

## Pattern of dog bite injuries, dog vaccination coverage and post-exposure prophylaxis against rabies among dog owners in Sokoto, Nigeria

Abdulaziz L. Abdulsalam<sup>1\*</sup>, Kehinde J. Awosan<sup>2</sup>

<sup>1</sup>Department of Paediatrics, Federal Medical Centre, Birni-Kebbi, Nigeria

<sup>2</sup>Department of Community Health, Usmanu Danfodiyo University, Sokoto, Nigeria

### ABSTRACT

**Background:** Periodic mass dog vaccination and prompt administration of post-exposure prophylaxis against rabies are believed to be crucial to reducing the high burden of endemic canine rabies in the at-risk communities around the world. **Aim:** This study aimed to determine the prevalence of dog bite injuries, dog vaccination coverage and post-exposure prophylaxis against rabies among dog owners in Sokoto, Nigeria. **Materials and Methods:** A cross-sectional study was conducted among 190 dog owners selected by multistage sampling technique. Data were collected with a set of pretested interviewer-administered questionnaire; and analyzed using IBM SPSS version 20 software. **Results:** Close to a quarter, 45 (23.7%) of the 190 respondents reported that either themselves or a member of their family have ever experienced a dog bite injury, with majority 38 (62.3%) of the 61 dog bite victims being children aged  $\leq 12$  years. Less than a third of respondents (28.4%) reported vaccinating their dog(s) in the last 12 months. Less than half, 25 (41.0%) of the 61 dog bite victims were commenced on post-exposure prophylaxis (PEP) for rabies; of these, only about a third (36.0%) had the complete PEP doses. **Conclusion:** Whereas, the prevalence of dog bite injuries was relatively high among the respondents in this study, with majority of the victims being children aged  $\leq 12$  years, dog vaccination coverage and uptake of PEP against rabies by them were low. Government and other stakeholders should promote responsible dog ownership, organize periodic mass dog vaccination campaigns, and make anti-rabies vaccine accessible to the populace.

**Keywords:** Prevalence, dog bite injuries, dog vaccination coverage, post-exposure prophylaxis

### INTRODUCTION

Rabies infection invariably results in death in human once clinical signs occur, and 99% of human deaths from rabies globally are due to bites by rabid domestic dogs.<sup>1</sup> The virus is spread through infected saliva in bites, scratches and through licks from infected animals in open wounds or on mucosal membranes, or from infectious material such as brain tissue from a rabid animal.<sup>2-4</sup> Also, the risk of transmission of the infection depends on the parts of the body bitten, with the percentage of rabid bites leading to clinical rabies ranging from 10% on the legs to 80% on the head.<sup>5</sup>

This explains why even though all age groups are susceptible to the disease it is more common in children less than 15 years. The World Health Organization (WHO) estimates that up to 40% of people who are bitten by suspect rabid animals are children under-15 years of age.<sup>2,6</sup> Also, at greater risk than the general

population are certain occupational groups including veterinarians, dog handlers, hunters, field naturalists or journalists and laboratory staffs working with rabies virus.<sup>6</sup> Recent data showed that rabies threatens over 3 billion people in Asia and Africa where more than 95% of the estimated 55,000 deaths from the disease each year occur.<sup>1,7</sup>

Mass dog vaccination is believed to be the most effective measure to control rabies and prevent human deaths.<sup>8</sup> The vast majority of human rabies deaths can be prevented through sustained dog vaccination programmes. Annual anti-rabies vaccination and public enlightenment campaign aimed at achieving at least 70% vaccination coverage that is necessary for maintaining the required level of herd immunity in the vaccinated population irrespective of dog population turnover rates such as deaths, births, immigration, emigration in the

\*Corresponding Author: Dr. Abdulaziz L. Abdulsalam, Department of Paediatrics, Federal Medical Centre, Birni-Kebbi, Nigeria.

E-mail: [doctorkay360@gmail.com](mailto:doctorkay360@gmail.com)

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period between campaigns,<sup>4</sup> are crucial to the control of rabies and eventually eliminate the disease among the dog population. While several countries endemic to rabies do not succeed in getting optimal vaccination coverage,<sup>3</sup> isolated studies conducted in some parts of Nigeria, including Zaria and Kafanchan,<sup>9</sup> Plateau State,<sup>10</sup> and Taraba States,<sup>11</sup> reported high dog vaccination coverage rates of 96.6, 97.8 and 86.0% respectively. But the findings from recent studies in the country point to the contrary, as anti-rabies vaccination coverage of dogs has fallen below 50% with increasing growth of dog and human population; it is believed that in the absence of concerted efforts and appropriate investment for the control of rabies, the burden of deaths due to the disease and the economic costs of its control will continue to be enormous in Nigeria.<sup>6</sup>

Currently, rabies is endemic in Nigeria; studies conducted across the country reported presence of rabies viral antigen in the brains of about a third of apparently healthy dogs.<sup>4,12,13</sup> The high endemicity of rabies in Nigeria has been attributed to several factors including vaccine and vaccination factors, increasing human activities involving dogs (such as hunting and dog trading), and increasing interactions between domestic and stray dogs.<sup>4,9,14,15</sup> Following exposure to suspected rabid animal, prevention of human rabies consists of prompt wound cleansing and administration of modern cell-culture vaccine and in cases of severe exposure, of rabies immunoglobulin.<sup>1</sup> Every year around the world more than 20 million people are vaccinated against rabies after being bitten, and an estimated 40% of post-exposure prophylaxis worldwide is given to children 5-14 years of age.<sup>2,6,7</sup>

Although, post-exposure prophylaxis is estimated to prevent 330,304 deaths in Asia and Africa, the economic cost of the disease is enormous; this has been estimated at USD 583.5 million in Asia and Africa alone, and at USD 1 billion worldwide, with most of the cost being due to cost of post-exposure prophylaxis.<sup>16,17</sup> This is a serious public health challenge in Asia and sub-Saharan Africa, as the average cost of rabies post-exposure prophylaxis can be a catastrophic household expenses for the victims in the poor populations across these continents, since a course of PEP can cost USD 40 in Africa and USD 49 in Asia where the daily income is about USD 1-2 per person.<sup>1</sup> Despite the high population of farmers and other occupational groups with high risk of exposure to rabies infection in Sokoto, Nigeria, little is known about the pattern of dog bite injuries, dog vaccination coverage and post-exposure prophylaxis against rabies among the groups at-risk in this area.

This study was conducted to assess the pattern of dog bite injuries, dog vaccination coverage, and post-exposure prophylaxis against rabies among dog owners in Sokoto, Nigeria.

## **MATERIALS AND METHODS**

### **Study Design, Population and Area**

This was a cross-sectional study among dog owners with establish households and with dogs of vaccination age (6 months) in Sokoto metropolis, Nigeria in April and June 2017. Sokoto metropolis is the capital of Sokoto State, Nigeria, and contains 5 of the 23 Local Government Areas (LGAs) in the state. Majority of the population are farmers, belong to the Hausa and Fulani ethnic groups, and Islam is their main religion.

### **Sample Size Estimation and Sampling Technique**

The sample size was estimated at 199 using the statistical formula for calculating sample size for cross-sectional studies,<sup>18</sup> a 13.5% prevalence of dog vaccination from a previous study,<sup>11</sup> a precision level of 5% and an anticipated response rate of 90%. The eligible participants were selected by a multistage sampling technique. At the first stage, two wards were selected in each of the 5 LGAs in Sokoto metropolis by simple random sampling using the ballot option. At the second stage, 10 areas / settlements were selected in each of the selected wards by simple random sampling using the ballot option. At the third stage, selection of participants was done in the selected areas / settlements by systematic sampling technique after doing a line listing of households that meet the inclusion criteria in the selected areas / settlements. Proportionate allocation of the study participants was done based on the projected population of the respective LGAs.

### **Data Collection and Analysis**

A structured interviewer-administered questionnaire was used to obtain information on study participants' socio-demographic profile, prevalence of dog bite, vaccination status of dogs, and the participants' post exposure practices. The questions were adapted from the questionnaires used in previous similar studies.<sup>9,19,20</sup> The questionnaire was pretested on 20 dog owners in Tambuwal LGA (situated outside Sokoto metropolis). The necessary modifications were made based on the observations made during the pretesting. Five Community Health Officers (CHOs) and Five Health Information Officers (HIOs) assisted in questionnaire administration after pre-training on conduct of survey research, the objectives of the study, selection of study participants and questionnaire administration. Data were analyzed using IBM SPSS version 20 computer statistical

software package. Quantitative variables were summarized using mean and standard deviation, while qualitative variables were summarized using frequencies and percentages.

### Ethical Consideration

Institutional ethical clearance was obtained from the Ethical Committee of Ministry of Health, Sokoto State, Nigeria. Permission to conduct the study was obtained from the administration of the respective LGAs and the traditional heads of the settlements where the study was conducted. Informed written consent was also obtained from the participants before data collection.

## RESULTS

### Socio-demographic characteristics of respondents

One hundred and ninety of the 200 questionnaires administered were adequately completed and found suitable for analysis, giving a response rate of 95%. The ages of the respondents ranged from 15 to 66 years (mean = 34 ± 9.9 years), with majority of them (76.9%) being in the 20-39 years age group. Most of the respondents were males (84.7%), married (71.1%), belong to the Hausa / Fulani ethnic groups (74.7%), and practiced Islam as religion (77.9%). Majority of respondents (52.6%) had secondary and tertiary education, and a larger proportion of them (37.4%) were either into business or were artisans (Table 1).

### Pattern of dog bite injuries among respondents

Close to a quarter, 45 (23.7%) of the 190 respondents reported that either themselves or a member of their family have ever experienced a dog bite injury; and with the total number of dog bite victims being 61. Of these, majority were by bitten by their own dogs (77.1%) and were children aged ≤ 12 years (62.3%) as shown in Table 2.

### Dog vaccination coverage among respondents

Less than a third 54 (28.4%) of the 190 respondents reported vaccinating their dog(s) in the last 12 months. The main reasons given for not vaccinating their dog(s) by the respondents who did not do so were not being aware of rabies (20.7%), not being aware of dog vaccination for rabies (19.6%), and the vaccination centre being too far away from their homes (16.3%). Other reasons given for not vaccinating their dogs are shown in Table 3.

### Uptake of post-exposure prophylaxis against rabies by respondents

Only 24 (39.3%) of the 61 victims of dog bites had their wound washed and flushed with soap/detergent and

plenty water, while about a third (32.8%) had traditional herbs applied to their wounds. Less than half, 25 (41.0%) of the 61 victims of dog bites were commenced on post-exposure prophylaxis (PEP) for rabies; of these, only about a third (36.0%) had the complete PEP doses. The most commonly cited reason for not commencing PEP or not completing the PEP doses was rabies vaccine not being affordable to them (39.6%) as shown in Table 4.

**Table 1: Socio-demographic characteristics of respondents**

Variables	Frequency (%) n =190
Age group (years)	
< 20	4 (2.1)
20-29	67 (35.3)
30-39	79 (41.6)
40-49	22 (11.6)
≥ 50	18 (9.5)
Sex	
Male	161 (84.7)
Female	29 (15.3)
Marital status	
Single	49 (25.8)
Married	135 (71.1)
Separated	2 (1.1)
Widowed	4 (2.1)
Tribe	
Hausa	109 (56.3)
Fulani	35 (18.4)
Yoruba	18 (9.5)
Igbo	20 (10.5)
Others	10 (5.3)
Religion	
Islam	148 (77.9)
Christianity	42 (22.1)
Educational level	
Primary and below	90 (47.4)
Secondary and tertiary	100 (52.6)
Occupation	
Unemployed	21 (11.0)
Farmer / hunter	63 (33.2)
Business / artisan	71 (37.4)
Civil servant	35 (18.4)

## DISCUSSION

This study assessed the pattern of dog bites, dog vaccination coverage and post-exposure prophylaxis against rabies among dog owners in Sokoto, Nigeria. The 23.7% prevalence of dog bite injuries among the respondents in this study is in agreement with the similarly high prevalence of dog bite injuries obtained in studies conducted in both developed and developing countries across the globe. While a community based study in Cheshire, United Kingdom, reported that 24.78% of participants have ever been bitten by a dog during their lifetime,<sup>21</sup> dog bite injuries constituted substantial proportions of consultations in other health facilities based studies across the globe including Haiti,<sup>22</sup> India,<sup>23</sup> Tanzania,<sup>24</sup> and Central Africa Republic.<sup>25</sup>

**Table 2: Pattern of dog bite injuries among respondents**

Variables	Frequency (%)
Self or family members ever experienced a dog bite (n = 190)	
Yes	43 (23.7)
No	145 (76.3)
(Total cases of dog bites = 61)	
Type of dog responsible for the bite (n = 61)	
Own dog	47 (77.1)
Stray dog	14 (22.9)
Age of dog bite victims (years) (n = 61)	
1-5	11 (18.0)
6-12	27 (44.3)
13-17	14 (23.0)
18 and above	9 (14.8)

Whereas, majority of the victims in this study (77.1%) were bitten by their own dogs, stray dogs were mostly responsible for the bites in studies conducted in Enugu, Nigeria (57.7%),<sup>26</sup> and Cheshire, UK (54.7%).<sup>21</sup> However, irrespective of the type of dog responsible, similar to the finding of majority of the dog bite victims in this study being children aged 12 years and below, children aged less than 15 years were the major victims of dog bite injuries in studies conducted across Nigeria including Zaria, Northwest Nigeria (55.6%),<sup>27</sup> and Ado-Ekiti, Southwest Nigeria (60.7%)<sup>28</sup>; and in other places including Central African Republic (60%),<sup>25</sup> and Kenya (54.6%).<sup>29</sup> These findings show the enormity of the burden of dog bite injuries worldwide, and they underscore the need for government to promote responsible dog ownership in order to prevent unnecessary contacts between the populace (particularly children) and dogs.

**Table 3: Dog vaccination coverage among respondents**

Variables	Frequency (%)
Vaccinated dog(s) in the last 12 months (n = 190)	
Yes	54 (28.4)
No	130 (68.4)
Cannot recall	6 (3.2)
Reason for not vaccinating dog (n = 92)	
Not aware of rabies	19 (20.7)
Not aware of vaccination for rabies	18 (19.6)
Not ware of vaccination center	9 (9.8)
Vaccination center too far from home	15 (16.3)
Inability to handle dog(s)	12 (13.0)
Lack of time	14 (15.2)
Vaccine not available	3 (3.3)
Vaccine not affordable	7 (7.6)
Beliefs contrary to vaccination	6 (6.5)

The 28.4% prevalence of dog vaccination in the last 12 months obtained in this study is too low compared with the high dog vaccination coverage rates of 86.0, 96.6

and 97.8% reported in studies conducted in Taraba, Kaduna and Plateau States of Nigeria respectively<sup>9,10,11</sup>; and it is far below the recommended 70% annual vaccination coverage required for maintaining the required level of herd immunity in the vaccinated population irrespective of dog population turn-over rates between campaigns.<sup>4</sup> Mass dog vaccination has been identified as the most effective measure to control rabies and prevent human deaths.<sup>8</sup> This is corroborated by the findings in a study conducted in Serengeti District, Northwestern Tanzania in which 60-70% dog vaccination coverage was sufficient enough to control dog rabies in the area and to significantly reduce demand for human post-exposure rabies treatment.<sup>30</sup> Specifically, the study reported 64.5, 61.0, 70.6 and 73.7% dog vaccination coverage rates after the 1st, 2nd, 3rd, and 4th central-point dog vaccination campaigns; with the incidence of dog rabies falling by 70% after the first campaign, and 97% after the second campaign, while the incidence of dog rabies did not differ significantly in unvaccinated control village of Musoma District.

**Table 4: Uptake of post-exposure prophylaxis against rabies by respondents**

Variables	Frequency (%)
*Type of first-aid wound care received (n = 61)	
Wound washed and flushed with soap/detergent and plenty water	24 (39.3)
Wound treated with traditional herbs	20 (32.8)
Pressure applied to stop bleeding	17 (27.9)
Had post-exposure prophylaxis (with rabies vaccine) (n = 61)	
Yes	25 (41.0)
No	36 (59.0)
Had complete PEP doses (n = 25)	
Yes	9 (36.0)
No	16 (64.0)
Reason for not getting PEP or completing PEP doses (n = 48)	
Not aware of rabies	5 (10.4)
Not aware of PEP for rabies	5 (10.4)
Hospital / pharmacy too far from home	4 (8.3)
Dog was vaccinated against rabies	4 (8.3)
Vaccine not recommended by doctor	1 (2.1)
Vaccine not available	2 (4.2)
Vaccine not affordable	19 (39.6)
Belief contrary to vaccination	5 (10.4)
Fear of injection	3 (6.3)

Also, the incidence of human bite injuries from suspected rabid dogs declined significantly in Serengeti District after dog vaccination, but not in the adjacent unvaccinated districts.<sup>30</sup> The fact that the main reasons cited for not vaccinating their dog(s) by the respondents that did not do so in this study were lack of awareness of rabies (20.7%) and dog vaccination against rabies (19.6%) brings to the fore the poor awareness of rabies prevention among the populace in Sokoto, Nigeria, and

it underscores need for government and veterinary health workers to organize periodic mass dog vaccination campaigns in the area.

Only about a third (39.3%) of the dog bite victims in this study had their wounds washed and flushed with soap/detergent and plenty water, while about a third (32.8%) had traditional herbs applied to their wounds; thus placing them at additional risk of tetanus infection in addition to the risk of developing clinical rabies, whose case fatality rate has been found to be 100% in several studies conducted in Nigeria and other West African countries.<sup>26,28,31</sup> This is similar to the finding in the study conducted in Ado-Ekiti, Nigeria, which reported that the most common (60%) pre-hospital treatment was application of herbal preparation.<sup>28</sup>

Findings from studies conducted in other places also showed high prevalence of improper wound treatment among victims of dog bite. A study in India<sup>23</sup> reported that half of the victims treated their wound with a local preparation, while a recent study conducted in China<sup>32</sup> reported that 81.2% of animal bites victims treated their wounds improperly after suspected rabies exposure. Another study conducted in a Bangladesh community reported that 59% of dog bite victims sought treatment from traditional healers instead of visiting the hospitals.<sup>33</sup> It is therefore necessary for government and health workers to pay sufficient attention to educating the public on appropriate wound care following bites by suspected rabid dogs in the rabies prevention campaigns.

The low uptake of post-exposure prophylaxis (PEP) against rabies among the respondents in this study with less than half of them (41.0%) being commenced on PEP, and only about a third (36.0%) of those commenced on PEP having the complete doses is worrisome in view of the concomitantly low dog vaccination rate among them; this implies that neither is the disease eliminated at source, nor are they protected from it after exposure. In contrast to the finding in this study, high uptake of PEP against rabies was reported in studies conducted in other cities in Nigeria including the neighboring city of Zaria, Northwest Nigeria (87.7%),<sup>27</sup> and Ado-Ekiti, Southwest Nigeria (92.9%).<sup>28</sup>

An estimation of the global burden of endemic canine rabies by Hampson et al.,<sup>34</sup> showed that whereas, the direct cost of post-exposure prophylaxis accounted for 20% of the estimated 8.6 billion USD economic losses due to endemic canine rabies globally, and lost income while seeking PEP accounted for another 15.5%, dog vaccination accounted for less than 1.5%. The fact that

inability to afford the vaccine was the main reason cited for either not being commenced on it, or not completing the PEP doses by the respondents in this study, as a larger proportion of them (44.2%) were farmers/hunters and those that were unemployed, provides additional evidence in support of the submission by Hampson et al.,<sup>34</sup> on the need for a greater focus on mass dog vaccination to eliminate the disease at source, thus reducing the need for costly PEP and preventing the large and unnecessary burden of mortality on at-risk communities.

## CONCLUSION

Whereas, the prevalence of dog bite injuries was relatively high among the respondents in this study, with majority of the victims being children aged  $\leq 12$  years, dog vaccination coverage and uptake of PEP against rabies by them were low. Government and other stakeholders should promote responsible dog ownership, organize periodic mass dog vaccination campaigns, and make anti-rabies vaccine accessible to the populace.

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## Conflict of interest

None declared.

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