

Research Article

Factors Associated with the Occurrence of Human Rabies Cases in Mali, 2018-2022

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Abstract

Introduction: Rabies is transmitted by the saliva of infected animals on excoriated skin or mucous membranes. Data from the epidemiological surveillance sub-directorate of the General Directorate of Health and Public Hygiene show an upsurge in cases of human rabies from 3 in 2020 to 10 in 2022 and dog bites from 742 in 2020 to 1702 in 2022, hence this study with the objective of studying the factors associated with the occurrence of the disease in Mali. **Methods:** This is an analytical cross-sectional study of data from 2018 to 2022, that took place from February 1 to September 30, 2023. Study population was made up of any suspected case of dog of rabies recorded in the DGSHP database from 2018 to 2022. Pearson or Fisher χ^2 tests and a α cut-off of 0.05 allowed comparisons. **Results:** Cases of dog bites were 368 including 24 cases of human rabies, i.e. a frequency of 6.52%. Factors associated with rabies were: lesion severity ($p = 0.0001$), lack of lesion management ($p = 0.0001$), failure to clean lesions ($p = 0.0001$), failure to visit a health facility after the bite ($p = 0.001$), lack of post-exposure vaccination ($p = 0.001$), notification structure ($p = 0.001$), lack of rabies vaccination of biting dogs ($p = 0.008$), bite lesions ($p = 0.039$). **Conclusion:** Vaccination of dogs, adequate care and community awareness will reduce the occurrence of rabies.

Keywords

Rabies, Associated Factors, Mali, 2023

1. Introduction

Rabies is a highly lethal zoonosis caused by RNA viruses of the genus *lyssavirus* of the family *Rhabdoviridae*, order *Mononegavirales*. It is transmitted through the saliva of infected animals following a bite, scratching or licking on excoriated skin or mucous membranes [1].

The annual number of deaths worldwide due to rabies is estimated at 59,000 in 2015, the majority of which occur in Asia (59.6%) and Africa (36.4%) [2].

In sub-Saharan Africa, the case fatality rate, according to the World Health Organization (WHO), is 0.01 to 3 cases per 100,000 inhabitants [3].

In Mali, a retrospective study conducted in Bamako from 2000 to 2003 revealed 10 cases of rabies out of 5,870 cases of animal bites, i.e. 0.17%, with an annual average of 1,470. The lethality was 100% [4].

The fight against rabies in Mali is supported by legislative and regulatory provisions through Law No. 01-022 of 31 May 2001 governing the repression of offences against animal health in the territory of the Republic of Mali, Decrees No. 01-339/P-RM of 9 August 2001 laying down the modalities for the application of Law No. 01-022 of 31 May 2001 on the repression of offences against animal health in the territory of the Republic of Mali and No. 06-412/P-RM of 27 September 2006 amending Decree No. 01-339/P-RM of 9 August 2001 (Article 16 of which makes it compulsory to vaccinate the canine species against rabies, free of charge during the campaigns) [5]. According to Decree No. 07-165/P-RM of 23 May 2007 establishing the list of compulsory diseases and the conditions of this declaration, rabies is included on the list of contagious diseases in Mali. It is one of the diseases that must be declared immediately (MADO/MADI). This fight is also re-

inforced by the organization of annual dog vaccination campaigns, the organization of World Rabies Day (celebrated September 28 each year), the free vaccination of people at risk, the care of bitten and exposed people, combined with the regular control of the stray dog population. The implementation of the One Health approach (intersectoral collaboration between human and animal health services, agriculture and the environment) is one of the best strategies for rabies control.

Despite the implementation of all these strategies, according to an observational study in a hospital setting carried out by Dembele JP et al. in Mali in 2020 [6], the hospital frequency of rabies was 1.16%. Data from the General Directorate of Health and Public Hygiene (DGSHP) show an upsurge in human rabies cases from 3 in 2020 to 10 cases in 2022 and cases of dog bites which increased from 742 in 2020 to 1702 in 2022 [7]. We initiated this study with the objective of describing the socio-demographic characteristics, describing the management of cases and identifying the factors associated with the occurrence of rabies in Mali in 2023.

2. Materials and Methods

2.1. Scope of the Study

The framework of the study was made up of the regions and their health districts of Mali.

Mali has an area of 1,241,238 km² and had nineteen (19) administrative regions, seventy-five (75) health districts. On the veterinary sector, it was made up of fifty-two (52) veterinary sectors, two hundred and seventy-two (272) veterinary

posts and one hundred and sixty-five (165) agents [8]. The human population was estimated at 21,726,000 in 2022 [9]. The dog population was estimated at 22,5681 with 11,038 vaccinated subjects, or 4.9% of vaccinated subjects [10].

2.2. Type and Period of Study

We conducted an analytical cross-sectional study of data from 2018 to 2022, that took place from February 1 to September 30, 2023.

Study population: This was made up of any suspected case of dog of rabies recorded in the DGSHP database from 2018 to 2022.

Inclusion criteria: Any suspected case of a dog bite completely recorded in the DGSHP database from 2018 to 2022.

Criteria for non-inclusion: Any case of dog bite recorded in the DGSHP database from 2018 to 2022 for which the information is incomplete.

Sampling: This was an exhaustive sampling. All suspected cases of dog of rabies in Mali's health districts recorded in the surveillance database, including those confirmed, were included.

Data collection: Data were collected from a data extraction and primary media review form for confirmation and triangulation of data from the surveillance database.

2.3. Variables

Dependent variables: Occurrence of rabies (yes/no)

Independent variables: Sociodemographic characteristics (gender, age, origin, occupation); date of notification, date of bite, date of appearance of the first signs, structure of notification, nature of exposure, location of lesions, consultation in a health centre, removal of the piece by the veterinary service, management (anti-rabies vaccination of the case and the dog, washing of the wound, dressing, antibiotic therapy, number of doses of vaccine, serotherapy, Td), prognosis (cases of bites, biting animals)

2.4. Data Entry and Analysis

The data was entered into Excel and then analysed with Epi Info 7. The maps were produced from QGIS. The results were presented in the form of tables, figures and maps. Proportions were calculated for qualitative variables, the mean for quantitative variables. Comparisons were made using Pearson's or Fisher's χ^2 tests according to the application criteria and a α cut-off of 0.05.

2.5. Ethical Considerations

The protocol has been submitted to the committee of the National Center for Ethics for Health and Life Sciences (CNESS) for approval (approval n°2023-158/MSDS-CNESS

of August 16, 2023). An information letter from the Director General of Health and Public Hygiene was sent to inform the administrative and health authorizations and all the structures surveyed before the start of the investigation.

The heads of the health structures surveyed gave their verbal agreement. This allowed us to access the data.

3. Results

3.1. Socio-demographic Characteristics

A total of 24 confirmed cases of human rabies out of 368 cases of dog bites, i.e. 6.52% (Table 1).

Table 1. Distribution of suspected rabies cases by category, Mali, 2018-2022.

Category	Frequence	Pourcentage
Rage	24	6,52
Bite (unconfirmed suspected cases of rabies)	344	93,48
Total	368	100

Rabies cases constituted 6.52% of the total sample. (Table 1)

Table 2. Distribution of cases by demographic characteristics of suspected rabies cases, Mali, 2018-2022.

Features	Frequency	Percentage
Sex		
Male	235	63,86
Female	133	36,14
Total	368	100
Age Groups		
1-20 years	278	75,54
21-40 years	53	14,4
41-60 years	34	9,24
61 years et plus	3	0,82
Total	368	100

The male sex accounted for 63.86% (Table 2) and the age group 1-20 years was 75.54%.

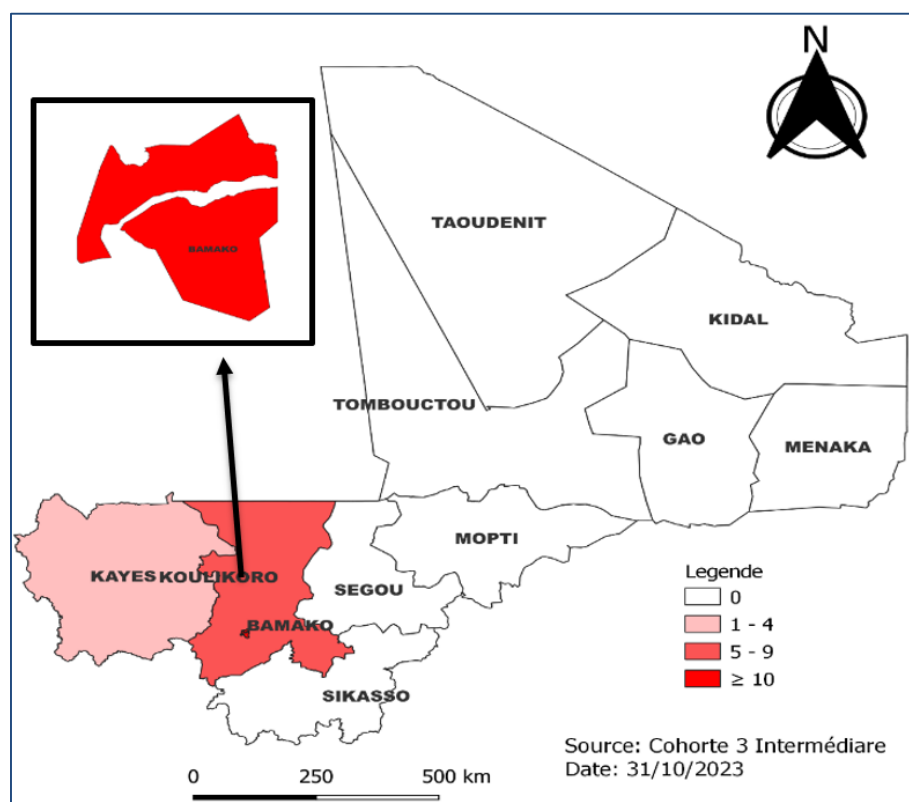


Figure 1. Distribution of human rabies and dog bite cases by region, Mali, 2018-2022.

The Koulikoro region recorded 31.52% (116/368) of bite cases and 37.5% (9/24) of rabies cases, followed by the District of Bamako with 26.08% (96/368) cases of dog bites and 50% (12/24) cases of human rabies (figure 1).

3.2. Pickup

Post-exposure rabies vaccine was administered in 92.93% of bitten patients (Table 2). The lesions were cleaned in 2.45% of our suspected cases (Table 2).

Table 3. Distribution of suspected rabies cases by vaccination post exposition, Mali, 2018-2022.

Vaccination post exposition	Frequence	Pourcentage
Yes	342	92,93

Vaccination post exposition	Frequence	Pourcentage
No	26	7,07
Total	368	100

3.3. Associated Factors

The study identified factors associated with the occurrence of rabies, namely the severity of the lesions ($p = 0.0001$; $X=221.38$), the lack of management of the lesions ($p = 0.0001$; $X=21.76$), the lack of cleaning of the lesions ($p = 0.0001$; $X=16.56$), non-consultation in a health facility after the bite ($p = 0.001$; $X=303.55$), the absence of post-exposure vaccination ($p = 0.001$; $X=337.71$), the notification structure ($p = 0.001$; $X=87.42$), the absence of anti-rabies vaccination of biting dogs ($p = 0.008$; $X=7.01$); $X=4.22$ bite lesions ($p = 0.039$) (Table 4).

Table 4. Crude associations between dog bite cases and rabies occurrence in Mali, 2018-2022.

Variables		Rage		Khi ²	p-value
		Yes	No		
Severity of lesions/number of bites	Serious/2 bites and more	19	6	221,38	0,0001
	Less serious/ 1bite	5	338		

Variables		Rage		Khi ²	p-value
		Yes	No		
Non-management of lesions	Yes	20	339	21,76	0,0001
	No	4	5		-
No wound cleaning	Yes	20	339	16,56	0,0001
	No	4	5		-
No consultation in a health facility after the bite	Yes	3	343	303,55	0,001
	No	21	1		-
No vaccination post exposition	Yes	24	2	337,71	0,001
	No	0	342		-
Notification Structure	CHU du Point G	6	0	87,42	0,001
	Autres	18	344		-
Vaccination of biting dogs	Unvaccinated	24	265	7,01	0,008
	Vaccinated	0	79		-
Nature of exposure	Bite	24	292	4,22	0,039
	Other	0	52		-
Location of lesions (n=20)*	Head and Upper Limb	12	126	3,40	0,064
	Trunk and lower limb	8	197		-
Age/ years	< 15	13	231	1,69	0,193
	≥ 15	11	113		-
Sex	Male	16	219	0,08	0,767
	Female	8	125		-

* It had 4 missing data.

4. Discussion

4.1. Socio-demographic Characteristics

Our study noted that about two-thirds of bite cases were male. Our result is similar to that of Sylla B. in 2021 in Sikasso, which recorded a sex ratio (male/female) of 1.67 [11]. It is lower than the study carried out by Haleche I et al. in Algeria in 2020 where 85% of cases were male [12]. In the study carried out by Hamidou Christian et al in Niger, 61.54% of the bitten people were male [13]. In our study, men had more contact with the biting dog than women. And the same observation has been made according to the WHO, which finds that in some countries men who are in close contact with animals are more frequently victims of dog bites than women [3]. As for the age of the bitten subjects, our study recorded the majority of bites in children. This result contrasts with that of Hamidou Christian Amadou et al, who found a predominance

of adults with an average age of 23 years and 40% for the age group under 15 years [13]. As for the results of Kampo et al, there was a predominance of the 1-20 year age group with 40% of cases [14], which was lower than that of our study. The difference between our study and those of the authors cited is explained by the size of the samples and the length of the periods of the data concerned.

As for the predominance of children in our observation, it could be explained by the fact that they most often provoke the biting animal either by trying to have fun with the animal, or by fleeing out of fear that encourages the biting animal to attack them. Their naivety does not allow them to take appropriate measures to avoid attacks. According to Sarah Mediouni, children are usually bitten by dogs during play activities [15].

4.2. Pickup

More than three-quarters of our patients benefited from post-exposure vaccination (92.93% of bitten patients). Our re-

sult was superior to those of Brahima Sylla who noted 87.5% administration on the same day, Kampo O et al. who reported an administration rate of 52.25% [14] and no administration in the study of Sawadogo M and Boushad M D. [16]. The differences observed between our study and these different authors could be explained on the one hand by the periods of their studies and the size of the cases concerned and, on the other hand, by the Malian national policy of compulsory vaccination of certain notifiable diseases, including rabies.

4.3. Associated Factors

Severe lesions were most common in rabies cases (19; 95%) compared to less severe ones (5; 15%). This trend was significant with $p = 0.0001$. It can be explained by the central proximity of the location of the lesions and their nature (bite). These lesions were a factor in the occurrence of rabies. Lesions were not frequently treated in rabies cases (20; 83.33%) compared to those treated (4; 16.67%). This trend was significant with a $p = 0.0001$. Failure to manage the lesions was a factor associated with the occurrence of rabies. The wounds of rabies cases were not often cleaned (20; 83.33%) compared to those cleaned. This difference was significant with a $p = 0.0001$. The majority of rabies cases had not consulted a health facility after the bite (21; 87.5%) compared to those who had used a health facility (3; 12.5%). This difference is significant with a $p = 0.001$. Rabies was linked to the failure to consult a health facility after the bite. Not all rabid cases had received post-exposure vaccination (24; 100%). This non-vaccination after exposure was associated with the occurrence of rabies with a $p = 0.001$. These trends in care could be explained by its high cost, the average cost of which is estimated according to the WHO at 108 USD, which is financially burdensome for people who earn barely 1 to 2 USD per day [17]. The other health facilities had reported more cases of rabies (18; 75%) than the University Hospital of Point G (6; 25%). This notification was related to the occurrence of rabies with a $p = 0.001$. This is explained by the pyramidal use of the country's health system, which encourages patients to consult peripheral structures as a first resort. No biting animals in your study were vaccinated (24; 100%). Non-vaccination of biting animals was a factor associated with the occurrence of rabies with a $p = 0.008$. All lesions were bites (24; 100%). These bites made up a factor for the occurrence of rabies with a $p = 0.03$. The lesions encountered in our study in rabies cases were mainly located in the head and upper limbs (12; 60%) compared to the trunk and lower limbs (8; 40%). This observation was not significant with a $p = 0.064$. But it contributes to the severity of the lesions according to the WHO categorization. Our study identified eight factors associated with the occurrence of rabies, while that of Brahima Sylla found no significance in relation to the risk factors for the occurrence of rabies [11].

5. Conclusion

Our study concerned 24 cases of human rabies out of the 368 cases of dog bites from 2018 to 2022, i.e. a proportion of human rabies occurrence of 6.52%. Children were more bitten with a predominance of men. The District of Bamako has reported more cases of human rabies (12 cases), followed by the Koulikoro region with 9 cases. Factors associated with the occurrence of human rabies were: severity of lesions, lack of management of lesions, failure to clean lesions, non-consultation in a health facility after the bite, failure to administer post-exposure vaccination, reporting structure, lack of rabies vaccination of biting dogs, and bite lesions.

We recommend the vaccination of dogs, adequate care and community awareness in order to reduce the occurrence of rabies.

What we already know about this topic

The proportion of human rabies cases in Mali

What this study adds

Our study produced the socio-demographic characteristics of human rabies cases in Mali.

Our study recognized the factors associated with the occurrence of human rabies in Mali.

The results of our study could be used for other research, other studies.

Abbreviations

CNESS	Committee of the National Center for Ethics for Health and Life Sciences
DGSHP	General Directorate of Health and Public Hygiene
MADO/MADI	Diseases that must be declared immediately
MSDS	Ministry of Health and Social Development
QGIS	Quantum geographical Information System
USD	Unites States Dollar
WHO	World Health Organization

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Bouyagui Traore: Project administration, Resources, Software, Writing – original draft

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Yacouba Coulibaly: Conceptualization, Data curation, Formal Analysis, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing

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Conflicts of Interest

The authors declare no conflicts of interest.

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