## **Original Research Article**

DOI: http://dx.doi.org/10.18203/2394-6040.ijcmph20175311

## Risk factors for dog bites in Moiben Sub-county, Uasin Gishu county, Kenya

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Received: 25 July 2017 Revised: 26 October 2017 Accepted: 27 October 2017

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#### **ABSTRACT**

**Background:** Rabies virus still causes human and animal deaths around the world. Human rabies is transmitted by an infected canine. If rabies-infected person is not treated within 48 hours, the virus could move to the central nervous system and cause irreversible cell damage that could be fatal. The aim of this study was to establish risk factors for dog bites in Moiben Sub-county, and whether there is a significant association between dog bite frequency and those risk factors.

**Methods:** A total of 339 respondents were selected from a total of 1152 households using multistage sampling, simple random sampling and systematic sampling methods. The head of the household responded to interviewer-administered questionnaires. Data was analyzed using SPSS version 22 of 2013. Associations were tested using chi square test and any associations reported at critical p-value of 0.05 and 95% confidence interval.

**Results:** This Study found more children <15 years bitten by dogs (351/643, 54.6%,  $X^2$ =26.3, p<0.01) than any other age bracket. There were significantly more males bitten compared with female victims (334/643, 51.9%,  $X^2$ =10.3, p=0.03). Strangers were bitten in larger numbers than family members (512/643, 79.6%,  $X^2$ = 7.11, p=0.03). The unconfined dogs bit people than the partially confined dogs (487/643, 75.7%,  $X^2$ =12.9, p=0.01). Most people were bitten during the wet season than in dry season (437/643, 67%,  $X^2$ =18.8, p=0.01).

**Conclusions:** The risk factors with significant association in dog bites in Moiben Sub-coounty were age and sex of the residents, dog confinement and seasons of the year. We recommend that the County government of Uasin Gishu controls the movement of dogs by enforcing the existing confinement policy and movement permits made mandatory for anyone intending to move a dog from one place to another. Free educational vaccination campaigns should be provided in order to attain 75% dog vaccination coverage.

**Keywords:** Dog confinement, Risk factors, Rabies, Human rabies, Moiben sub-county

## INTRODUCTION

Human rabies is spread by infected saliva that enters the body through a bite or broken skin inflicted by a rabid animal including dogs. After inoculation, the virus enters small nerve endings at the site of the bite and travel up the nerve to reach central nervous system (CNS) where it causes swelling or inflammation leading to the symptoms

of the disease.<sup>1</sup> Other secretions such as milk, tears and urine may contain the virus but transmission across mucous membrane or via pre-existing cuts are unusual. Rabies virus transmission has also been recorded through inhalation (bat excreta in caves, brain aerosol in laboratory accidents).<sup>2</sup> Human to human transmission is virtually unknown, though transmission through organs transplant from donor to recipients has been documented.<sup>3</sup>

Incubation period depends on the length of nerve and depth of the bite. It may last from two weeks to six months or years. Apart from severity of the bite, which determines the risk of infections, other factors that affect the rabies exposure include the size of the viral inoculums, the route and location of exposure as well as individual host factors such as age and host immune defense. 5.6

Incubation periods are shortest after bites on the head and they are longer when the distance between the bite and the brain is great. The earliest signs (prodromal stage) are non-specific and last for few days. Then fever, malaise and headache follow. Pain or paraethesia at the original bite (well healed wound by then) is strongly suggestive of rabies. Neurological symptoms follow a generalized muscular activity which frequently ends with patient in opisthotonus. This is followed by hydrophobia.<sup>3</sup> These symptoms are shown during the furious forms of rabies where the animal is very excited, bite vigorously and viciously at anything i.e., sticks stones, grasses, other animals and humans without provocation. In dump form (paralytic form) of rabies, the patient may appear sick, retreats steadily and quietly goes downhill with some paralyses followed by death. Other signs in cats are pupil dilation, dropped jaw, seizures, fly biting and scratching. In dogs, signs include change in the tone of barking, dropping of the lower jaw, and viciously attacking any moving object. In cattle, the signs seen are abnormal bellowing, ataxia, abrupt cessation of lactation and bloating. In human, signs and symptoms include experience of delirium, abnormal hallucinations, insomnia, anxiety, confusion, agitation, nausea and vomiting among others.8

### **METHODS**

This study was designed as a cross sectional study whose purpose was to uncover the risk factors for dog bites in individuals within rural areas of Moiben Sub-county. The study was conducted between the month of January and March 2014. A total of 339 respondents were selected from a total of 1152 households using multistage sampling, simple random sampling and systematic sampling methods respectively. The head of the household or a representative was picked to complete the interviewer-administered questionnaire. The exclusion criteria were enforced at all times so that those below 20 years of age or above 80 years of age did not participate in the study. Whenever the household head was not present, a representative from the household was picked to participate in the study

The questionnaires and data were coded and entered into statistical package for social scientists SPSS version 22 of 2013 for analysis. They were summarized and laid out in terms of frequencies, cross tabulation and percentages. Significance of the relationship between variables was determined by use of chi-square test  $(X^2)$  of independence

and the critical p-values were determined at 5% and 95% confidence intervals.

#### RESULTS

## Risk factors of dog bites

The responses for the variables: dog bites, sex, age, Relationship of dog/victims, confinement and seasons were tested using chi-square to establish if there were any associations. The cross tabulations of the variables and their respective Chi-square statistics are shown in the Table 1.

### Distribution of dog bites based on gender and age

There were more dog bite cases among males (334/643, 51.9%) than in females (309/643, 48.1%,  $X^2$ =10.3, p<0.03) (Table 1). The proportion of bitten respondents within the various age categories was also different with approximately 54.6% bite cases reported among people less than 15 years old, followed by 16-30 years at 18.2%, 31–45 years at 15.1% and more than 46 years at 12.1%. The incidence of dog bites was therefore significantly higher amongst individuals less than 15 years of age ( $X^2$ =26.3, p<0.01). In addition, there were higher dog bites among males than females across all age groups ( $X^2$ =10.3, p<0.05). As expected, it was also found that strangers (visitors) were significantly more vulnerable to dog bites (512/643, 79.6%,  $X^2$ =7.11, p=0.03) than members of the family (20.4%) where the dog belonged.

## Dog confinement

A total of 643 people were bitten by 247 dogs (Table 2). Therefore, on average one dog bit 2.6 people in Moiben Sub-county in a period of one year preceding this study. The proportion of stray dogs was 73.0% (486/666) of the dog population. Twenty seven percent (180/666) were partially confined either by chaining or housing during the day and released at night. One confined dog bit an average of three people (156 victims bitten by 46 partially confined dogs). Among the dogs that had bitten an individual, only 18.6% (46/247) were from among those confined. The confined dogs mainly bit at night when they were set free to guard the family. Of the confined dogs, 26% (46/180) had bitten an individual as compared to 41% (201/486) of the unconfined ones. There was a significant relationship between dog bite and confinement ( $X^2=12.9$ , p=0.01).

## Seasonal distribution of bites

Dog bite incidents were reported throughout the year with more bite incidents during the wet months (March–Sept) (437/643, 67.9%) of the year compared to dry months (October–February) (206/643, 32.1%) of same year. There was therefore a significant difference in the proportions of bite incidents between the two seasons ( $\chi^2$ =18.88; p<0.01).

Table 1: The frequency of dog bites and association with risk factors.

Factors	Variables (victims)	Bites			
		Yes (%)	No	Total	
Sex	Male	334 (51.9)	596	930	$X^2 = 10.3$
	Female	309 (48.1)	795	1104	p=0.03
Age	<15 years	351 (54.6)	601	952	
	16-30 years	117 (18.2)	312	429	V2 26 2
	31-45 years	97 (15.1)	304	401	$X^2 = 26.3$ = p=0.01
	>46 years	78 (12.1)	174	252	p=0.01
		643	1391	2034	
Relationship with biting dog	Family members	131 (20.4)	301	432	V2 7 1 1
	Stranger	512 (79.6)	1090	1602	$X^2 = 7.11$ p=0.03
	Total	643	1391	2034	p=0.03
Dog confinement	Partially confined	156 (24.3)		2034	X <sup>2</sup> =12.9 p=0.01
	Stray	487 (75.7)	1391		
	Total	643			
Season	Wet	437 (67.9)		2034	X <sup>2</sup> =18.8 p=0.01
	Dry	206 (32.1)	1391		
		643			

Table 2: The association between the dog bites and dog confinements.

Dog that had Bitten								
		Yes	No	Total				
Confinement	Partially	46	134	180	$X^2 = 12.9$ ,			
	Stray	201	285	486	p=0.01			
Total		247	419	666				

## **DISCUSSION**

## The risk factors for dog bites among residents

This study found that the risk factors for dog bites include the age and gender of individuals. Similarly, dog confinement and season of the year were found to be risk factors and similar findings were documented by Nanyingi et al.9 The current study revealed that, there were 666 dogs in 339 households in Moiben Sub-county with majority (48.7% 165/339) of the households keeping two dogs. Therefore on average there were 2 dogs per household (666/339). This proportion was higher compared with similar research study done by Kitala et al in Machakos County. 10 Other studies that have found lower proportions of dogs per household were conducted in Turkey and Thailand.  $^{11,12}$  A study done in Kisumu County Kenya, however, had higher a proportion of people owning dogs compared to the current findings in Moiben Sub-county. 13 In our study it was also established that the dog to human ratio was 1:3 (666:2034). This was higher when compared to 1:4.6 ratio documented by Kongkaew et al. 12 The higher the dog to human ratio the higher the risk posed by the increasing stray dogs as demonstrated by X<sup>2</sup> value of 14.1 and the significance level of calculated p value of 0.01.

The WHO has indicated that 98% of human rabies occurs in regions with large number of stray dogs. <sup>14</sup> To control the stray dogs and overall dog population it is documented that China introduced in the city of Beijing the 'one-dog policy'. <sup>15</sup> This, in our view could be helpful in containing the transmission of rabies.

## Relationship between dog confinement and dog bites distribution

Although majority of Moiben sub-county residents kept dogs, only a small proportion (27%) of dogs were partially confined. Majority of the dogs in Moiben Subcounty were left to stray (73%) and hence exposed the residents to the risk of being bitten. Similar observations were made by Tenzin et al who noted that presence of a high density of stray dogs was a risk factor for the transmission of human rabies. 16 Our current study shows that, majority of the victims (75.7%) were bitten by stray dogs; this was in agreement with a study done in Kisumu County where 71% of the victims were bitten by stray dogs<sup>13</sup>. There was strong association between dog bites and dog confinement ( $X^2 = 14.1 p = 0.01$ ). Similar findings were reported by Kongkaew et al. 12 The increase in the number (73.0%) of stray dog in our study area, was also found to increase the potential risk for exposure to human rabies infection; this is supported by WHO guidelines for rabies control.<sup>17</sup> It has been documented that India has

one of the highest prevalence of human rabies in the world primarily because of the high number of unconfined dogs. <sup>18</sup> Studies have also observed that, in traditional Africa, that is, most of sub-Saharan Africa, the issue of roaming dogs seem not to be one of a lack of ownership, but rather an inability or unwillingness by owners to confine their dogs. <sup>17,19</sup>

In the current study majority of the respondents interviewed stated that they confined their dogs to prevent them from roaming, biting people and in essence reduce dangers of their dogs being bitten by stray dogs and wild animals, which could infect them with rabies virus. These findings were in agreement with past research by Agarwal et al who demonstrated that dogs were the main hosts for and therefore responsible for human rabies deaths worldwide.<sup>20</sup> It has further been reported that elimination of stray dogs by baits, health education through the press and legislation were the most effective ways of reducing infection and transmission of human rabies.<sup>16,20</sup>

# Relationship between dog bite frequency and age and sex of victim

The hosts (victims) risk factors for dog bites were age and sex, with association of  $\gamma^2$  at 44.3, p=0.05 and 27.3, p=0.05 respectively. On age, young children less than 15 years were the main victims (55%). It has been shown that within this age bracket, children were fond of playing with dogs and were too young to understand the risks posed by dogs.<sup>21</sup> Tenzin et al found that increased dog bite incidents in children is considered a behavioral risk because of their extreme curiosity, lack of inhibition, limited knowledge and experience about dog behavior, and inability to protect themselves from an attack.16 Earlier findings as contained in the WHO's report revealed that majority of dog bite cases among children were not reported.<sup>22</sup> It has been found that majority of these cases are not treated because they are not reported to parents or health officials. The report adds that, lack of awareness, and high costs of post-exposure treatment were some of the causes that prevent people from seeking treatment.<sup>22</sup>

Our current findings further revealed that dog bite injuries were more common in males than in females, and these findings were consistent those reported elsewhere. There are other researchers who have also shown that children and males have higher probability of sustaining dog bites due to their closeness to dogs. 14,23

# Relationship between seasons and distribution of dog bites

Environments also play some part in enhancing the probability of dog bites. Environmental risk factors include time, season and individuals occupations. Our study showed that, dog bite incidents occurred throughout the year with increased cases during the wet months

(March–August). Such observations were attributed to high frequency of straying dogs in search for food because at this time households have hardly enough for the family hence no food is left for dogs and at same the time it's a mating (breeding) season. These findings contradicted those by Kongkaew et al, where they documented that higher incidence of dog bites and rabies infection occur in the summer seasons in Thailand and warmer weather in the US. But similar findings were reported in Bhutan where winter season (September–November) had a higher proportion of dog bite incidents (22%) compared to summer where the incidents were lowest (10%) during months of June–August. In the straying dogs in search for food because the same that same the time incidents were lowest (10%) during months of June–August.

#### **CONCLUSION**

The risk factors that included age of people, sex of people, dog confinement, and season were significantly associated with dog bites at ( $\chi^2$ =26.3, p<0.01), ( $\chi^2$ =10.3, p<0.03), ( $\chi^2$ =14.1, p<0.01) and ( $\chi^2$ =18.88; p<0.01) respectively.

#### Recommendations

The authors recommend that the Government should control the movement of dogs and movement permits should be mandatory for anyone intending to move a dog from one place to another. It should also provide free educational vaccination campaigns in order to attain the WHO-recommended 75% dog vaccination coverage.

### Declaration

The authors declare that this work is their original work that has not been published or submitted elsewhere for publication. This work was funded by the authors' own contributions and there is no conflict of interest of any form.

Funding: No funding sources Conflict of interest: None declared

Ethical approval: The study was approved by the

Institutional Ethics Committee

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Cite this article as: Tuwei PK, Kariuki SM. Risk factors for dog bites in Moiben Sub-county, Uasin Gishu county, Kenya. Int J Community Med Public Health 2017;4:4401-5.