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A short report on epidemiological investigation of dog bite cases in association with temperature rise as a part of climate change

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Abstract

Background: Rabies is a neglected disease that claims more than 5000 human's deaths in Pakistan that account for 10% global load of rabies related deaths annually. Dogs are major carriers for this zoonotic ailment in the country. Global climatic changes, especially rise in temperature, is altering ecological niche of reservoir of infectious diseases. Pakistan is among those countries which are most effected by the temperature rise. This rise has a relation in increase in dog bites and subsequent rabies cases to develop.

Methods: Passive data of dog bite cases is acquired from Institute of Public health and were examined for 12 consecutive months. Data analyzed by SPSS software for frequency distribution of dog bite cases in comparison with different months of the year.

Results: Data analysis indicate a positive correlation between temperature rise and dog bites rates. This study found prevalence of 2.56% dog bite cases and seasonality in dog bites.

Conclusion: These finding recommend further study to investigate other factors involved in increase of dog bite cases in high temperature months of years. In order to develop understanding the reasons of subsequent rabies cases associated with dog bites. Bats are the most sensitive mammals to high temperature and they migrate and even die due to hike in temperature, which later may become source of various zoonotic diseases including rabies. Carnivorous bats are believed to be primary reservoir for rabies worldwide but Pakistan do not have this bat specie (*Desmodus rotundus*). However, increase in dog bite and rabies cases with every year suggest to monitor Indian fruit bat (*Pteropus giganteus*) which are prevalent in Pakistan. Ecological Niche Model (ENM) should be used for bats to determine their role in rabies ecology in Pakistan.



Introduction

Rabies is a fatal viral infection that can infect all mammals, but domestic dogs cause over 99% of all human deaths caused by rabies [1]. According to World Health Organization total of 35000 cases of rabies with 97% reported in Asia in 1992 [2] while the survey by WHO in 2013-2014 estimated 56% in Asia and 44% in Africa, contributes to at least 55000 deaths per year worldwide [1]. In subcontinent >40,000 persons die from rabies every year; dog bite is the main source of transmission in 94%-98% cases [3].

A study in 2015 estimate globally canine rabies, causes over 3.7 million disability-adjusted life years (DALYs) and 8.6 billion USD (95% CI) economic losses annually [4]. The recent studies from both Asia and Africa based on probability decision tree modelling [5]; community surveys [6] and contact tracing [7], show much more death than officially reported. These WHO surveys suggest that not only rabies related death increase with passing years but also niche of lyssavirus changes with time. About 23,800 deaths per year reported in Africa that was once have minimum share in global burden of rabies [8]. This difference in figures, at one place, is suggestive of cases reporting increase in the underdeveloped regions of the world particularly in Africa because of advanced Surveillance techniques and methods[9] but at the same time this data is clear verdict that there are other factors particularly of ecological nature, emerged with time which are now aggravating the situation. Climate change along with many other factors are the probable answer to the substantial increase in rabies cases and death associated with it [10]. Therefore, it is imperative to understand these infectious zoonotic diseases using Ecology Niche Model (ENM) to develop a profound understanding [11]. Climate change at one hand has put certain species on the verge of extinction [12] and at the same time it has disturbed hierarchy in the ecosystem [13]. The whole food web has got imbalanced which made certain species predominate the other species [14]. Animal migration to avoid nutrients scarcity and temperature extreme has not only made them survive but gave them a key role in spreading transboundary zoonotic diseases [15]. This study aims to investigate the prevalence of dog bites in different months of the years as well as its relation with subsequent rabies cases by comparing with published data in Pakistan.

Methods

Data of dogs-bite cases that were reported by municipal town community from Data Gunj Buksh Town, an administrative town (tehsil) in Lahore, Pakistan was obtained and processed. In order to calculate total population of dogs in town, pervious data reports were opted which indicated dog to human ratio of 1: 7.8 [15] and even higher ratio of dogs in areas with low social and economic status [16]. Areas with higher density of human population also had higher proportion of stray and pet-dogs [17]. A total of 1173 cases of dog bites are reported in June 2016 to June 2017. Estimated population of dogs in our study areas is 45,697 as shown by Table No. 1. We divided total dog bite cases with total dog population of study area to get prevalence of dog bites which is almost consistent with prevalence of dog rabies cases reported by Masood and Saghir in 1995-1997 that is 2.66 %. We measured data in percentage for comparison [18]. We also analyzed data temporally to find pattern of disease spread to identify peak cases of diseases in different months and seasons around a year.

Results

A total of 1173 dog bites cases are reported in areas with dog population of 45,697. We found prevalence of 2.56% dog bite cases and seasonality in dog bites. This study found positive correlation of dog bites with temperature rise. More cases are reported in summer season (March-August) i.e. 60% as compared to winter season (September-February) i.e. 40% shown in Fig 1 and Fig 2.

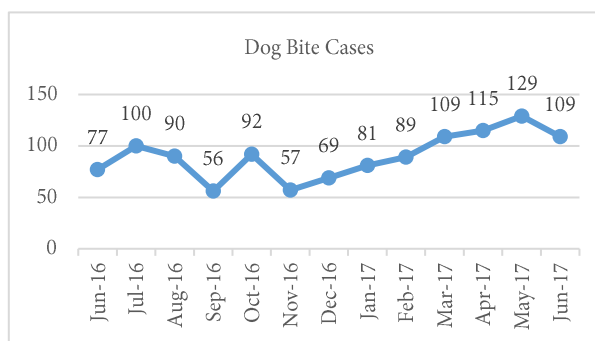


Figure 1: Dog bites cases during June 2016-June 2017 in Data Gunj Buksh town.

Discussion

Increased dog activity during warmer months of year is probable cause of increase in number of dog bites cases.

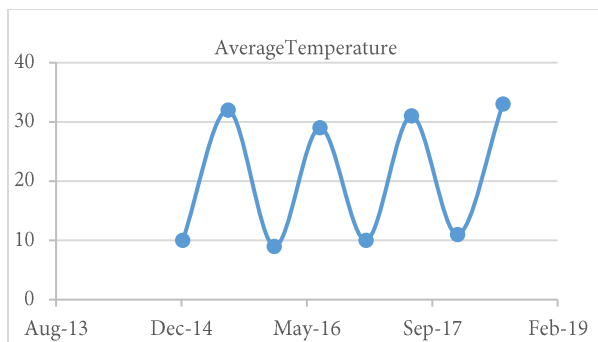


Figure 2: Average temperature in oC during different months of year in Pakistan, (AccuWeather).

Sr. No	District/ Tehsil	Region	Population
1	Lahore District	Urban	11,126,285
2	Lahore Cantt Tehsil	Urban	1,636,342
3	Lahore City Tehsil	Urban	3,655,774
4	Model Town Tehsil	Urban	2,698,235
5	Raiwind Tehsil	Urban	855,626
6	Shalimar Tehsil	Urban	2,280,308

Table 1: Block Wise Provisional Summary Results of 6th Population & Housing Census-2017 (Pakistan Bureau of Statistic)

There is restricted movement of people particularly children in winter months. Previous studies suggests children are most of vulnerable to dog bites due to nature. Other explanations include annual holidays in summer allow school children more outdoor activities. Which could be one of the compelling reason in increase in number of dog bites during summer. Besides this people in summer season wear thin and open clothing as compared to colder months where people wear thick jackets and fully covered body clothes. These loose outfits could be one of the reason for increased exposure to rabies virus in case of dog bite.

Temperature rise as a result of climate change [12] result in mass migration of animals particularly mammals. Bats are the most sensitive mammals to temperature. This results in change in ecological niche of bats as reported by pervious study through using Moderate Resolution Imaging Spectro-radiometry. Normalized Difference Vegetation Index (NDVI) data is generated that enhanced our in-depth understanding of the reservoir of this disease [19]. Our ability to control rabies and other bats borne zoonotic infections lies in monitoring this reservoir. It is reported heat waves in recent years result in wiping of entire colonies of bats in some areas of Pakistan. These frugivorous bats which although do not spread rabies by bits but they harbor

Lyssavirus. Their death in large number may serve as a source of diseases including rabies particularly for stray dogs when they eat them.

They contract rabies in this way but as we lack data and surveillance techniques to prove this way of rabies spread. This is probably the main reason of increase in rabies cases in wildlife particularly in jackals and strays dogs that comes in close contact with them. Subsequently there is increase in human rabies cases worldwide particularly in the sub-continent where climate change has devastated people life's strikingly. Climate change if not address according to Paris agreement than not only we see increase in incidences of infectious diseases but also there is chance of emergence of new infectious viral disease due to change in ecological niche of their reversions [20].

Vaccine failure could be one of among major reason in the spread of rabies disease in Pakistan. There major reason for vaccine failures in most developing countries including Pakistan is lack of proper cold chain when used in field condition [21]. Lack of awareness in public in dealing stray dogs especially rabid dogs has contributed in spread and deaths related with this diseases.

Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this paper.

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