

Rabies by Dog Bites in Benin: Determinants of Good Knowledge of the Rabies Risk among Subjects Exposed in the Plateau Department in 2023

Benoit Sedegnon Agossoukpe¹, Finagnon Armand Wanvoegbe², Georgia Barikissou¹,
Ignace Coovi Nonwanou Tokpanoude¹, Elvire Se Djossou¹, Phinées Adegbola³,
Gilchrist Mègnisse Orphé Laly⁴, Tagnon Gautier Raphaël Gnonlonfoun⁵, Badirou Aguemon¹

¹Public Health Unit, Faculty of Health Sciences, University of Abomey-Calavi, Abomey-Calavi, Cotonou

²Department of Internal Medicine, Faculty of Health Sciences, University of Abomey-Calavi, Abomey-Calavi, Cotonou

³National School of Technicians in Public Health and Epidemiology, University of Parakou, Parakou, Benin

⁴Comlan Alfred Quenum Regional Institute of Public Health (IRSP-CAQ), Ouidah, Benin

⁵ITM Antwerp Alumni (Institute of tropical medicine of Antwerp), Antwerp, Belgium

Email: benseag@yahoo.fr

How to cite this paper: Agossoukpe, B.S., Wanvoegbe, F.A., Barikissou, G., Tokpanoude, I.C.N., Djossou, E.S., Adegbola, P., Laly, G.M.O., Gnonlonfoun, T.G.R. and Aguemon, B. (2024) Rabies by Dog Bites in Benin: Determinants of Good Knowledge of the Rabies Risk among Subjects Exposed in the Plateau Department in 2023. *Open Journal of Epidemiology*, **14**, 378-396.

<https://doi.org/10.4236/ojepi.2024.142027>

Received: February 24, 2024

Accepted: May 27, 2024

Published: May 30, 2024

Copyright © 2024 by author(s) and Scientific Research Publishing Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

Rabies, a viral zoonosis, is one of the neglected tropical diseases (NTDs) that mainly affects poor and vulnerable populations. Human rabies is endemic in Benin. Although listed among the notifiable diseases, it nevertheless remains a neglected and under-reported disease. The objective of this study was to investigate the determinants of knowledge of rabies risk among subjects exposed to human rabies by dog bites in the Plateau department of Benin. Methods: This was a cross-sectional study with an analytical aim which involved a sample of 900 people aged at least 18 years old chosen randomly and residing in the Plateau department for at least six months. A pre-tested and validated digital questionnaire served as a data collection tool. Data analysis was done with R 3.4.1 software. The prevalence ratio was used as a measure of association. The confidence threshold was set at 5%. We carried out a multiple logistic regression using the likelihood ratio (top-down approach) in order to identify the main factors which influenced the good knowledge of human rabies in the population of Plateau. Results: In the study population, 80.89% of the subjects surveyed lived in a rural area. The sex ratio (Male/Female) was 1.11. The average age of the subjects was 40.24 ± 14.52 years. The prevalence of dog bites was 4.11% (95% CI = [3.00; 5.63]) or 37 subjects bitten. After evaluation of knowledge of rabies risk in the study population, the main factors which positively influenced good knowledge of human rabies were age (p

linear trend < 0.01), residence of the subject in the municipality of Pobè (ORa = 8.34; 95% CI = 0.83 - 1.23; $p < 0.01$), individual dwelling (ORa = 17.95; 95% CI = 13.12 - 49.58 ; $p < 0.01$), educational level of at least secondary (ORa = 5.53; CI 95 = 3.06 - 10.15 ; $p = 0.01$), the existence of a veterinary center (ORa = 3.66; CI 95 = 1.07 - 12.43 $p = 0.01$) and knowledge of a dog bites victim (ORa = 6.55; 95% CI = 2.73 - 8.25; $p < 0.01$). Conclusion: This population study confirms that human rabies remains a public health problem with a need to raise awareness among populations on good prevention practices against human rabies after a dog bite in the Plateau department. This could help to improve strategies surveillance for the control and eradication of human rabies through the implementation of the One Health approach.

Keywords

Rabies, Determinants, Knowledge, Associated Factors, Benin

1. Introduction

Rabies, a viral zoonosis, is a neglected tropical, neuro-invasive disease caused by Rhabdovirus, commonly transmitted by the saliva or bites of certain infected warm-blooded animals such as domestic dogs and cats, which mainly affects poor and vulnerable populations [1] [2] [3]. It is present on all continents, except Antarctica, and represents a public health problem in developing countries [4] [5] [6]. The burden of the disease is borne mainly by Africa and Asia where dogs are the main vector of transmission to humans; it is responsible for up to 99% of all transmissions of rabies to humans. On these two continents, more than three (03) billion people are potentially exposed to rabies. Rabies is one of the deadliest infectious diseases, with a case fatality rate approaching 100%, but deaths due to rabies are rarely reported especially in Africa and particularly in the Republic of Benin [7]. Worldwide, nearly 60,000 people still die each year from this disease [4]. Africa is one of the continents hardest hit by rabies, accounting for more than a third of the world's estimated human deaths each year [8].

In Benin, rabies is endemic. Although listed among the notifiable diseases (decree n°. 2005 - 637 of October 13, 2005), it nevertheless remains a neglected disease. There is no national rabies data management system to bring together human and animal health services. Effective pre- and post-exposure vaccines have existed for about a hundred years, but disproportionate distribution is observed in many countries in Africa. They are not readily available or accessible to those who need them [5]. However, a minority of the population is aware of the risks associated with rabies and the measures to take to prevent human infection, such as seeking post-exposure prophylaxis when a bite occurs, for example. Thus, based on the principle that improving knowledge will make it possible to minimize the burden of morbidity linked to rabies [9], this study aimed to iden-

tify the factors associated with knowledge of the rabies risk in subjects exposed to bites of dogs in order to contribute to developing community awareness and education messages focused on these factors.

2. Materials and Methods

2.1. Community, Type and Study Objective

The study took place in five communes and thirty clusters in the Plateau department, located in the south of Benin. It was a cross-sectional description with the analytical aim and the data was collected from June 1, 2023, to August 31, 2023.

2.2. Sampling, Eligibility Criteria, Recruitment and Data Collection

The sampling method was probabilistic using a three-stage cluster random sampling technique. The cluster unit is represented by a district/village of the Plateau department and the study included 30 clusters.

At the first stage, a random choice of the 30 clusters as well as the four reserve clusters was made in proportion to the size of the villages/neighborhoods in the department. The four reserve clusters served as a replacement cluster in case for one reason or another, one of the 30 clusters was inaccessible.

In the second stage, a systematic random choice of 30 households was made in each of the 30 clusters. In fact, a sampling step was calculated by dividing the number of households in each village by 30. The first household corresponded to a number x drawn at random between 1 and k . The other households were selected by adding, each time, k to the last number.

In the third stage, a respondent aged at least 18 years old was chosen by simple randomness from each chosen household.

Moreover,

- apolygamous family was considered as a single household.
- when, for one reason or another, the cluster was inaccessible, it was replaced by one of the reserve clusters.
- when the interviewers miss a household twice (morning and evening), or when a household does not consent to participate in the survey, or when a household the members of at least 18 years of age is absent on both visits, they were considered non-respondent;
- abandoned concessions, administrative, commercial, educational and religious structures (etc.) were not considered in the sampling.

The data was collected using a questionnaire and it was an individual interviewer-respondent interview. This questionnaire included related information:

- socio-demographic (age, sex, ethnic group, marital status, type of household, profession, level of education subject, father, mother) and economic (socio-economic level) data;
- geographic data: household distance to health center, type of nearby health center, typology of nearby health facility;

- dog bites and cohabitation with dogs: Date of bite, date of consultation, first, second and third-line treatment, site of bite, nature of the animal, symptom, etc.
- monitoring and preventing human rabies: Number of dogs in the household, vaccination status of the dog, organization of vaccination campaign in the locality, stray dog or not, compliance with the dog's vaccination appointment, etc.

The sample size n was determined by the SHWARTZ formula to which we applied a cluster effect k .

$$n = k \frac{Z_{\alpha}^2 pq}{i^2}$$

p : Estimated prevalence of knowledge of rabies risk = $1 - q = 0.5$

q : $1 - p = 0.5$

α = the accepted risk of error = 0.05

Z_{α}^2 : gap reduced to agreed risk = 1.96

i : desired precision for the results = 0.05

k : cluster effect = 2

n : minimum number of people to survey = 768.3

Considering and adding to this size a non-response rate of 10%, the minimum number of people to survey was 845. Given that only one person per household will be surveyed, the number of households to be surveyed survey was also 845. Considering that the study will include 30 clusters, the number of households included per cluster was therefore 29. We therefore included, for practical reasons and to facilitate calculations in the field, 30 households per cluster. Furthermore, in addition to the 30 clusters to be investigated, four reserve clusters were selected to replace, if necessary, clusters that will not be accessible during collection.

Inclusion criteria

People aged at least 18 years old and crossing the following criteria were included in this study:

- residents in the Plateau department for at least six months;
- present in their dealership on the day the collection teams visit;
- having given their free and informed consent to the study;
- chosen from one of the households drawn according to the sampling plan.

Non-inclusion criteria

The respondents with below criteria were not included in the study:

- having visitor status in the sampled households;
- suffering from an apparent cognitive disorder that does not allow them to understand and answer the questionnaire;
- not belonging to the households sampled according to the sampling plan;
- belonging to households absent from their compound when collection agents visited.

2.3. Data Processing and Statistics Analysis

The questionnaire used as part of this study (available in the appendix) was de-

signed by the author, pre-tested, validated and incorporated into the KoboCollecttoolbox server which served as collection support. The collected data was extracted from the kobotoolbox server. They were analyzed with R software version 4.3.1. Descriptive statistics were used and results were presented as mean \pm standard deviation for quantitative variables with a normal distribution and as median for those with an asymmetric distribution. The frequencies of qualitative variables were expressed as percentages.

The dependent variable of the study was “good knowledge of rabies.” It is a binary qualitative variable with two modalities: “good” and “bad”.

A subject was said to have good knowledge of the rabies risk when (A) he correctly answered 50% of the knowledge items provided, (B) he recognized at least 3 signs of human rabies, (C) he knew that human rabies is a fatal disease and that he should get vaccinated after exposure to a dog bite.

The explanatory variables were composed of socio-demographic and economic factors, the practice of dog bite prevention, the characteristics of the animal service, individual factors, and as well as factors linked to the rabies surveillance system in the department.

For the analytical aspect, the Pearson chi-square test was used to test the associations in univariate analysis between the dependent variable and each independent variable. At this level, all variables with a $p < 0.2$ are taken to construct the logistic regression model. For all analyses, the significance threshold was set at 0.05%.

2.4. Ethical Considerations

The study received a favorable opinion from the local ethics committee for biomedical research at the University of Parakou, which judged it to be compliant and respect fundamental ethical principles. It also received authorization from the Ministry of Health of Benin. In addition, the free and informed consent of the respondents was obtained before each interview.

3. Results

3.1. Description of the Study Population

This study included 900 people residing in the five (05) communes of the Plateau department.

3.1.1. Sociodemographic Characteristics

The average age of the subjects was 40.24 ± 14.52 years with extremes ranging from 18 years to 86 years. The most represented age group was: [30; 50 [years. Male subjects were the most represented with a proportion of 52.56%, i.e. a sex ratio (Male/Female) of 1.11. Of the surveys, 58.78% were Christians. In the study population, 80.89% of those surveyed lived in rural areas. Among the respondents, 46.22% were heads of household, the wives of household were surveyed in 34.78% of cases and the child of household in 18.78% of cases. Overall, 77.0% of habitats were collective. The distribution of subjects surveyed according to so-

cio-demographic characteristics is summarized in **Table 1**.

The average household size was 5.97 ± 2.57 people with the extremes of 1 to 20 people as presented in **Table 2**.

Table 1. Distribution of subjects surveyed on rabies in the Plateau department according to socio-demographic characteristics in 2023 (n = 900).

Variables	Workforce	Percentages
Place of residence		
Rural	728	80.89
Urban	172	19.11
Sex		
Male	473	52.56
Feminine	427	47.44
Religion		
Christianity	529	58.78
Endogenous	222	24.66
Muslim	149	16.56
Band age (years)		
18; 30[	256	28.4
[30; 50[	363	40.3
≥50	281	31.2

Table 2. Distribution of subjects surveyed on rabies in the Plateau department according to household characteristics in 2023 (n = 900).

Variables	Workforce	Percentages
Position in the household		
Head of household	416	46.22
Wife of household	313	34.78
Child of household	169	18.78
Other	2	0.22
Type of habitat		
Collective	693	77.00
Individual	207	23.00
Household size (people)		
≥4	760	84.44
<4	140	15.56
Level instruction		
Uneducated	498	55.33
Primary	256	28.45
Secondary	135	15.00
Superior	11	1.22
Income monthly (FCFA)		
<52,000	848	94.22
≥52,000	52	5.78

3.1.2. Socioeconomic Characteristics of Households

More than half of the subjects surveyed in the 900 households are not educated (55.33%) while 28.45% would have stopped their studies in primary school, 15.00% in secondary school and 1.22% have reached a level of university. The median monthly household income of the 120 subjects was 50,000 CFA francs with an IIQ: [30,000; 80,000] F CFA as indicated in **Table 3**.

3.2. Prevalence of Dog Bites and Knowledge of Rabies Risk Among Exposed Subjects

A total of 37 cases of dog bites were recorded in the study population. The prevalence of dog bites was 4.11% (95% CI = [3.00; 5.63]) (**Figure 1**). The prevalence of good knowledge of the rabies risk after dog bite in the study population was 66.11% with 95% CI = [62.96 - 69.13].

Table 3 presents the prevalence of dog bites in each commune of the Plateau department in 2023. Among subjects who were bitten by a dog, the male/female ratio was 1.46. The mean age in this population was 43.08 ± 13.10 years.

In terms of education, 43.65% were uneducated, 70.27% lived in collective housing and 83.02% were in rural areas.

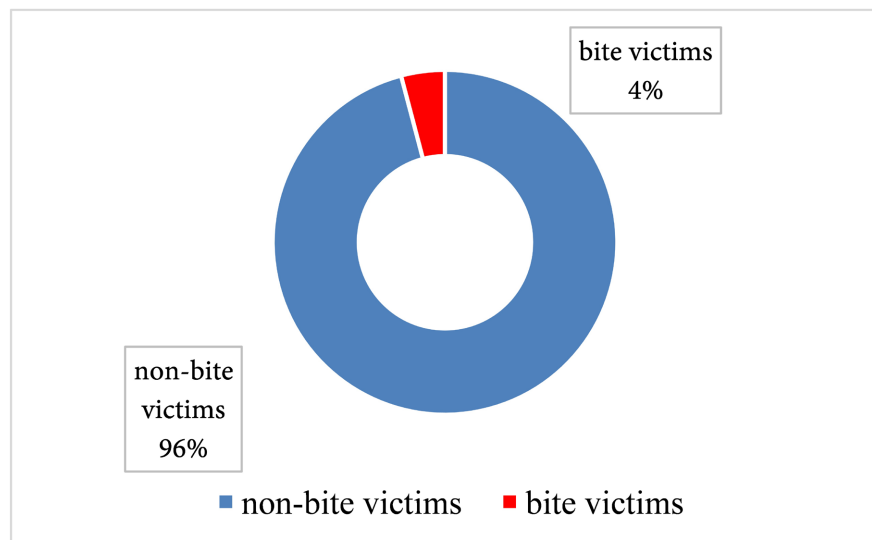


Figure 1. Prevalence of dog bites in the Plateau department in 2023 (n = 900).

Table 3. Prevalence of dog bites by municipality in the Plateau department in 2023.

Municipality	NOT	Frequency		95% CI
		neither	%	
AdjaOurè	150	5	13.51	4.54 - 28.77
Ifangni	150	12	32.43	18.01 - 49.79
Kétou	240	11	29.73	15.87 - 46.98
Sakété	150	2	5.41	0.66 - 18.19
Pobè	210	7	18.92	7.96 - 35.16

3.3. Factors Associated with Good Knowledge of the Rabies Risk among Subjects Exposed to Human Rabies

Several variables were statistically associated with good knowledge of human rabies in the Plateau department. These are the municipality of residence, age, area of residence, level of education, existence of a veterinary service, cohabitation with a dog, presence of a dog in the neighborhood and knowledge of a victim of a dog bite. Bivariate and multivariate analyses are presented in **Table 4** and **Table 5** respectively.

Table 4. Bivariate analysis between good knowledge of the rabies risk in the population of Plateau and the presumed associated factors in 2023.

Variables	Effective	Good knowledge		RP	95% CI	p-value
		Yes	%			
Municipality						
AdjaOuèrè	150	80	53.33	1		<0.01
Sakété	150	113	75.33	1.41	1.18 - 1.68	
Ifangni	150	115	76.67	1.44	1.20 - 1.71	
Kétou	240	173	72.08	1.35	1.14 - 1.60	
Pobè	210	114	54.29	1.02	0.83 - 1.23	
Residence						
Rural	728	470	64.56	1		0.04
Urban	172	125	72.67	1.13	1.01 - 1.25	
Band age						
<30 years	256	161	62.89	1		0.09
[20; 30[	363	255	70.25	1.12	0.99 - 1.25	
50 years and over	281	179	63.70	1.01	0.89 - 1.15	
Sex						
Feminine	427	275	64.40	1		0.30
Male	473	320	67.65	1.05	0.95 - 1.15	
Religion						
Endogenous	207	95	45.89	1		<0.01
Islam	149	109	73.15	1.59	1.33 - 1.90	
Christianity	529	376	71.08	1.55	1.32 - 1.81	
Position of the subject in relation to the head of household						
Child of household	169	100	59.17	1		0.08
Head of household	416	288	69.23	1.17	1.01 - 1.34	
Wife of household	313	205	65.50	1.11	0.95 - 1.28	
Other	2	2	100.00	1.69	1.49 - 1.91	
Type of habitat						
Collective	693	400	57.72	1		<0.01
Individual	207	195	94.20	1.63	1.51 - 1.75	
Household size						
						0.01

Continued

≥4	760	490	64.47	1		
<4	140	105	75.00	1.16	1.04 - 1.29	
Level instruction						<0.01
Uneducated	498	281	56.43	1		
Primary	256	191	74.61	1.32	1.19 - 1.46	
Secondary	135	113	83.70	1.48	1.33 - 1.65	
Superior	11	10	90.91	1.61	1.31 - 1.97	
Income average monthly						0.31
< 52,000F CFA	848	291	34.32	1		
≥ 52,000F CFA	52	14	26.92	0.78	0.49 - 1.23	
Existence of a center veterinarian						0.11
No	878	577	65.72	1		
Yes	22	18	81.82	1.24	1.01 - 1.52	
Cohabitation with a dog						<0.01
No	687	427	62.15	1		
Yes	213	168	78.87	1.27	1.15 - 1.38	
Availability of dog at neighbor's house						<0.01
Do not know	341	148	43.40	1		
No	314	248	78.98	1.82	1.59 - 2.05	
Yes	245	199	81.22	1.87	1.63 - 2.14	
Victim of a dog bite						0.02
No	668	428	64.07	1		
Yes	232	167	71.98	1.12	1.01 - 1.23	
Knowledge of a dog bite victim						<0.01
No	730	445	60.96	1		
Yes	170	150	88.24	1.45	1.33 - 1.56	

Table 5. Multivariate model between good knowledge of rabies risk in the population of Plateau and the presumed associated factors in 2023.

	RCA*	95% CI	p-value	p trend linear
Municipality				
AdjaOuèrè	1			
Ifangni	1.77	0.97 - 3.19	0.06	
Kétou	1.09	0.63 - 1.87	0.74	
Pobè	0.74	0.44 - 1.23	0.25	
Sakété	2.15	1.21 - 3.78	0.01	
Band age				
<30 years	1			<0.01
[30; 50[	2.21	1.43 - 3.41	<0.01	
50 years and over	1.94	1.22 - 3.08	<0.01	

Continued

Place of residence				
Rural	1	-		
Urban	2.04	1.26 - 3.29		<0.01
Type of habitat				
Collective	1	-		
Individual	25.51	13.12 - 49.58		<0.01
Level instruction				
Uneducated	1	-		
Primary	2.79	1.85 - 4.18		<0.01
Secondary	5.58	3.06 - 10.15		<0.01
Superior	11.46	1.29 - 101.01		0.03
Existence of a center veterinarian				
No	1	-		
Yes	3.66	1.07 - 12.43		0.04
Cohabitation with a dog				
No	1	-		
Yes	2.09	1.34 - 3.23		<0.01
Availability of dog at neighbor's house				
No	1	-		
Yes	1.70	1.08 - 2.65		0.02
Knowledge of a dog bite victim				
No	1	-		
Yes	4.75	2.73 - 8.25		<0.01

*RCA: Adjusted coast ratio

Compared to the subjects surveyed in the commune of AdjaOuèrè, the subjects surveyed in the commune of Sakété are 2.15 times more likely to have good knowledge of the rabies risk and this is statistically significant ($p = 0.01$).

Compared to subjects under 30 years old, subjects aged 30 years and over are more likely to have good knowledge of the rabies risk and this is statistically significant (linear trend $p < 0.01$).

Compared to subjects from rural areas, subjects living in an urban environment are 2.04 times more likely to have good knowledge of the risk of rabies and this is statistically significant ($p < 0.01$).

Compared to uneducated subjects, subjects with a primary school education are 2.79 times more likely to have good knowledge of the risk of rabies and this is statistically significant ($p < 0.01$).

Compared to uneducated subjects, subjects with secondary education are 5.58 times more likely to have good knowledge of the risk of rabies and this is statistically significant ($p < 0.01$).

Compared to uneducated subjects, subjects with a higher education level are 11.46 times more likely to have good knowledge of the rabies risk and this is statistically significant ($p = 0.03$).

Compared to subjects living in an environment where a veterinary service is non-existent, subjects living in an environment where a veterinary center exists are 3.66 times more likely to have good knowledge of the rabies risk and this is in a statistically significant manner ($p = 0.04$).

Compared to subjects who did not live with a dog, subjects who lived with a dog were 2.09 times more likely to have good knowledge of the rabies risk, and this was statistically significant ($p < 0.01$).

Compared to subjects whose neighbors did not have a dog, subjects whose neighbors had a dog were 1.70 times more likely to have good knowledge of the risk of rabies, in a statistically significant manner ($p = 0.02$).

Compared to subjects who do not have knowledge of a dog bite victim, subjects who do are 4.75 times more likely to have good knowledge of the risk of rabies and this is statistically significant ($p < 0.01$).

4. Discussion

The main limitation of this study is its nature. Being transversal in nature, we were only able to take a snapshot of the situation present on Plateau at the time of the study. Thus, the associations observed between good knowledge of rabies and the explanatory variables could also vary over time.

4.1. Sociodemographic Characteristics of the Subjects Surveyed

The average age of the subjects surveyed was 40.24 ± 14.52 years with extremes ranging from 18 years to 86 years. It is higher than the average age found by Carrara *et al.* in 2012 (37.7 years) reviewed from 1990 - 2012 [10]. The difference observed could be due to the fact that Carrara *et al.* in their study also included subjects aged under 18 years while the present one had exclusively included subjects aged at least 18 years. It remains lower than that found by Barbosa Costa *et al.* in Cameroon in 2018 (43.6 years) [11]. The average age of the subjects found by Niang *et al.* in 2020 in the community of Sokone in Senegal was 29.1 years [12].

The age group most represented in the present study was: [30; 50[years corresponding to the youth of the active population in our cities and countryside.

Male subjects were the most represented with a proportion of 52.56%, or sex ratio (Male/Female) of 1.11. In the review by Carrara *et al.* [10], the sex ratio (Male/Female) was 3.5. Niang *et al.* in their study in 2020 reported a sex ratio (Male/Female) of 1.5 close to that found in the present study [12].

Christianity is the dominant religion in the present study (58.78%) unlike the study reported by Niang *et al.* in 2020 in Senegal where the Muslim religion was predominant with a proportion of 91.10% [12]. Although secular, the populations of southern Benin are predominantly Christian in contrast.

4.2. Socioeconomic Characteristics of Survey Subjects

The median monthly household income was 50,000 CFA francs, IIQ: [30,000;

80,000] and more than half of the households had a monthly income close to the Beninese Guaranteed Interprofessional Minimum Salary.

More than half of the subjects surveyed are not educated (55.33%), those educated had 28.44% a level of study corresponding to primary school, 15.00% to secondary school and 1.22% have reached a level of university. These observations would be due to the predominantly rural study area.

4.3. Prevalence of Dog Bites in the Community

In the Plateau department, the prevalence of dog bites was estimated at 4.11% in 2023. This proportion is similar to that found by Niang *et al.* in 2020 in Senegal (4.55%; 37/813) [12] and lower than those of Hergert and Nel Louis in 2013 in South Africa on the one hand and Ahmed *et al.* in Ethiopia in 2021 on the other hand (28.2%; 94/326) [13] [14]. The low prevalence of dog bites in the Plateau department could be explained by the low reporting of bites cases due to endogenous beliefs and the lack of perception by communities of the risk of developing human rabies. Sociological gravity assimilates dog bites to spiritual and mystical facts requiring a discreet solution. However, the difference observed between the proportion of bites in the present study and that found by Ahmed *et al.* in Ethiopia, could be explained by the size of our different samples. The sample of this study carried out in the Plateau is approximately 2.5 times larger than the one carried out in Ethiopia.

4.4. Factors Associated with Good Knowledge of Human Rabies

Factors that predict good knowledge of human rabies in the community of the Plateau Recovered department are the municipality of residence, the area of residence, the type of habitat, the age group, the level of education, the existence of a veterinary center, cohabitation with dogs, availability of dogs among neighbors and knowledge of a dog bite victim.

The subjects' municipality of residence influenced their knowledge of human rabies in the Plateau department. This observation is accepted since in the literature, certain diseases occur disproportionately in countries and within a country in a different way from one region to another. This observation was also made in the department of Plateau with regard to the knowledge of human rabies. The multivariate logistic regression analysis performed in the study by Rinchen *et al.* showed that residency was significantly associated with adequate knowledge of rabies [15]. The same observation was made by Madjadinan *et al.* in their study in Chad [16]. These conclusions are also supported by the results found by Awuniet *et al.* in Ghana in 2017 who found that district of residence was statistically associated with knowledge of rabies using the Pearson chi-square test [3].

Age was corroborated with knowledge of certain illnesses. Through the present study, it appears that younger subjects are likely to misunderstand rabies. In a study carried out in India [16], Madjadinan *et al.* also came to the conclusion

that the age of the subjects influences their knowledge related to rabies. This observation is consolidated with regard to the results found by Leblanc *et al.* with his study in Madagascar in 2018 which are unanimous. Indeed, according to their conclusions, lower knowledge scores were associated with younger respondents [17].

The type of habitat is a determinant of health [18] and can therefore influence health knowledge, as is the case in this study.

The role of education in the knowledge of certain diseases such as human rabies is admitted. Our study confirms that uneducated subjects are the most susceptible to ignorance of human rabies. This remark is also shared by Herbert *et al.*, Sambo *et al.*, Bouaddi *et al.* who reached similar conclusions respectively in Tanzania (2009 and 2010), in India (2010) and in Morocco (2018) [9] [19] [20]. Furthermore, other authors who have investigated the same theme as us have not reached the same conclusion.

Cohabitation with dogs can influence knowledge of rabies, as is the case in the Plateau department. Knowledge of a person who was the victim of a dog bite that resulted in death from human rabies could also influence knowledge of human rabies. The multivariate logistic regression analysis performed in the study by Rinchen *et al.* in Bhutan in 2017 showed that having seen a case of human rabies was significantly associated with adequate knowledge of rabies [15] and the results from the analysis by Al-Mustapha *et al.* with the same regression method in Nigeria in 2020 [21] corroborates the susceptibility of dog owners to have good knowledge of canine rabies.

Other studies found that non-dog owners were 1.6 times more likely to have heard of rabies than dog owners [13].

5. Conclusions

The results of this study prove that the population in rural areas is very exposed to human rabies due to cohabitation with dogs with unknown vaccination status, and this constitutes a real public health problem.

In view of the results obtained, despite the good overall knowledge of human rabies by this study population, it is urgent to strengthen awareness-raising actions aimed at rural and illiterate populations on the risk of developing human rabies following the bites of dogs.

The strengthening of existing surveillance strategies for the control and eradication of human rabies will involve the application of the One Health approach but it should be recognized that the eradication of the phenomenon is not limited to the intensification of awareness and monitoring efforts. A more holistic and integrated approach is needed, involving collaboration between health authorities, local communities, veterinarians as well as technical and financial partners.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this pa-

per.

References

- [1] WHO (2016) Human Rabies Transmitted by Dogs: Current Status of Global Data. *The Weekly Epidemiological Record*, Report No. 91, 13-20.
- [2] WHO (2020) Rabies: Epidemiology and Burden of Disease.
- [3] Awuni, B., Tarkang, E., Manu, E., Amu, H., Ayanore, M.A., Aku, F.Y., *et al.* (2019) Dog Owners' Knowledge about Rabies and Other Factors That Influence Canine Anti-Rabies Vaccination in the Upper East Region of Ghana. *Tropical Medicine and Infectious Disease*, **4**, Article 115. <https://doi.org/10.3390/tropicalmed4030115>
- [4] WHO (2021) Rabies. WHO, Geneva.
- [5] WHO (2018) Zero by 30: The Global Strategic Plan to End Human Deaths from Dog-Mediated Rabies by 2030. WHO, Geneva, 59.
- [6] Sahu, D.P., Preeti, P.S., Bhatia, V. and Singh, A.K. (2021) Anti-Rabies Vaccine Compliance and Knowledge of Community Health Worker Regarding Animal Bite Management in Rural Area of Eastern India. *Cureus*, **13**, e14229. <https://doi.org/10.7759/cureus.14229>
- [7] Fooks, A.R., Banyard, A.C., Horton, D.L., Johnson, N., McElhinney, L.M. and Jackson, A.C. (2014) Current Status of Rabies and Prospects for Elimination. *The Lancet*, **384**, 1389-1399. [https://doi.org/10.1016/S0140-6736\(13\)62707-5](https://doi.org/10.1016/S0140-6736(13)62707-5)
- [8] Mbilo, C., Coetzer, A., Bonfoh, B., Angot, A., Bebay, C., Cassamá, B., *et al.* (2021) Dog Rabies Control in West and Central Africa: A Review. *Acta Tropica*, **224**, Article 105459. <https://www.sciencedirect.com/science/article/pii/S0001706X19310575> <https://doi.org/10.1016/j.actatropica.2020.105459>
- [9] Sambo, M., Lembo, T., Cleaveland, S., Ferguson, H.M., Sikana, L., Simon, C., *et al.* (2014) Knowledge, Attitudes and Practices (KAP) about Rabies Prevention and Control: A Community Survey in Tanzania. *PLOS Neglected Tropical Diseases*, **8**, e3310. <https://doi.org/10.1371/journal.pntd.0003310>
- [10] Carrara, P., Parola, P., Brouqui, P. and Gautret, P. (2013) Imported Human Rabies Cases Worldwide, 1990-2012. *PLOS Neglected Tropical Diseases*, **7**, e2209. <https://doi.org/10.1371/journal.pntd.0002209>
- [11] Barbosa Costa, G., Gilbert, A.T., Monroe, B., Blanton, J., Ngam Ngam, S., Recuenco, S., *et al.* (2018) The Influence of Poverty and Rabies Knowledge on Healthcare Seeking Behaviors and Dog Ownership, Cameroon. *PLOS ONE*, **13**, e0197330. <https://doi.org/10.1371/journal.pone.0197330>
- [12] Niang, K., Tine, J.A.D., Ndao, A.B., Diongue, F.B., Diallo, A.I., Faye, A., *et al.* (2020) Knowledge and Attitudes of Health Care Providers and the Population about Rabies in Sokone Health District, Senegal. *Open Journal of Preventive Medicine*, **10**, 63-71. <https://doi.org/10.4236/ojpm.2020.104004>
- [13] Hergert, M. and Nel, L.H. (2013) Dog Bite Histories and Response to Incidents in Canine Rabies-Enzootic KwaZulu-Natal, South Africa. *PLOS Neglected Tropical Diseases*, **7**, e2059. <https://doi.org/10.1371/journal.pntd.0002059>
- [14] Ahmed, M.J., Dirirsa, G., Mengistu, D.A., Demena, M. and Geremew, A. (2022) Rabies Prevention and Control Practices and Associated Factors among Dog Owners in Chiro, West Hararghe, Ethiopia. *Journal of Public Health Research*, **11**. <https://doi.org/10.1177/22799036221129373>
- [15] Rinchen, S., Tenzin, T., Hall, D., van der Meer, F., Sharma, B., Dukpa, K., *et al.* (2019) A Community-Based Knowledge, Attitude, and Practice Survey on Rabies

- among Cattle Owners in Selected Areas of Bhutan. *PLOS Neglected Tropical Diseases*, **13**, e0007305. <https://doi.org/10.1371/journal.pntd.0007305>
- [16] Madjadinan, A., Hattendorf, J., Mindekem, R., Mbaipago, N., Moyengar, R., Gerber, F., *et al.* (2020) Identification of Risk Factors for Rabies Exposure and Access to Post-Exposure Prophylaxis in Chad. *Acta Tropica*, **209**, Article 105484. <https://doi.org/10.1016/j.actatropica.2020.105484>
- [17] Leblanc, C., Kassié, D., Ranaivoharimina, M., Rakotomanana, E.F.N., Mangahasimbola, R.T., Randrianarijaona, A., *et al.* (2024) Mixed Methods to Evaluate Knowledge, Attitudes and Practices (KAP) towards Rabies in Central and Remote Communities of Moramanga District, Madagascar. *PLOS Neglected Tropical Diseases*, **18**, e0012064. <https://doi.org/10.1371/journal.pntd.0012064>
- [18] Febvrel, D., Squinazi, F., Bex, V., Deroubaix, P., Drougard, C., Estecahandy, P., *et al.* (2019) Factors Contributing to a Healthy Habitat. State of Knowledge and Recommendations to Establish Public Policies for Healthy Housing. Ph.D. Thesis, High Council of Public Health. <https://ehesp.hal.science/hal-02190365/>
- [19] Herbert, M., Basha, S.R. and Thangaraj, S. (2012) Community Perception Regarding Rabies Prevention and Stray Dog Control in Urban Slums in India. *Journal of Infection and Public Health*, **5**, 374-380. <https://doi.org/10.1016/j.jiph.2012.05.002>
- [20] Bouaddi, K., Bitar, A., Bouslikhane, M., Ferssiwi, A., Fitani, A. and Mshelbwala, P.P. (2020) Knowledge, Attitudes, and Practices Regarding Rabies in El Jadida Region, Morocco. *Veterinary Sciences*, **7**, Article 29. <https://doi.org/10.3390/vetsci7010029>
- [21] Al-Mustapha, A.I., Tijani, A.A., Bamidele, F.O., Muftau, O., Ibrahim, A., Abdulrahim, I., *et al.* (2021) Awareness and Knowledge of Canine Rabies: A State-Wide Cross-Sectional Study in Nigeria. *PLOS ONE*, **16**, e0247523. <https://doi.org/10.1371/journal.pone.0247523>

Appendix

Community Questionnaire

No.	Variables	Terms	Answer
HOUSEHOLD INFORMATION			
1.	Presence of an adult aged at least 18 in the household	1. Yes 2. No If not, come back and visit the household. Choose another household	/__
2.	Sanitary zone	1. Pak 2. Sakif	/__
3.	Municipality	1. Pobè 2. Kétou 3. Adja-Ouèrè 4. Sakété 5. Ifangni	/__
4.	Borough	Choose the district	
5.	Village	Choose the village	
6.	Place of residence	1. Urban 2. Rural	/__
7.	Type of habitat	1. Individual 2. Collective	/__
8.	Household size	Enter the number of people living in the household	/__/_
9.	Monthly household income	Enter the average monthly income in F CFA	.....F
INFORMATION ON THE SUBJECT SURVEYED			
10.	Does the household agree to participate in the study?	1. Yes 2. No If no, choose another household	/__
11.	Position of the respondent in the household	1. Head of household 2. Head of household's wife 3. Child of the head of the household 4. Other	/__
12.	Age of respondent	Enter your age in years	/__/_
13.	Gender of respondent	1. Male 2. Feminine	/__
14.	Educational level	1. Uneducated 2. Primary 3. Secondary 4. Superior	/__
	If not educated, specify whether literate or not in local language	1. Literate 2. Not Literate	/__
15.	Religion	1. Endogenous 2. Christianity 3. Islam 4. No religion	/__
16.	Are there veterinary centers in your area?	1. Yes 2. No 3. I don't know	/__
KNOWLEDGE OF HUMAN RABIES INVESTIGATION			

Continued

17.	What do you think human rage is?	<ol style="list-style-type: none"> 1. Do not know 2. Disease transmitted from dogs to humans 3. Brain-related disease 4. Poisoning 5. Diseases caused by spirits 6. Diseases induced by witchcraft 7. Other to specify 	Check all true answers
18.	How is rabies transmitted?	<ol style="list-style-type: none"> 1. Do not know 2. Disease transmitted from dogs to humans 3. Disease transmitted from one dog to another 4. Disease transmitted from man to dog 5. Disease transmitted from man to man 	Check all true answers
19.	How could rabies be transmitted from a dog to a human?	<ol style="list-style-type: none"> 1. Do not know 2. Bite 3. Scratch 4. Licking 	Check all true answers
20.	What do you think are the signs of animal rabies?	<ol style="list-style-type: none"> 1. Do not know 2. Lack of appetite/difficulty eating 3. Barks or meows differently 4. Saliva excessively 5. Bites the wound site where it was exposed to the rabies virus 6. Reacts excessively to touch, noise or light 7. Stagger or fall 8. Is partially or completely paralyzed 9. Disappearance of the animal 10. Behaviour change 11. Hustle 12. Photophobia 13. Other signs to specify 	Check all true answers
21.	What do you think are the signs of rabies in humans?	<ol style="list-style-type: none"> 1. Do not know 2. Irritability 3. Tingling from the wound 4. Hydrophobia 5. Bark 6. Sweat 7. Aggressiveness 8. Hustle 9. Leak 10. Other signs to specify 	Check all true answers
22.	How do you think rabies can be prevented?	<ol style="list-style-type: none"> 1. Do not know 2. Vaccination of dogs 3. Slaughter of stray dogs 4. Cat vaccination 5. Vaccination of other pets 6. Human vaccination regardless of any bite 7. Human vaccination after bite 8. Other to specify 	Check all true answers

Continued

23.	What is the minimum age for dog vaccinations?	1. Do not know 2. Before the age of three months 3. At threemonthsold 4. After three months of age	/__/
ATTITUDE AND PRACTICES			
24.	In your opinion, why is the presence of a dog important in a home?	1. Do not know 2. The dog provides security and keeps thieves away from the house 3. The dog protects against evil spirits 4. The dog receives bad luck instead of its master 5. Eating dog meat protects against rabies 6. Eating dog meat protects against witchcraft 7. The dog is a good companion 8. Otherto specify	/__/
25.	Do you think a dog bite can cause rabies?	1. Yes 2. No	/__/
26.	Do you think that declared human rabies is fatal, that is, incurable?	1. Yes 2. No	/__/
27.	Do you think vaccinating your dog can protect it against rabies?	1. Yes 2. No	/__/
	Do you have a dog at home here?	1. Yes 2. No	/__/
	If so, is your dog vaccinated against rabies?	1. Yes 2. No 3. Do not know	/__/
28.	If the dog is vaccinated, what do you think about the cost of the vaccine given to the dog?	1. Free 2. Cheaper 3. Acceptable, affordable cost 4. Dear 5. Very expensive	/__/
	If Not Vaccinated, why haven't you vaccinated your dog?	1. High cost of vaccines 2. Vaccine not available in the locality 3. No veterinary practice in the area 4. Veterinary office very far from home 5. Absence/insufficiency of financialresources 6. Don't know where dog vaccinations are done 7. No need to vaccinate a dog 8. Vaccines killdogs 9. Vaccines cause rabies in dogs 10. Didn't know you need to vaccinate a dog 11. Otherto specify	Check all true answers
29.	Does one of your neighbors have a dog?	1. Yes 2. No 3. Do not know	/__/
30.	If yes, have the dog(s) been vaccinated against rabies?	1. Yes 2. No 3. Do not know	/__/
31.	Have you ever been bitten by a dog?	1. Yes 2. No	/__/

Continued

		1. Consultation in a health center	
		2. Identification of the dog's vaccination status	
		3. Consultation of the dog with a veterinarian	
		4. Consultation with a traditional therapist	/__/
		5. Consultation with a religious leader	
		6. Home care by family	
		7. Other to specify	
	Are you vaccinated against rabies?	1. Yes	/__/
		2. No	
32.	Do you have a loved one who has been bitten by a dog?	1. Yes	/__/
		2. No	
	Has anyone close to you or a member of your family been diagnosed with rabies in the past?	1. Yes	/__/
		2. No	
33.	What was the evolution of rabies?	1. Deceased	
		2. Cured without after-effects	/__/
		3. Cured with after-effects	
		1. Systematically	
		2. If there are worrying signs	
34.	If you or a loved one are bitten by a dog, in which case will you go to the hospital?	3. If there is money	/__/
		4. If there is injury	
		5. If the one who was bitten accepts	
		7. If the traditional practitioner does not succeed	
		1. Consultation in a health center	
		2. Identification of the dog's vaccination status	
		3. Consultation of the dog with a veterinarian	
35.	What will you do if in the near future you or a loved one is bitten by a dog?	4. Consultation with a traditional therapist	Check all true answers
		5. Consultation with a religious leader	
		6. Home care by family	
		7. Other to specify	
	Have you already participated in or benefited from awareness raising on rabies prevention in your locality?	1. Yes	/__/
		2. No	
36.	If Yes, which structure organized this awareness?	1. Ministry of Health	
		2. Local NGOs	
		3. Other	/__/
		4. I do not remember	