

# Risk of human exposure to animal bites in China: a clinic-based cross-sectional study

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**Human exposure to animal bites is the most important public health concern in relation to rabies transmission. This study aims to determine the factors associated with human exposure to animal bites in China. A cross-sectional study of visitors to rabies prevention clinics who were seeking treatment because of exposure to animal bites or scratches was conducted in Wuhan, China. Humans exposed to animal bites ( $n = 1015$ ) were interviewed, and 87% of the bites were attributed to domestic animals. The risk types for animal bites included unprovoked aggression (31.7%), excessive play (27.5%), insufficient preparedness (26.7%), and improper care of animals (14.1%). Children aged 1–15 years (OR = 9.069, 95% CI: 4.572–17.987,  $P < 0.001$ ) were more likely to be injured because of excessive play. Nonvaccinated people (OR = 2.168, 95% CI: 1.034–4.545,  $P = 0.040$ ) and people who discontinued the rabies vaccine regimen (OR = 2.600, 95% CI: 1.561–4.331,  $P < 0.001$ ) were at risk of rabies exposure and were more likely to be injured because of improper care of animals. This study showed that domestic animals were responsible for most animal bites. The associated factors were age, educational attainment, and animal ownership. Community health education with a special attention to schoolchildren and animal owners should be provided.**

**Keywords:** human exposure; animal bites; associated factors; wound infection; rabies

## Introduction

Animal bites have the potential to cause infections,<sup>1</sup> sepsis,<sup>2</sup> rabies,<sup>3</sup> and mortality.<sup>4</sup> Animal bites and bite-associated diseases are recognized to be serious health and economic problems all over the world.<sup>4</sup> The prevalence of animal bites was determined as 2.82 cases per 1000 people in Iran<sup>5</sup> and 1.55 per 1000 residents in Canada.<sup>6</sup> Children below 15 years of age were at greater risk for animal bites, with a reported incidence rate of 32.98% in India.<sup>7</sup> Epidemiological data indicated that 19 million humans were bitten by animals in Southeast Asia every year.<sup>8</sup> Animal bites accounted for 1% of all emergency

department visits and more than \$50 million in health care costs yearly in the United States.<sup>9</sup> The prevalence and high cost associated with animal bites make prevention of these injuries a priority in endemic countries. Understanding and mitigating the risk of exposure to animal bites provides an opportunity to reduce the health impairment and catastrophic health expenditure associated with this exposure.<sup>10</sup>

Both stray and domestic animals have the potential to bite humans. Exposure can occur under provoked and unprovoked conditions.<sup>11,12</sup> Earlier studies on the epidemiology of animal bites in India,<sup>13</sup> Iran,<sup>14</sup> Ethiopia,<sup>11</sup> Pakistan,<sup>15</sup> Bhutan,<sup>16</sup> and Spain<sup>17</sup> reported that stray animals caused the overwhelming majority of animal bites. Several recent studies

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in India,<sup>18</sup> Sri Lanka,<sup>19</sup> and Nigeria<sup>20</sup> indicated that domestic animals were responsible for most exposures. Some studies reported that animal bites were mainly provoked,<sup>7,21</sup> while other studies indicated that most animal bites were unprovoked.<sup>13,20,22</sup>

The exposure-to-risk situations refers to the conditions that pose a risk of animal bites or the potential risk types under which the victims were bitten or scratched. China is an endemic country for animal bites. According to the statistics provided by the Ministry of Public Health of China in 2009, it was estimated that more than 40 million people were bitten or scratched annually in China. The high prevalence of animal bites in China makes an animal bite study an essential health priority. However, no prior studies have attempted to investigate the risk factors for animal bites in China. Previous studies in China were mainly on the rabies epidemic,<sup>23,24</sup> and these studies ascertained the risk factors for human rabies using retrospective data, with the inherent limitations of such methods, such as insufficient data regarding the risk factors for animal bites.

The present study focused on the risk types and associated factors under which the victims were bitten. To our knowledge, this is the first study to identify the potential risk types and associated factors for animal bites in this study area. The findings of the current investigation may help in developing and implementing practical and effective strategies to prevent animal bites.

## Materials and methods

### Study site

The present study was conducted between March and May 2016 in the city of Wuhan, the capital of China's central Hubei province. Wuhan is one of the five largest pet-owning cities in China, with more than 130,000 domestic animals, most of which are dogs.<sup>25</sup> It was reported that dogs injured more than 60,000 people yearly in the city, according to the statistical report from the Wuhan Centers for Disease Prevention and Control.

### Data collection

The investigation was organized and coordinated by Huazhong University of Science and Technology and the Wuhan Association of Community Health. Huazhong University of Science and Technology provided training to the investigators (undergraduates and the primary medical staff from anti-rabies

clinics) who conducted the survey on animal bite victims and were consulting for the rabies prevention clinics (RPCs). The senior investigators (graduate students) checked the collected questionnaires daily to perform quality control. Data were entered double-blindly into the database by two different researchers using Epidata 3.0 to guarantee accuracy.

### Measurement variables

The dependent variables were exposure-to-risk situations for animal bites. There is no standard classification of such exposure-to-risk situations. Alabi *et al.*<sup>20</sup> and Patle and Khakse<sup>7</sup> classified the cause of animal bites as provoked and unprovoked. Risk types were specifically classified in this study as unprovoked aggression, excessive play with animals, insufficient preparedness to handle animals, and improper care of animals. Unprovoked aggression refers to gratuitous hostility, motiveless antagonism, and violent behavior, which means that if someone makes an unprovoked attack, they attack someone who has not tried to harm them in any way. Excessive play with animals is defined as undue play, which means that someone plays with animals too much, such as people sharing their food with animals and making contact with animals. Insufficient preparedness means people do not take protective measures or adequate precautions when in contact with animals, including physical and mental readiness, awareness, and watchfulness. Those people fail to pay close attention to animals. Improper care of animals refers to inappropriate attention and unsuitable and inopportune behaviors toward animals, for example, the owner tries to remove food while an animal is eating, or disturbs animals caring for their babies, or teases the animals.

### Key predictors

**Potential covariates.** Demographic variables included age (1 = "1–15 years old," 2 = "16–30 years old," 3 = "31–45 years old," 4 = "46–60 years old," and 5 = "61 years old and above"), gender, and education (0 = "senior school and below" and 1 = "university and above"). The habit of playing with animals (0 = "yes/always" and 1 = "no/occasionally" or "never") was obtained through self-report.

**Animal injury history.** Participants were asked to identify the type of biting animals. Responses were categorized as: 1 = "domestic animals possessed by

other people,” 2 = “own domestic animals,” and 3 = “stray animals.”

**Knowledge of rabies.** Questions regarding knowledge of rabies included: the source of rabies virus transmission, whether rabies is preventable, would they take the rabies vaccine on schedule, and would they learn knowledge of rabies. Responses were coded as: 0 = “no/wrong answer” or “don’t know” and 1 = “yes/right answer.”

### Statistical analysis

Four regression analyses were performed in our research, and in each logistic regression model, one of the variables, that is “unprovoked aggression,” “excessive play with animals,” “insufficient preparedness to handle animals,” or “improper care of animals,” was considered as the outcome variable to analyze the associated factors of the corresponding risk type. The association between risk types and associated factors was tested using logistic regression. The risk types for animal bites are unordered multicategorical variables, including “unprovoked aggression,” “excessive play with animals,” “insufficient preparedness to handle animals,” and “improper care of animals.” In the analysis, the dichotomies were set as: 1 = yes and 0 = no. The interviewed bite victims’ responses were recorded as four binary variables under which condition they were bitten or scratched. Logistic regression was conducted for each binary variable separately. Each of the four corresponding risk types was coded as follows: 1 = presence of the risk type and 0 = absence of the risk type. Demographic variables, animal injury history, biting animals, and knowledge and attitude toward rabies that were significantly correlated with the risk type were the independent variables.

Data were analyzed to identify the ratios for each item. SPSS® V21.0 (IBM Corp, Armonk, NY) was used for all analyses. For all comparisons, differences were tested with two-tailed tests and *P* values less than 0.05 were considered statistically significant.

### Ethics statement

The present study was approved by the Research Ethics Committee of Tongji Medical College of Huazhong University of Science and Technology. All participants read the objectives statement of the investigation and signed informed consent forms.

**Table 1. The characteristics of participants and biting animals**

Characteristic	<i>n</i>	%
Gender		
Female	564	55.6
Male	450	44.4
Age		
1–15 years old	168	16.6
16–30 years old	365	36.1
31–45 years old	176	17.4
46–60 years old	196	19.1
61–88 years old	110	10.8
Educational attainment		
Senior school and below	551	54.3
University and above	464	45.7
Habit of playing with animals		
Yes	577	56.9
No	438	43.1
Risky situations		
Improper care	143	14.1
Excessive play	279	27.5
Insufficient preparedness	271	26.7
Unprovoked aggression	322	31.7
Biting animal		
Dog	646	63.6
Cat	280	27.6
Mouse	59	5.8
Monkey	30	3
Biting animal ownership		
Own domestic animals	394	38.8
Domestic animals of other people	489	48.2
Stray animals	132	13

Written informed consent was obtained from all the guardians of minors (under 18 years old) after an explanation of the purpose of the research. The methods of the present study were carried out in accordance with the approved protocol.

## Results

A total of 1080 animal bite victims were interviewed at six RPCs. Sixty-five questionnaires were excluded from the analyses because they were incomplete. The final analysis was undertaken on 1015 questionnaires.

### Sociodemographic characteristics of the victims and the types of biting animals involved

Table 1 presents the sociodemographic characteristics of the victims and the types of biting animals

**Table 2. Factors associated with unprovoked aggression**

Variables	P	OR	95% CI for adjusted OR	
			Lower	Upper
Age (Ref. = 61–88 years old)				
1–15 years old	<0.001	0.279	0.152	0.510
16–30 years old	0.112	0.652	0.384	1.106
31–45 years old	0.078	0.591	0.329	1.061
46–60 years old	0.170	0.671	0.379	1.186
Education attainment (Ref. = University and above)				
Senior school and below	0.074	1.349	0.972	1.872
Biting animal (Ref. = Cat or other animals)				
Dog	0.004	1.626	1.166	2.266
Biting animal ownership (Ref. = Own domestic animals)				
Stray animals or domestic animals of other people	<0.001	7.026	4.928	10.018
Habit of playing with animals (Ref. = Yes)				
No	<0.001	2.639	1.900	3.666
Knowledge of source of transmission (Ref. = Yes)				
No	0.072	1.826	0.947	3.522
Rabies is preventable (Ref. = Don't know or No)				
Yes	0.007	1.765	1.168	2.668
Would take the rabies vaccine on schedule (Ref. = Don't know or disagree)				
Agree	0.026	3.764	1.174	12.068
Will learn the knowledge of rabies (Ref. = Yes)				
No	0.072	0.588	0.330	1.049

Ref., reference.

involved as the cause of injuries. There were more bite cases in females (55.6%) than in males (44.4%). The median age of all animal bite victims was 26 years old (range: <1 to 88 years old; mean: 33.84 years old). Approximately half of the bite cases were reported in people less than 29 years old. Those in the age group of 16–30 years old were the most common victims of animal bites (36.1%). In terms of educational attainment, 54.3% of the participants had the education level of senior school and below, while the remaining 45.7% of the participants had the education level of university and above. More than half (56.9%) of the victims liked playing with animals.

The victims were predominantly bitten by dogs (63.6%), followed by cats (27.6%), and the remaining biting animals were mice (5.8%) and monkeys (3%). Nearly half (48.2%) of the biting animals were owned by other people, while 38.8% of animals involved in the injuries were owned by the victims, and only 13.0% of the biting animals were not owned and were stray animals.

### *Risk types and associated factors*

More than one-third of injuries were reported to be due to unprovoked aggression (31.7%), followed by excessive play with animals (27.5%) and insufficient preparedness (26.7%), and the remaining 14.1% of the injuries were caused by improper care of animals.

Table 2 shows the factors associated with unprovoked aggression. Children aged 1–15 years old were less likely to be injured for unprovoked aggression (OR = 0.279, 95% CI: 0.152–0.510,  $P < 0.001$ ). The risk for unprovoked aggression was higher in dogs (OR = 1.626, 95% CI: 1.166–2.266,  $P = 0.004$ ). The risk of stray animals and domestic animals in the possession of other people was higher than that of domestic animals owned by the victims (OR = 7.026, 95% CI: 4.928–10.018,  $P < 0.001$ ). People who did not like playing with animals (OR = 2.639, 95% CI: 1.900–3.666,  $P < 0.001$ ), who knew rabies is preventable (OR = 1.765, 95% CI: 1.168–2.668,  $P = 0.007$ ), and who would take the rabies vaccine on schedule (OR = 3.764, 95% CI: 1.174–12.068,

**Table 3. Factors associated with excessive play**

Variables	P	OR	95% CI for adjusted OR	
			Lower	Upper
Age (Ref. = 61–88 years old)				
1–15 years old	<0.001	9.069	4.572	17.987
16–30 years old	0.012	2.273	1.199	4.309
31–45 years old	0.298	1.460	0.716	2.978
46–60 years old	0.899	0.954	0.463	1.965
Education attainment (Ref. = Senior school and below)				
University and above	0.001	1.747	1.257	2.429
Habit of playing with animals (Ref. = No)				
Yes	<0.001	1.916	1.345	2.728
Previous animal injury history (Ref. = Yes)				
No	0.062	0.732	0.527	1.015
Biting animal ownership (Ref. = Stray animals or domestic animals of other people)				
Own domestic animals	<0.001	2.561	1.820	3.603
The biting animal vaccinated (Ref. = Don't know/No)				
Yes	0.092	1.341	0.954	1.886
Rabies is infectious (Ref. = Yes)				
No	0.051	0.731	0.533	1.002

Ref., reference.

$P = 0.026$ ) were more likely to be bitten for unprovoked aggression.

Table 3 displays the factors associated with excessive play. People aged 1–15 years old (OR = 9.069, 95% CI: 4.572–17.987,  $P < 0.001$ ) and 16–30 years old (OR = 2.273, 95% CI: 1.199–4.309,  $P = 0.012$ ) were more likely to be bitten for excessive play. People who had higher educational attainment (university and above) (OR = 1.747, 95% CI: 1.257–2.429,  $P = 0.001$ ) and who liked playing with animals (OR = 1.916, 95% CI: 1.345–2.728,  $P < 0.001$ ) were more likely to be injured under this risky circumstance. The risk of domestic animals owned by the victims was higher than that of stray animals and domestic animals in the possession of other people (OR = 2.561, 95% CI: 1.820–3.603,  $P < 0.001$ ).

Table 4 presents the factors associated with insufficient preparedness. Compared with dogs, the risk for insufficient preparedness was higher in cats and other animals (OR = 1.445, 95% CI: 1.078–1.938,  $P = 0.014$ ). People who knew that rabies is risky to human health (OR = 1.754, 95% CI: 1.007–3.057,  $P = 0.047$ ) and those who would learn the knowledge of rabies (OR = 1.951, 95% CI: 1.205–3.157,  $P = 0.007$ ) were more likely to be bitten under this risky situation.

Table 5 presents the factors associated with improper care. The risk of domestic animals owned by the victims was higher than that of other animals (OR = 5.641, 95% CI: 3.389–9.389,  $P < 0.001$ ). People who did not know that animal vaccine was helpful for rabies control (OR = 2.168, 95% CI: 1.034–4.545,  $P = 0.040$ ) and those who would discontinue the rabies regimen if the wounds were not serious (OR = 2.600, 95% CI: 1.561–4.331,  $P < 0.001$ ) tended to be injured for the improper care of animals.

## Discussion

The present study shows that domestic animals contributed to 87% of the exposure. This finding is inconsistent with previous studies, which reported that stray and/or roaming animals accounted for most incidents,<sup>12,13,16</sup> and is in line with other studies that indicated that domestic animals were responsible for most exposures.<sup>18,19</sup> Due to the well-implemented China Stray Pet Care Project and overcrowded cities, there are few stray animals in the streets and communities. Besides, with the growth of the economy and the improvement in living standards, the number of domestic animals has been growing rapidly in recent years. The number of domestic dogs and cats in Chinese

**Table 4. Factors associated with insufficient preparedness**

Variables	P	OR	95% CI for adjusted OR	
			Lower	Upper
Age (Ref. = 61–88 years old)				
1–15 years old	0.179	0.666	0.369	1.204
16–30 years old	0.791	0.934	0.564	1.547
31–45 years old	0.285	1.346	0.781	2.319
46–60 years old	0.432	1.242	0.724	2.130
Habit of playing with animals (Ref. = No)				
Yes	0.096	1.289	0.956	1.738
Biting animal (Ref. = Dog)				
Cat or other animals	0.014	1.445	1.078	1.938
Rabies is a risk to human health (Ref. = Don't know or disagree)				
Agree	0.047	1.754	1.007	3.057
Rabies is infectious (Ref. = Don't know or No)				
Yes	0.051	1.344	0.999	1.808
Will learn the knowledge of rabies (Ref. = No)				
Yes	0.007	1.951	1.205	3.157

Ref., reference.

households reached 150 million in 2013,<sup>26</sup> and it has been increasing by 10% yearly.<sup>25</sup> Domesticated animals have become an increasingly important part of the life of Chinese people, who are likely to experience daily interactions with animals within their own homes and the homes of other people. These domestic animals in households can provide people with companionship, yet they can also present people with the potential risk for injury under certain circumstances. This suggests the need to increase awareness to prevent bites by domestic animals in China.

In many studies, animal bites have been reported for different age groups. Most studies indicated that animal bite injuries were more common in children aged less than 15 years olds,<sup>11–13,15,16</sup> while other studies reported that the most common age group was 10–20 years old,<sup>5,27</sup> and a study conducted by Ganasva *et al.* showed that nearly half of the cases were in people >50 years old.<sup>28</sup> National Family Planning Policy (the one-child policy before 2016) limited most Chinese families from having more than one child. The only child is always under the watchful eye of their guardians, who can protect them from animal bites, especially for unprovoked aggression. Our research results indicated that the highest rate of animal bites occurred in the age group of 16–30 years old. A previous study reported that people aged 16–30 years old were the pre-

dominant pet owners in China.<sup>26</sup> We also observed that people in this age group were more likely to be injured from excessive play with animals, compared with other associated situations. Therefore, the educational program should be administered to guide this vulnerable group to behave safely with animals.

The most common risk type for animal bites is unprovoked aggression, which is mainly caused by a dog. The result is consistent with published studies.<sup>13,22</sup> Compared with animals owned by the victims, stray animals and domestic animals in the possession of other people are prone to attack people unprovoked. The reason might be the sense of unfamiliarity toward the victims. People who do not like playing with animals, who know the rabies is preventable, and those who would take the rabies vaccine on schedule would be more likely to be bitten under this situation. These people are more knowledgeable about the consequences and the treatment of animal bites, and they would be more cautious when confronting an animal. Consequently, they are less likely to be injured by animals, except for unprovoked aggression, which is difficult to prevent. Unprovoked attacks by aggressive animals reduce the quality of life by placing a burden on the health care system and reducing participation in outdoor activities.<sup>22</sup> The high prevalence of injuries due to unprovoked aggression indicates that

**Table 5. Factors associated with improper care**

Variables	P	OR	95% CI for adjusted OR	
			Lower	Upper
Age (Ref. = 61–88 years old)				
1–15 years old	0.240	0.548	0.201	1.494
16–30 years old	0.717	1.153	0.533	2.495
31–45 years old	0.583	1.267	0.544	2.949
46–60 years old	0.125	1.866	0.841	4.138
Biting animal ownership (Ref. = Stray animals or domestic animals of other people)				
Own domestic animals	<0.001	5.641	3.389	9.389
Rabies is a risk to human health (Ref. = Don't know or disagree)				
Agree	0.077	3.002	0.889	10.139
Animal vaccination is helpful for rabies control (Ref. = Agree)				
Don't know or disagree	0.040	2.168	1.034	4.545
Would discontinue the rabies regimen if the wound is not serious (Ref. = Occasionally/Never)				
Always	<0.001	2.600	1.561	4.331

Ref., reference.

legislative measures that include controlling stray animals and encouraging owners to properly confine their domestic animals should be implemented.

With the growing pet population, excessive play with animals has emerged as a risk situation for animal bites, and the biting animals are mainly owned by the victims. This finding is consistent with a previous study.<sup>29</sup> This study showed that children under 15 years old and people aged 16–30 years old were most vulnerable for animal bites under this situation, which is partly in accordance with other studies.<sup>11,18,30</sup> Children and young people are often bitten by animals because they share their food with animals<sup>30</sup> and have contact with animals.<sup>11</sup> The result of this study also shows that people who like playing with animals are more likely to be bitten for excessive play. Domestic animals might bite during play.<sup>21</sup> Even though biting during play might be fun for the animal, it can be dangerous for people. People with higher educational attainment (university and above) are more likely to be injured for excessive play with animals. The reason is that 39% of pet keepers in China have university degrees and above.<sup>26</sup> It is suggested to avoid wrestling or playing excessively with domestic animals, especially for the younger and the better educated.

Insufficient preparedness is regarded as a risk type for animal bites. When compared with dogs, cats and other animals are the main biting animals for this situation. Unless the bite is completely unprovoked or the animal is sick, most bites

can be prevented by careful monitoring.<sup>31</sup> The perception that “the bite would not happen to me,” until a bite occurred, is a significant barrier to injury prevention.<sup>32</sup> People who know that rabies is infectious and who do not know that rabies is a risk to human health are likely to be bitten for insufficient preparedness. Due to poor awareness of the risk of rabies, these people failed to pay close attention to animals, especially to cats. People should be aware of the fact that any animal can bite, and they need to behave appropriately with animals.

The last risky situation is improper care of animals, mainly involving domestic animals owned by the victims. Provoked bites may occur if the keeper tries to remove food while the animal is eating,<sup>12</sup> or the owner disturbs animals that are caring for their babies, and bites also happen if someone teases the domestic animal. People who do not know that animal vaccination is helpful for rabies control, as well as who would always discontinue the rabies regimen if the wound is not serious, are vulnerable in the situation of improper care. These people do not know the techniques, such as mass vaccination and appropriate post-exposure prophylaxis to prevent the serious health consequences of animal bites. Owing to the lack of knowledge and awareness, they might care for the domestic animals improperly, resulting in a bite. Therefore, an educational program should be conducted that focuses on animal behavior, vaccination, communication, and the ethological

needs of common domestic animals, such as dogs and cats.

The present study highlights that the circumstances surrounding animal bites varied differently. A previous study conducted by our team had reported that improper wound treatment and delayed administration of post-exposure prophylaxis of animal bite victims were common, which could lead to the rabies vaccines not being able to provide full protection.<sup>33</sup> A high prevalence of animal bites, coupled with improper wound treatment and delayed post-exposure prophylaxis, is a worrisome trend. That might be the reason why China is ranked second in the world for the number of reported rabies cases.<sup>34</sup> Most bites are considered to be preventable.<sup>35</sup> The viewpoint mainly presented in previous studies was that bites occur because people misinterpret or do not recognize fearful animal behavior,<sup>22,36</sup> suggesting that animal bites are mainly due to “aggression,” so intervention programs were mainly about signals that an animal is concerned and might bite.<sup>37</sup> Animal bites were reported to mainly affect children,<sup>11–13,15</sup> consequently, intervention programs have traditionally targeted children.<sup>31,38</sup> However, our study indicated that people aged 16–30 years old were the most vulnerable to animal bites, which occurred not only because of unprovoked aggression, but also because of excessive play, insufficient preparedness, and improper care. The results are essential in the development and implementation of the strategies to tackle animal bites.

### Strengths and limitations of this study

There are several strengths to these analyses that ought to be considered. This investigation is the first clinic-based cross-sectional study to observe the risk situations for animal bites, as well as the associated factors. The findings of this study would help to adopt and develop a global strategy for animal bites and rabies transmission intervention using existing control tools, like mass vaccination of dogs and animal birth control techniques. Population-based health education and mass vaccination of domestic animals should be strategically planned to prevent animal bites at the local, national, and international levels.

Unavoidably, the present study has some limitations that need to be acknowledged. First, given the limitations of the cross-sectional design, firm con-

clusions concerning its possible causal effects cannot be drawn. However, the findings can be valuable to provide directed public health messaging and interventions. Second, the study site is mainly in an urban area, with few farmers (1.2%). However, it was reported that the animal bite incidence rate was higher in urban than in rural area,<sup>39</sup> hence, the study of risky situations for animal bites in an urban area is necessary. Third, no standard classification of such risky situations could be found. Therefore, we classified the risky situations as unprovoked aggression, excessive play with animals, insufficient preparedness to handle animals, and improper care of animals. Finally, the present study only considered the perception of the victims, which might be different from the view of the animal owners.

### Conclusions

In conclusion, this clinic-based study showed that domestic animals contributed to most cases of animal bites, which occurred under risky situations, including unprovoked aggression, excessive play, insufficient preparedness, and improper care. The results indicated that the majority of the respondents did not behave appropriately when approaching the animals. Therefore, large-scale community-based prevention strategies are needed to address the multiple associated factors for risky situations of animal bites. The establishment of systematic and sustained programs to propagate how to prevent animal bites is a priority today.

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### Author contributions

Q.L., F.C., P.F., S.C., and Z.L. conceived and designed the study. J.S. participated in the acquisition of data. Q.L. and F.C. analyzed the data. J.S. and A.D.H. gave advice on methodology. Q.L. and F.C. drafted the manuscript. T.R.L., Q.J., and A.D.H. revised the manuscript. All authors read and approved the final manuscript. S.C. and Z.L. are the guarantors of this work and have full access to all the data in the study and take responsibility for its integrity and the accuracy of the data analysis.

## Competing interests

The authors declare no competing interests.

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