ORIGINAL ARTICLE

Prevalence and associated factors of Dog Bites: A cross-sectional study among Primary School Children in Madawaki District Gusau, Nigeria

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ABSTRACT

Introduction: Dog bite is a global public health concern because it is the main risk factor for human rabies and it particularly affects children. In Nigeria, most dog bites are from stray dogs and their vaccination status remains unknown. Thus, this study aimed to investigate the prevalence and associated factors of dog bite among public primary school children in Madawaki district Gusau, Nigeria. **Methods:** A cross-sectional study was conducted using an unequal stratified sampling technique among 999 children aged 11 to 13-year-old at seven public primary schools from September 2017 to January 2020. A self-reported history of dog bites, socio-demographic characteristics, knowledge on interaction with dogs, knowledge on the implication of dog bites, risk behaviours of children and dog ownership were collected using a validated questionnaire. **Results:** The prevalence of dog bites was 54.5%. The predictors of dog bite among the children were being a male (Adjusted Odds Ratio; AOR = 2.252; Confidence Interval; CI = 1.719, 2.949), dog ownership by respondent's family (AOR = 1.456; CI = 1.089, 1.946), dog ownership by neighbours of the respondents (AOR = 1.752; CI =1.334, 2.303), total score for knowledge on interaction with dogs (AOR = 0.884; CI = 0.858, 0.911), and total score for risk behaviours of children (AOR = 1.020; CI =1.004, 1.035). **Conclusion:** Poor knowledge on interaction with dogs, children's risk behaviours around dogs, dog ownership and being male were the factors associated with a high prevalence of dog bite among primary school children from this study. These factors should be considered in order to develop an effective awareness campaign in schools to reduce the prevalence of dog bites among children.

Keywords: Dog bites, Children, Knowledge, Behaviours, Nigeria

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INTRODUCTION

Dog bites are a global concern that is sometimes fatal and it particularly affects children, as well as fear of contracting rabies infection (1–4) and posttraumatic stress disorders, which requires psychological treatment (5). Dogs are responsible for more than 50% of the bites from animals (6). It has also been reported that the risk of experiencing bites from domestic animals during an individual's lifetime is 50%, of which dog bites account for 80-90% of the total risk (7).WHO report shows that, children have a high prevalence of dog bites in late childhood (8). The common body parts of children where dog bites are head, neck and face (9,10), whereas adults are limbs (11,12). According to the Centre for Disease Control (CDC), about 52 million people live together with dogs in the United States of America (USA) in 1994, with an estimate of 17% bites that require medical attention, out of 4.7 million dog bites (13).

It is estimated that a total of 61,000 deaths occur annually worldwide due to rabies, of which 38.8% of the cases occurring in Africa (14). With a population of about 2-5 million dogs recorded in the 2006 census in Nigeria, an estimated 10,000 people are exposed to rabies infection via dog bite annually (15). It has been reported that there is an increasing number of dog bite cases in Nigeria (16), which is attributed to the high population of stray and domestic dogs; thereby, endangering the community (17). About 42% of dog bite victims in Nigeria are children (2). Children tend to underestimate the consequences of a dog bite on their life because they are careless and inexperienced than adults regarding interactions with dogs (18). They may also be at a higher risk due to limited understanding of the dog's body language and the expressions that usually lead to bite (19).

The implication of dog bite with physical injuries includes simple scratches, bruises, puncture, lacerations, crushing and tearing, which in most cases require reconstructive surgery (20), as well as facial damage, neurovascular injuries, musculoskeletal injuries and death (5,21,22). They also suffer from nightmares and posttraumatic stress syndrome, sequelae to a previous dog bites or attack (5,18). Local systemic wound infections were reported together with other complications associated with wound healing, such as keloid and hypertrophic scar formations. These complications are involved in short and long-term effects linked to dog bite injuries in humans (18,19). In addition, post-traumatic stress syndrome (PTSD) was reported to adversely affect the life of dog bite victim, including lack of interest in school, aggressiveness with peers, isolation, insomnia and nightmares (5). Besides physical injuries and psychological or emotional discomfort for children, there is a likelihood of contracting rabies infection and tetanus due to secondary bacterial invasion of *Clostridium tetani* via the victim's broken skin (23).

Various factors have been associated with the prevalence of dog bites among children. In overall, the most common risk factors for dog bite among children were gender more especially male, age (24), risk behaviours (25), knowledge on interaction with dogs (12) and environmental factors such as dog ownership (11,24,26). Children lack the experience and understanding of dogs' physical expressions; therefore, increasing their vulnerability to dog bites. These events, coupled with their weaker nature, make them sustain more serious injuries compared to adults. Hence, it has also been established that children less than 15-year-old are more susceptible to dog bite compared to adults (27). Despite the problems highlighted on dog bites among children in Nigeria, no study has been conducted on the prevalence of dog bites among children in Zamfara state. The objective of this study is to determine the prevalence of dog bites and their associated factors among Primary school children in Madawaki district Gusau, Nigeria.

MATERIALS AND METHODS

Study location and study duration

This study was conducted at primary schools in Madawaki district, which is under Gusau local government area of Zamfara state from north-western Nigeria. It has an area of 3,364km2 (1,299 sq. mi), covering a population of 528,400 inhabitants (28). It is located on the Latitude 120 10′ 12.86′′N and Longitude 60 39′ 50.83′′E. The predominant religion and ethnicity of the people in this area are Islam and Hausa respectively, with low socioeconomic status and the majority of them (53.2%) are male. There is no laws regulating dog ownership within the state, including Madawaki district and many of these dogs move freely without confinement while few are confined for security purposes or used as pets. The study duration was from September 2017 to January 2020.

Study design and subjects

A cross-sectional study design was conducted to determine the prevalence of dog bites and the associated factors among primary school children in Madawaki district of Gusau in Zamfara state. Also, the prevalence was investigated within a three-month study period. The minimum sample size was determined using a formula for two-group comparison (29). The minimum sample size before adjustment for eligibility and estimated response rate was 882. The calculated sample size for the study was 1,226 after all adjustments were made ($Z\alpha = 1.96$; $\alpha = 0.05$). Unequal stratified sampling was used in selecting the participants. The study participants were selected from seven (7) public primary schools in the Madawaki district of Gusau with 4200 students (study population). Four out of these seven schools were in urban locations (urban strata) while three were in semi-urban areas (semi-urban strata). Thereafter, participants were randomly selected from their primary school classes (4, 5, and 6), followed by selecting equal proportions according to the sample size. There were a total of 21 classes comprising 12 from urban schools and 9 from semi-urban schools. Given that the study population was 4,200 children and a sample size estimation of 1226, 59 children were required to be selected from each class.

Study instrument

A closed-ended and pretested questionnaire adopted from Seligsohn (30) was administered in this study. It was constructed in English language, validated and subsequently translated into Hausa language before it was administered to the study participants. This questionnaire contained six different sections (Section A to E). Section A was designed to collect data on respondents' socio-demographic characteristics and the items included age, gender, ethnicity, religion, number of siblings per household and their residential areas. Section B consist information regarding dog bites within the last three months. Respondents were asked to respond to questions presented with "yes'' or ''no'' options. Dog bite checklist was used to demonstrate the kind of injuries experienced by the respondents, such as abrasion, laceration, puncture, crushing and avulsion, and affected parts of the body (i.e., head/neck, chest/trunk, hands, legs and others). Furthermore, information was recorded on the location of dog bite events which comprises their homes, neighbour's homes, school and others. The last item in the section was whom the victim reported the bite (i.e., my parent, school teacher, friends and others).

In section C, children knowledge on interaction with dogs was evaluated using 23 items, including questions such as ''hitting dogs can lead to bite'' and dichotomous responses of either ''yes, ''no'' or ''not sure''. Each item was scored as 1, thereby amounting to a maximum score of 23 and a minimum score of zero. A high score

indicates better knowledge on interaction with dogs and otherwise if the score is low. Section D was designed to assess the knowledge on the implication of dog bites on the victim's health. The response was the same as presented in Section C. On the other hand, information on dog ownership was collected in Section D by asking the participant if either they owned a dog in their homes, neighbour's home or living in the same area with free-roaming dogs. Participants were instructed to select one out of the available options; ''yes'' ''no'' and ''I don't know''. Section F was designed to evaluate the risk behaviours, which was further divided into three segments. The first segment had 14 items, comprising behaviours displayed by children when they come across dogs. The second segment had 9 items describing children's reactions when dogs run after them, whereas the third segment also had 9 items describing the behaviours of children when dogs are barking at them. This section has a 5-point Likert scale ranging from 1 = never to 5 = always. The maximum score obtainable in the section was 118 while the minimum score was zero. Participants having higher scores were regarded to express higher risk behaviours. Such behaviours involved chasing a dog away, throwing a stone at the dog, kicking a nearby dog as well as screaming or shouting among others.

Data collection

The data was collected between November 2018 and May 2019. The inclusion criteria entailed respondents aged between 11 and 13 years old and being a student from one of the seven public primary schools in the study area. All students that were absent from school on the day scheduled for the study were excluded. Parents and children were briefed about the study and written consent was obtained prior to commencement. Three teachers from each participating school were trained to guide the participant to fill the translated questionnaire (Hausa language version). It took an average of 20 minutes for respondents to complete the questionnaire.

Data analysis

Data were descriptively analysed and presented as frequency and percentage for categorical variables. Data were checked for normality using the level of skewness and kurtosis. Normally distributed data were presented in mean and standard deviation. Chi-square test statistic was applied to identify the association between dog bites and categorical variables such as gender and dog ownership, whereas simple logistic regression was conducted for the association of dog bite with numerical data such as knowledge and risk behaviours. To determine the predictors for dog bites among primary school children, multiple logistic regression analysis was performed. A p-value of less than 0.05 was considered statistically significant while adjusted odds ratio (AOR) and parameter estimates were presented at a 95% confidence interval.

Ethical approval

This study was approved by the ethics committee for research involving human subjects (JKEUPM), Universiti Putra Malaysia, No. JKEUPM-2018-286. The respondents were briefed about the study and their participation was voluntary. Parents of the selected respondents agreed and signed the guardian/parent's consent form before the inception of the study. In addition, the Ministry of Education issued permission to conduct the study through the Zamfara State Universal Basic Education Board (ZUBEC) at their Local Government Education Authority office in Gusau. Participants were assured that all information provided would be kept in strict confidentiality.

RESULTS

Characteristics of respondents

The overall prevalence of dog bites was 54.5% while prevalence among male and female respondents was 63% and 45%, respectively. The sociodemographic characteristics (gender, age, ethnicity, religion, number of siblings per household and residential area), dog ownership, the total score for knowledge on interaction with dogs, implication of dog bite to health and risk behaviours of children that lead to dog bite are shown in Table I. A total of 999 respondents from seven public primary schools in Madawaki district of Gusau were recruited.

The respondents' gender distribution showed that 53.2% (531) and 46.8% (468) were males and females, respectively. A higher proportion of the respondents 66.0% (659) were less than or equal to 12 years old, whereas 340 (34.0%) were greater than 12 years old. However, the mean age of all the respondents was 11.9 (SD = 0.83). More than half of the respondents 51.3% (512) live in urban areas, 19.0% (190) were from semi-urban while 27.5% (275) were from rural areas. Only 22 respondents (2.2%) were not sure of their residential areas. The majority of the respondents (83.2%) belong to Hausa ethnic group, 9.4% (94) were Yoruba while the other ethnicities were less than 2% of the total study population. A higher proportion of respondents 76.2% (762) had less than 10 siblings per household and the mean household number of siblings of all respondents was 6.8 (SD = 4.0). Most of the respondents were of Islamic faith 98.0% (984) while Christians accounted for 2.0% (15) of the studied population.

The median (interquartile range) for total scores of knowledge on interaction with dogs, on the implication of dog bite to health and total score for risk behaviours of children, was 6.0 (7.0), 1.0 (2.0) and 95.0 (12.0), respectively. Dog ownership among respondents indicated that 34.2% (342) of them were from families who owned dogs, whereas 65.8% (658) did not own dogs. In addition, more than half 56.2% (562) of the

Table I: Characteristics of the respondents (n=999)

Characteristics	Frequency	Percentage	Median (IQR)
Gender			
Male	531	53.2	
Female	468	46.8	
Age			
≤ 12 years	659	66.0	
> 12 years	340	34.0	
Ethnicity			
Hausa	831	83.2	
Yoruba	94	9.4	
Igbo	15	1.5	
Nupe	18	1.8	
Zabarmawa	13	1.3	
Kambari	16	1.6	
Igala	12	1.2	
Religion			
Islam	984	98.5	
Christian	15	1.5	
Number of siblings per household per household			
Less than 10	761	76.2	
More than 10	238	23.8	
Residential area			
Urban	512	51.3	
Semi- urban	190	19.0	
Rural	275	27.5	
Not sure	22	2.2	
Total score for Knowledge on interaction with dog			6.0 (7.0)
Total score for Knowledge on implication of dog bite to health			1.0 (2.0)
Total score for risk behaviours of children that can leads to bite from dog			95.0 (12.0)
Dog ownership by respondent's family			
Yes	341	34.1	
No	658	65.9	
Dog ownership by respondent's neighbours			
Yes	561	56.2	
No	438	43.8	

respondents affirmed that their neighbours owned dogs. While respondents whose neighbours didn't own dog were 438(43.8%).

Associated factors of dog bite

There was a significant association between gender (χ^2 32.99, df = 1, p = 0.001), dog ownership by family (χ^2 = 4.208, df = 1, p = 0.04) and dog ownership by neighbours (χ^2 = 19.499, df = 1, p = 0.001) with dog bite as shown in Table II. However, other sociodemographic characteristics of the respondents were not associated with the prevalence of dog bite.

Table II: Association of socio-demographic characteristics, dog ownership and dog bite among respondents

Variables	Dog Bite		χ^2	*df*	*p*-value
	Yes n (%)	No n (%)			
Gender			32.599	1	0.001
Male	334 (62.9%)	197 (37.1%)			
Female	210 (44.9%)	258 (55.1%)			
Ethnicity			1.851	2	0.396
Hausa	459 (55.2%)	372 (44.8%)			
Yoruba	45 (47.9%)	49 (52.1%)			
Others	40 (54.1%)	34 (45.9%)			
Religion			2.739	1	0.098
Islam	539 (54.8%)	445 (45.2%)			
Christian	5 (33.3%)	10(66.7%)			
Residential area			1.830	3	0.608
Urban	282 (55.1%)	230 (44.9%)			
Semi-urban	108 (56.8%)	82 (43.2%)			
Rural	141 (51.3%)	134 (48.7%)			
Not sure	13 (59.1%)	9 (40.9%)			
Age			3.451	1	0.037
≤ 12 years	345 (52.4%)	314 (47.6%)			
> 12 years	199 (58.5%)	141 (41.5%)			
Number of siblings			1.964	1	0.161
Less than 10	405 (53.2%)	356 (46.8%)			
More than 10	139 (58.4%)	99 (41.6%)			
Dog ownership by family			4.208	1	0.04
No	343 (52.1%)	315 (47.5%)			
Yes	201 (58.9%)	140 (41.1%)			
Dog ownership by neighbours			19.499	1	0.001
No	273 (62.3%)	165 (37.7%)			
Yes	271 (48.3%)	290 (51.7%)			

(*): *p-value* < 0.05, χ^2 = Chi- square statistics, *df* = degree of freedom

Association of knowledge and risk behaviours with dog bites

Respondents' Knowledge of the interaction with dogs and risk behaviours were significantly associated with dog bites (Table III). In contrast, respondents' knowledge of the implication of a dog bite to health was not associated with the prevalence of dog bites.

Table III: Association between knowledge, behaviours and dog bite among respondents

Variables	Crude OR (95% Cl)	*p* - value
Total score for knowledge on interaction with dog	0.893 (0.869, 0.919)	0.001
Total score for knowledge on implication of dog bite to health	1.049 (0.960, 1.147)	0.287
Total score for risk behaviours of children	1.030 (1.015, 1.044)	0.001

(*): *p-value* < 0.05, OR = odds ratio, Cl = confidence interval

Associated factors of dog bite

The predictors of dog bite among respondents were gender (males), dog ownership by the family, dog ownership by neighbours, and total score for knowledge on interaction with dogs. Specifically, male respondents were more likely (AOR = 2.252; Cl = 1.719, 2.949) to experience dog bites compared to females. Respondents whose families own a dog were more likely (AOR = 1.456; Cl = 1.089, 1.946) to record a dog bite event compared to those whose families do not own dogs. There were higher odds of experiencing dog bites among respondents whose neighbours did not own a dog (AOR= 1.752; Cl = 1.334, 2.303) compared to those whose neighbours owned a dog. Furthermore, the odds of dog bite events were lower (AOR= 0.884; Cl = 0.858, 0.911) among respondents who had a higher total score for knowledge on interaction with dogs. However, the total score for risk behaviours of children (AOR= 1.020; Cl = 1.004, 1.035) indicated that the higher the score, the higher the risk of experiencing a dog bite among the respondent (Table IV).

Table IV: Factors of dog bite among respondents

Variable	Crude OR (95%Cl)	Adjusted OR (95%Cl)	*p*-value
Gender			
Female	1.00		
Male	2.083 (1.617, 2.684)	2.252 (1.719, 2.949)	0.001
Dog ownership by Family			
No	1.00		
Yes	1.319 (1.012, 1.718	1.456(1.089, 1.946)	0.011
Dog ownership by Neighbours			
Yes	1.00		
No	1.771(1.373, 2.284)	1.752 (1.334, 2.303)	0.001
Total score for knowledge on interaction with dog	0.893(0.869, 0.919)	0.884(0.858, 0.911)	0.001
Total score for risk behaviours of children that can leads to dog bite	1.030(1.015, 1.044)	1.020(1.004, 1.035)	0.012

(*): *p-value* is significance at p < 0.05, OR= odds ratio, Cl = confidence interval

DISCUSSION

This study investigated 999 primary school children and the prevalence of dog bites was 54.5%. The result is in agreement with findings from the other related studies conducted in Nigeria, in which the prevalence of dog bites among children ranged from 50.6% to 55.7%, respectively (3,31). However, the prevalence is lower compared to 85.9% reported by Ishaya and his colleagues in Plateau state (32), higher than 0.44% (33) and 0.89% (2) in Abia and Ekiti states, respectively. These differences in the prevalence of dog bites could be attributed to variations in the lifestyle and practices relating to dog handling, dog ownership and knowledge about the interaction with dogs. These studies were also conducted in different geographical locations with varying population of dogs and number of people that keep dogs for different purposes. The higher prevalence of dog bites among respondents in this study may be due to poor knowledge on interaction with dogs, high-risk behaviours of children within the study area (Madawaki district), gender (male) and coupled with the common culture of leaving children to play around dogs without proper supervision. It could be a consequence of poor control of free-roaming dogs or irresponsible dog ownership (31). Studies conducted in other countries have also demonstrated that the prevalence of dog bites among children could vary with geographical locations (10).

Comparisons between the present result and studies conducted in other countries highlight the variations in the prevalence of dog bites among children. For instance, lower prevalences were reported in Austria (0.31%) (23), Belgium (0.24%) (25), South Africa (1.5%) (5) and in Trinidad (28.1%) (30). Male children had higher odds of reporting a dog bite compared to female children in this study. This finding is consistent with other studies reporting higher risks of dog bites among males than females in Nigeria (2,17) and elsewhere (30,32,34,35). A study conducted in the USA reported that males experienced dog bites more than females across all age groups (10). In this study, most respondents were from Islamic background, as well as cultural belief that advocates for females to remain indoors, whereas male children are more allowed to roam about (3). Such a lifestyle increases the exposure of male children to dogs in the environment and may contribute to higher risks of dog bites (3).

Moreover, studies have shown that male children have preponderances to dog bite compared to female children (23,36). Another factor associated with the prevalence of dog bites in this study was dog ownership. Respondents whose families owned dogs had higher odds of reporting dog bites than those without such animals in their homes. This is in agreement with studies conducted in different geographic locations (10,24,37). However, it is lower

compared to the study conducted by Westgarth and his colleagues (38). This finding shows that respondents whose families owned dogs had a higher risk of a dog bite. This might be due to frequent exposure to dogs and respondents' poor knowledge about the animal's behaviours. Likewise, these events were supported by a study reporting that children who owned dogs in their households manifest more risk behaviours when in contact with dogs compared to those lacking such animals in their homes (37). This study also suggests that children whose families owned dogs do not care on when the animal should be approached for any form of engagement, thereby, resulting to bite in most cases.
This study predicted that respondents whose neighbours did not own a dog had higher odds of reporting dog bites. However, it is in contrast to the reported findings in Korea where respondents whose neighbours owned dogs had higher odds of dog bites (39). In this study, respondents whose neighbours did not own a dog may have a higher risk of dog bite probably due to fear or anxiety they might have demonstrated when coming a across dog, which eventually results in a bite. It could be a consequence of their urge in engaging dogs irrespective of the communicative signals usually displayed by dogs when avoiding an interaction. Therefore, it indicated that the dog bites recorded in this study involved more community dogs among respondents whose families either owned or did not own a dog.

Knowledge of interaction with dogs was also associated with the prevalence of dog bites in this study. Respondents with poor knowledge of interaction with dogs had a higher risk to report a dog bite. This is in agreement with a study conducted by Dixon in the USA (40). Other research findings have supported this study by demonstrating a higher risk of recording dog bites among school children due to their poor knowledge on how to properly interact with dogs (41). Likewise, the finding corroborates the outcome of a study, which revealed that good knowledge reduces the risk of dog bites among children (42). It is also in agreement with a published report from Philadelphia that showed pain eliciting interaction, such as stepping or falling on a dog could elicit dog bites among children (43).

This study demonstrated that poor knowledge on how to interact with dogs leads to unsafe interaction with the animal and misunderstanding their communicative signals, which if undermined may culminate into a bite (44). Higher risks of dog bites due to poor knowledge as shown in this study could be due to respondents' confidence while engaging dogs despite having poor knowledge of the animal's body language or communicative signals. Risk behaviours of children were found to be associated with the prevalence of dog bites among respondents in this study. Specifically, every unit increase in the score of risk behaviours of children was associated with an increased risk of experiencing a dog bite. This means that the higher the risk behaviour score, the higher the risk for dog bites among the respondents. It is in agreement with several risk behaviours of children reported by a study from the Czech Republic, which includes playing with a dog, stroking a dog and attempting to take away a toy from dogs (35). It also corroborates the findings from previous studies (24,30).
This study predicted that children that showed high risk behaviours while around dogs had higher odds of reporting dog bite compared to those with low-risk behaviours. These findings are consistent with the studies conducted in USA and Philadelphia (12,43). Additionally, this study was also supported by research findings describing risk behaviours such as coming close to the dog's face, gazing between human and dog without hitting and stepping or petting the dog (45). High-risk behaviours for dog bites among children could be the result of children natural behaviours when engaging dogs that are either familiar or not familiar with them, without considering the negative effects of such engagement.

CONCLUSION

This study found that the predictors of higher prevalence of dog bites among primary school children were poor knowledge on interaction with dogs, children's risk behaviours around dogs, dog ownership and being a male child. Hence, these factors should be considered when developing and implementing awareness campaigns in schools to reduce the prevalence of dog bites among primary school children.

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