

# Investigating the Relationship between the Presence of Domestic Animals and the Frequency of Mosquito Bites in Residential Houses: A Case Study

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## Abstract

**Aim:** Diverting the blood-feeding mosquitoes from humans to domestic animals is an effective strategy known as zoo prophylaxis. In this regard, the present study aimed to investigate the relationship between keeping domestic animals and the frequency of mosquito bites in residential houses. **Methods:** A number of 150 families were involved in this study resided in Varzaneh City, Isfahan province, Iran. Data on the mosquito bites were collected using a checklist. The descriptive statistics and analytical parametric tests such as correlation and analysis of variance were performed using SPSS 22 software. **Results:** Based on the results, 26% of the participants in this study have reported keeping domestic animals. Moreover, 44.7% of the families reported the movement of nondomestic animals inside their houses. Only 7.7% of families who had domestic animals have reported mosquito bites. The statistical analysis showed a significant ( $P < 0.01$ ) inverse relationship between keeping domestic animals with mosquito bites. **Conclusion:** Our findings showed that domestic animals in residential houses could serve as a biological shield diverting blood-seeking mosquitoes from humans to animals. Therefore, such a simple, environmentally friendly, and efficient strategy could be employed to prevent mosquito-carrying diseases in the study region.

**Keywords:** Bite, blood-feeding, domestic animals, mosquito, zoo prophylaxis

## INTRODUCTION

Mosquitoes are a large group of insects belonging to the Diptera order and Nematocera suborder.<sup>[1]</sup>

*Culicidae*, *Simuliidae*, and *Ceratopogonidae* are the major disease-carrying families of the mosquitoes distributed worldwide.<sup>[2]</sup>

Among them, *Culicidae* mosquitoes have been well known as vectors of malaria (by *Anopheles* mosquito), arboviruses, and parasites causing types of filariasis, as well as the most important group of arthropods causing bite pain in humans.<sup>[3]</sup>

*Culicidae* mosquitoes are also considered important in medicine because of transmitting yellow fever, dengue hemorrhagic fever, and West Nile viruses.<sup>[4]</sup>

Their biological characteristics, especially their blood-feeding behavior, have caused these insects to be recognized as the most important health pests.<sup>[5]</sup>

Based on the statistics, more than two billion people in the tropical regions are exposed to the aforementioned diseases transmitted by these mosquitoes. Although in the past decades outstanding efforts have been made for developing vaccines

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against the above diseases, none of them have achieved satisfactory results.<sup>[6]</sup> It has widely been assumed that changing and destruction of the wetlands, the restoration of dry areas, the construction of canals and water storage pools, and agricultural and various industrial activities are among the most important reasons have increased the habitats for *Culicidae* mosquitoes. In addition, the population growth and shifting of the population movement from the suburbs to the city center, especially in developing countries, are associated with the compromised sewage system and the nonobservance of hygiene principles, which in turn speed up the risk of pests spreading in these areas.<sup>[7]</sup>

Up to now, several strategies including mosquito nets, window nets, use of sprays, and the use of zoo prophylaxis have been introduced to practically prevent mosquitoes from entering residential houses.<sup>[8-11]</sup>

The last one, zoo prophylaxis, is defined as a strategy, in which blood-feeding mosquitoes are directed toward domestic animals or semi-domestic animals or urban animals. Indeed, in this method, live animals are used as the available source of food (blood), to keep mosquitoes away from humans, which also called active zoo prophylaxis. However, in the passive zoo prophylaxis, this occurs naturally and without human intervention by blood-feeding from animals such as sparrows, crows, cats, and dogs.<sup>[12]</sup>

Based on the abovementioned notes and considering the importance of zoo prophylaxis in residential areas as well as the lack of the public knowledge about this simple and effective method, the present study was conducted to investigate the relationship between the presence of domestic animals and the frequency of mosquito bites in residential homes. The findings of such studies can increase public knowledge and show the zoo prophylaxis as an effective available strategy in preventing mosquito-carrying diseases, especially in the endemic regions. The role of disease prevention by animals around humans has been shown in the studies of researchers around the world.<sup>[13]</sup> However, in Iran, less attention has been paid to the importance of this issue. Because the use of pesticides is easy and profitable for manufacturing companies.

## MATERIALS AND METHODS

This is a descriptive cross-sectional study that was conducted in the summer of 2021 among the residents of Varzaneh City, Isfahan province, Iran. To decrease the study bias, 150 families were randomly selected from the north, south, east, west, and center of the mentioned city. A checklist covering several questions was designed by the research group and completed in face-to-face interviews by the volunteer families. This researcher-made checklist that was previously used in previous studies.<sup>[14]</sup>

The first part of the checklist was designed to collect the demographic information of the participants, and then 44 questions were asked in terms of domestic/nondomestic

animals, mosquito bites, the use of other preventive measures (sprays and nets), sewage disposal, the presence of green spaces and wasteland, the presence of water ponds and wells at home, the number of bites and the time of mosquito bites, the body sites that has been bitten, and the type of biting agents, such as mosquitoes, belongs to the *Culicidae* family and the sandflies belongs to the *Psychodidae* family.

The inclusion criteria were being a resident of Varzaneh city, as well as voluntarily participating in the study, with having the ability to answer questions. Furthermore, the families who did not cooperate well or did not complete the questionnaire were excluded from the study. The collected data were analyzed by SPSS 22 (IBM Corp., Armonk, New York, USA) software using descriptive statistics and the analytical parametric tests such as correlation and analysis of variance.

## RESULTS

The demographic information revealed that 41% of fathers and 59% of mothers of families had primary education or elementary school level. In the studies, families 31.3% of the fathers were self-employed, whereas the majority of the mothers (90%) were housewives. The family size of the studied was 3 and 4 people with 60% frequency. The majority of families had a monthly income below 110 dollars with a frequency of 48.7%. The 74% of the participants have reported keeping a domestic animal, whereas 44.7% of families had close contact with nondomesticated animals in their houses. Table 1 summarizes the information on the keeping of domestic and nondomestic animal in studied families. Based on our findings, 92.3% of families who keep domestic animals did not report mosquito bites. However, 51.3 of the families who have not been keeping domestic animals have reported mosquito bites [Table 2]. We

**Table 1: Demographics of the studied families on keeping domestic and nondomestic or free living animals**

Variable	n (%)
Domestic animals	
Yes	39 (26)
No	111 (74)
Nondomestic or free living animals	
Yes	67 (44.7)
No	83 (55.3)

**Table 2: The rate of mosquito bites in homes with domestic animals**

Variable	n (%)
Domestic animals (yes)	
Bites (yes)	3 (7.7)
Bites (no)	36 (92.3)
Domestic animals (no)	
Bites (yes)	57 (51.3)
Bites (no)	54 (48.7)

performed the Chi-square tests to determine the relationship between the presence of the domestic/nondomestic animals with the frequency of mosquito bites. The findings showed a significant inverse correlation between the presence of domestic animals with mosquito bites. On the contrast, a significant direct relationship was observed for being in contact with the nondomestic animals and the frequency of mosquito bites [Table 3]. The relationship between mosquito bites with the presence of water and streams near the house, the presence of agricultural land near the house, the type of sewage disposal, the state of garbage disposal, the presence of green space near the house, the presence of a pond in the house, and the way of sewage disposal. The relationship between sanitary conditions of the house and the frequency of mosquito bites was also obtained by McNemar and Chi-square statistical tests and summarized ( $P < 0.01$ ) in Table 4.

### DISCUSSION

Based on our findings, out of 39 of the families who had domestic animals in their houses, only three families have reported mosquito bites. Indeed, in 92.30% of the families keeping domestic animals, no mosquito bites were observed. These results revealed a significant and inverse relationship between keeping domestic animal with mosquito bites.<sup>[15]</sup> Previously, studies have also shown that the presence of domestic animals reduces the risk of malaria infection which are consistent with the results of the present study. The presence of livestock and other animals can be effective in reducing disease cases, this is zoo prophylaxis.<sup>[16]</sup> Zoo prophylaxis is more effective when combined with other methods of protection such as using mosquito nets and window nets.<sup>[13]</sup>

**Table 3: Association between keeping domestic animals and mosquito bites**

Variable	$\chi^2$	P
Domestic animal - mosquito bite	42.451	0.001
Nondomestic animal - mosquito bite	8.203	0.004

**Table 4: The relationship between health/sanitary conditions and mosquito bites**

Variable	$\chi^2$	P
Separate domestic animal - mosquito bite	111.720	0.254
Open window - mosquito bite	0.068	0.795
House location - mosquito bite	4.563	0.033
Presence of water streams - mosquito bite	62.527	0.001
Presence of agricultural lands - mosquito bite	45.378	0.001
Type of sewage - mosquito bite	52.155	0.001
Status of waste disposal - mosquito bite	47.803	0.001
Livestock waste disposal - mosquito bite	60.494	0.001
Green spaces - mosquito bite	10.414	0.001
Water pond - mosquito bite	71.910	0.001
Building life - mosquito bite	0.125	0.302
Type of sewage disposal - mosquito bite	34.588	0.001

Furthermore, for this reason, in African societies, domestic animals such as cows are used to divert blood-feeding mosquitoes carrying malaria from humans to animals. Although both humans and animals could serve as the food source for blood-seeking mosquitoes, it seems that these mosquitoes would prefer blood-feeding from animals if they have access to different hosts; otherwise, they can tolerate the current situation of different hosts.<sup>[17,18]</sup>

In fact, the presence of domestic and semi-domestic animals can attract a large number of mosquitoes to them for bloodfeeding. Besides, humans can also employ other physical, mechanical, and chemical strategies to prevent mosquitoes from blood-feeding and to protect their sleeping and resting places and life; however, domesticated animals do not have such facilities, hence facilitates the natural diversion of blood-feeding mosquitoes from humans toward these domestic animals that live outside the residential houses and places where humans live. Accordingly, one of the purposes of the current study was to shed light on this valuable role of domestic and semi-domesticated animals in natural zoo prophylaxis.

Worth mentioning, a previous study by Massebo *et al.* revealed that the prevalence of malaria is higher in houses where animals such as cattle live in close contact with humans and do not have a specific place to keep them.<sup>[19]</sup>

These findings suggest that the presence of animals in the yard and around the places where humans live has a much greater role in diverting mosquitoes from feeding on humans. Considering that humans should also use mosquito nets in their houses, sleeping or resting places to further prevent mosquitoes from feeding on. Where mosquitoes still have access to urban animals freely outside the seals and mosquito nets around human habitations.

According to these findings, the presence of domestic animals could attract blood-feeding mosquitoes toward them and hence keeping animals can be used as a preventive measure to escape from mosquito bites. This notion is supported by our findings as a significant ( $P < 0.01$ ) relationship was observed between keeping domestic/nondomestic animals and mosquito bites. In accordance, the presence of domestic and semi-domesticated animals or urban animals next to humans in urban and rural communities plays an essential role in the blood-feeding deviation of *Culicidae* mosquitoes. Mosquito blood feeding is a critical behavior with major implications for pathogen transmission. This behavior depends on food needs and environmental conditions that affect mosquito feeding patterns. The availability of humans and animals can change the contact rate of mosquitoes for blood feeding. By completing the protection of houses, the possibility of mosquitoes encountering humans is reduced. In this case, mosquitoes tend to feed on free urban animals.<sup>[19,20]</sup>

Investigating the relationship between mosquito bites and the sanitary conditions of the houses has shown a direct

and significant relationship between mosquito bites and the presence of nearby water streams, agricultural land, the type of disposal sewage, waste disposal status, livestock waste disposal, the presence of green space, the presence of a pond in the house, and the method of sewage disposal have a significant relationship and with the location of the house as well.

## CONCLUSION

Our findings revealed a significant inverse relationship between keeping domestic animals and mosquito bites. On the contrast, a significant direct relationship was observed between mosquito bites and the presence of nondomesticated animals in the house. This means that nondomestic animals are not settled in one place, but live around residential areas, so the amount of blood feeding by mosquitoes from free urban animals takes place anywhere in the city. For mosquitoes, there is no difference between domestic and nondomestic animals. However, when the animal is permanently present in the house, the deviation of blood-feeding from humans to animals is quite visible. Furthermore, investigating the relationship between mosquito bites and the sanitary conditions of the houses has shown a direct and significant relationship between mosquito bites and the presence of nearby water streams, agricultural land, the type of disposal sewage, waste disposal status, livestock waste disposal, the presence of green space, the presence of a pond in the house, and the method of sewage disposal have a significant relationship and with the location of the house as well. Our findings showed that keeping domestic animals in residential houses could serve as a biological shield diverting blood-seeking mosquitoes from humans to animals. Therefore, such a simple, environmentally friendly and efficient strategy could be employed decision makers and health staffs to prevent mosquito-carrying diseases in the study region.

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## Conflicts of interest

There are no conflicts of interest.

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