zoonotic disease caused by the *Leishmania* parasite[1]. The disease is mainly transmitted by the bite of infected female phlebotomine sandflies[2]. The World Health Organization classified the disease as a neglected tropical disease[2,3]. There are several forms of human leishmaniasis, and the most common forms are cutaneous leishmaniasis (CL), which causes skin sores, and visceral leishmaniasis (VL), which affects several internal organs (usually the spleen, liver and bone marrow)[4]. All forms of the disease have been strongly associated with poor socioeconomic status, population displacement, a weak immune system and climate change[5-8]. Leishmaniasis cases have been reported in almost all continents in about 89 countries, with an estimated 700000 to 1 million new cases occurring annually. Most cases occur in East Africa, Southeast Asia and South America[4,9]. Outbreaks of human leishmaniasis worldwide were reported from East African countries namely Sudan, South Sudan and Ethiopia[10-15].

Sudan is a highly endemic country for leishmaniasis (both CL and VL). The disease represents a serious health problem that may affect the whole healthcare system[16]. The geographical distribution of the disease in Sudan have a high relation to the distribution of the vectors. Studies revealed that VL is endemic in the savannah area, which starts from the Gadarif state in the east to the White Nile State in the west and from the Kassala state in the northeast to the Blue Nile State in the south. Also, VL was reported in some scattered foci in the Kordofan state and Darfur state. Moreover, CL is found in a fluctuating pattern mainly in the northern, central and western parts of the country[17-26].

West Kordofan is the 18<sup>th</sup> state of Sudan. It was established in July 2013 on the border with the Republic of South Sudan in the east, North Kordofan state in the North and South Darfur state in the west. People of West Kordofan, especially the Mesairya tribe, continuously move to and from South Sudan where leishmaniasis disease is endemic[7]. The state also contains many south Sudanese refugee camps spread almost all over the state. The geographical location together with the high presence of the suspected infected refugees makes the people of the West Kordofan state very vulnerable to leishmaniasis (for both CL and VL). A community-based study in two West Kordofan cities, namely

Muglad and Babnousa, reported that out of 1781 randomly selected volunteers, 238 persons (13%) tested positive for leishmaniasis[27]. Based on that, there is still a need for a deeper look at the epidemiology of the disease in the whole state, in both males and females and in all age groups, to design and implement suitable prevention and eradication programs for the disease at the state level. Thus, this study aimed to find out the frequency and distribution of human leishmaniasis based on sex and age in the West Kordofan state for 5 years.

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## MATERIALS AND METHODS

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The present retrospective study was conducted among patients who were admitted to any hospital in the West Kordofan state, Sudan from January 1, 2016 to December 31, 2020 to test the presence of human leishmaniasis of any type in the population of West Kordofan. In addition to the clinical symptom and signs, the positive results were recorded after performing at least one of the following leishmaniasis standard tests: direct agglutination test, enzyme-linked immunosorbent assay and leishmania skin test. Data of age, sex and presence of any type of leishmaniasis were retrieved from the medical records department in the Ministry of Health West Kordofan, with the approval of the ministry ethical committee. The medical record department follows the guidelines of the International Classification of Diseases 10 coding.

### Statistical analysis

Descriptive statistics and data analysis were done using STATA package version 16 (Stata Corp LLC, College Station, TX). Z test was applied to compare the proportions between the study groups. If the *P* value was less than or equal to 0.05, it indicated that there was a significant difference between the proportions of the two groups.

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## RESULTS

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A total of 162443 patient records (87847 female and 74596 male patients) from 2016 to 2020 were retrieved. Of these, 4.39% were found to be positive for leishmaniasis. Among them, 34.7% were females and 65.3% were males. The diagnostic prevalence of the infection was first found to be very low in 2016 (2.57%). After 1 year in 2017, the highest reported prevalence of 5.83% was observed and then started to decrease (with some fluctuation) to 3.67% in 2020 (Figure 1).

Sex-related differences in leishmaniasis prevalence are presented in Table 1. The prevalence was significantly higher ( $P \leq 0.05$ ) in males compared to females in the period from 2017 to 2020, while in 2016 there was no significant variation between the sexes ( $P > 0.05$ ). The prevalence of leishmaniasis was relatively increased with participant age in both females and males. The prevalence reached its peak in patients 15-44 years, which was 6.58%, then decreased to be the lowest of 1.95% among patients  $\geq 65$  years (Tables 2 and 3). In addition to that in all age groups, males had a higher prevalence of leishmaniasis than females.

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## DISCUSSION

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Leishmaniasis is an endemic neglected zoonotic disease in Sudan, widespread all over the country from the eastern states to the western states and from southern states to northern states[16]. However, few data about the epidemiological and demographical distribution of the disease in western states is available, especially in West Kordofan, and it seems to be overlooked[20,24,25,27]. Thus the current study is the first comprehensive attempt to describe the epidemiological and demographical distribution of the disease in the state.

In this study, the data on human leishmaniasis was collected from the annual health statistical reports for 5 years (2016–2020) and was analyzed to show the burden of the disease in the West Kordofan state, Sudan. The results highlight that a total of 162443 people were admitted to the hospitals and health care centers in the state. Of these, 7128 people were infected during this period. In 2016 the prevalence of leishmaniasis was found to be very low at 2.57%. Surprisingly, it was raised to 5.83% in 2017, and from then it seemed to decrease. The reason could be that the government of Sudan in collaboration with the World Health Organization and other related international organizations developed diagnostic and control strategies to limit the spread of the disease in October 2014[28,29]. The first 2 years (2015 and 2016) were for training the health care professionals in the state on the new diagnostic and prevention methods. That may explain the low prevalence in the 1<sup>st</sup> study year because of the use of the low sensitivity diagnostic test. Then after implementing the new diagnostic method in 2017 the rate was raised. In line with that, after 2017 the prevalence of leishmaniasis was decreasing because of implementing the new control strategies.

**Table 1 Sex distribution of different patients infected with leishmaniasis classified by year**

Year	Female, n (%)	Male, n (%)	Total, n (%)	P value
2016	244 (1.85)	405 (3.37)	649 (2.57)	0.2277
2017	780 (3.99)	1322 (7.99)	2102 (5.83)	0.0002
2018	621 (3.45)	1142 (7.49)	1763 (5.30)	0.0002
2019	409 (2.36)	941 (5.83)	1350 (4.03)	0.0015
2020	420 (2.12)	844 (5.77)	1264 (3.67)	0.0008
Total	2474 (2.82)	4654 (6.24)	7128 (4.39)	0.0001

**Table 2 Age and sex distribution of patients infected with leishmaniasis**

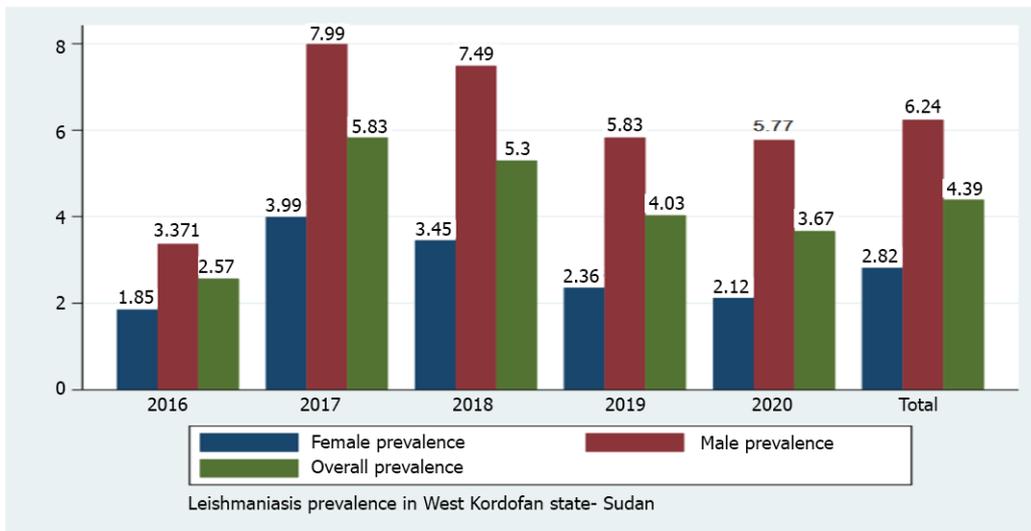
Age group	Female, %	Male, %	Total, %	P value
< 1 yr	2.22	5.05	3.52	0.0001
1-4 yr	3.93	4.5	4.19	0.2523
5-14 yr	5.47	7.89	6.57	0.0001
15-44 yr	5.63	7.68	6.58	0.0001
45-64 yr	2.81	4.42	3.55	0.0012
≥ 65 yr	1.73	2.2	1.95	0.3452

**Table 3 Comparing the sex-wise proportion of human leishmaniasis reported in each age group**

Year	Sex	Age group					
		< 1%	1%-4%	5%-14%	15%-44%	45%-64%	≥ 65%
	Females						
2016		1.19	2.66	4.52	3.51	1.85	1.06
2017		2.16	1.80	6.00	4.97	2.47	2.01
2018		1.44	3.35	4.97	5.55	2.39	1.55
2019		3.54	3.90	5.54	6.81	2.98	1.77
2020		2.51	4.83	5.98	6.73	4.04	2.03
Total		2.22	3.93	5.47	5.63	2.81	1.73
	Males						
2016		0.92	3.81	6.59	5.20	2.30	1.19
2017		2.06	5.26	8.30	6.90	3.70	2.35
2018		3.26	3.69	7.64	8.50	3.81	2.08
2019		4.64	3.75	6.90	7.20	5.08	2.12
2020		14.11	5.90	9.84	10.23	6.84	3.14
Total		5.05	4.50	7.89	7.68	4.42	2.20

The current study found that the overall prevalence of leishmaniasis in West Kordofan was lower than that reported by Sharief *et al*[27] in 2019. This may be due to the difference in sample size and study period, which were bigger and longer, respectively, in the current study compared with the other study. Nevertheless, the study area could have a great impact on the result. In their study, Sharief *et al* [27] collected data in two districts in the state, but the current study collected data from all 14 districts.

Sex-related distribution of human leishmaniasis in the study revealed that males were highly affected compared to females with an overall percentage of 65.3% and 34.7%, respectively. This is in line with Awadalla *et al*[30], Ebrahim *et al*[25] and Collis *et al*[31] and disagrees with Mohammed *et al*[20]. This result might be justified because the majority of males are nomads. They are moving seasonally to the tropic and subtropic areas in South Sudan whereby the exposure to the risk of sandflies bites is high. The same exposure of males in different agricultural areas may be a contributing factor to the infections. Consequently, males are more vulnerable than females.



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Figure 1 Prevalence of leishmaniasis during 2016-2020 according to sex.

Age-wise distribution found that people in the age group 15-44 had the highest prevalence among all populations. Similar results were reported by Awadalla *et al*[30], Osman *et al*[24], Ebrahim *et al*[25] and Collis *et al*[31]. These studies indicated that the adult men and women aged between 15-44 years were more affected by the disease compared to the lower and higher age groups. This can be put in the context that this age group is the working-age group in all fields, especially the agricultural field. In contrast, a study conducted by Mohammed *et al*[20] indicated that the most affected age groups were children between 1-year-old and 5-years-old.

In addition, the lowest reported prevalence in this study was found in the age group > 65 years. Although this group of people is more vulnerable to infections because the immune system weakens, they have a relevant low prevalence of the disease. The possible reason that these patients might have less exposure to the infection is due to their lifestyle, which keeps them away from the areas where the carrier host exists, especially in the agricultural areas.

This study provided important epidemiological information about human leishmaniasis in West Kordofan, which is missing from the scientific literature despite its urgent need to design a collaborative effort and immediate action by policymakers and governments (federal and state government) for prevention and eradication programs in light of the one health concept. However, the absence of data about the infection (type, site and status), *Leishmania* parasite and other potential risk factors in some included studies are considered as limitations of the current study.

## CONCLUSION

The results of the current study indicate that leishmaniasis is endemic in the study area even though the numbers of patients in the 5 consecutive years were varying. In addition, the disease was common in males and adults. The interpretation of these findings should take into consideration the absence of information about some important confounding factors. Further studies need to be carried out to clarify the economic impact of the disease on the public health sector in the state and the role of domestic animals in the epidemiology of the disease in Sudan.

## ARTICLE HIGHLIGHTS

### Research background

In Sudan, human leishmaniasis is endemic, and the prevalence of the disease varies throughout the country. Although the disease in Sudan is serious, there is no overall estimation of the prevalence of human leishmaniasis in the western parts of the country, especially in the West Kordofan state.

### Research motivation

The lack of published studies about human leishmaniasis in the western parts of Sudan especially in the West Kordofan state may cause a problem for the policymakers and local governments to develop and

adopt a suitable prevention program to deal with the disease at the state level and the country level.

### **Research objectives**

The objective of this study was to find the frequency and distribution of human leishmaniasis based on sex and age in West Kordofan, Sudan for 5 years.

### **Research methods**

A 5-year retrospective study from 2016 through 2020 was carried out using local hospital records of leishmaniasis patients. The positive results were recorded after performing at least one of the following leishmaniasis standard tests: direct agglutination test, enzyme-linked immunosorbent assay and leishmania skin test.

### **Research results**

A total of 162443 patient records from 2016 to 2020 were retrieved. Of these, 4.39% were found to be positive for leishmaniasis. The disease has been more common in males (65.3%) than in females (34.7%). The highest reported prevalence (6.58%) was in patients 15-44 years, and the lowest prevalence (1.95%) was among patients  $\geq 65$  years.

### **Research conclusions**

The results of the current study indicate that leishmaniasis is endemic in the study area even though the numbers of patients in the 5 consecutive years were varying. In addition, the disease was common in males and adults.

### **Research perspectives**

Further studies need to be carried out to clarify the economic impact of the disease on the public health sector in the state and the role of domestic animals in the epidemiology of the disease in Sudan.

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## **FOOTNOTES**

**Author contributions:** Abdulslam Abdullah A, Ahmed M, Gadeed A, Eltayeb A, Ahmed S, Hamad S and Hussein M conceived and designed the study and directed implementation and data collection; Abdulslam Abdullah A, Ahmed M and Hamad S analyzed and interpreted the data and drafted the manuscript; Abdulslam Abdullah A, Ahmed M, Gadeed A, Eltayeb A, Ahmed S, Hamad S and Hussein M edited the manuscript for intellectual content and provided critical comments on the manuscript; All authors gave final approval of the version to be published, have agreed on the journal to which the article has been submitted and agreed to be accountable for all aspects of the work.

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