Prevalence and Determinants of Chikungunya in Jaipur City between August to October 2016: A Secondary Data Analysis

A Capstone project submitted to
Johns Hopkins Bloomberg School of Public Health & IIHMR University
in partial fulfillment of the requirements for
the award of the degree of
Master of Public Health

by

Abiral Nidhi
MPH - Cohort IV (2016-18)

Under the guidance of
Dr. S. D. Gupta M.D, PhD

October 2017

Acknowledgement

The success and final consequence of this capstone required a lot of direction and assistance from several individuals and I am extremely fortunate to have got this all along the conclusion of my capstone.

I respect and thank my Faculty Advisor and Capstone Guide, Dr. S.D Gupta, for providing me an opportunity to do the capstone work in IIHMR, Jaipur and giving me all support and guidance although his busy schedule managing the university affairs in the capacity of the Chairperson, which made me complete the capstone duly.

I owe my deep gratitude to Dr. Mohan Lal Bairwa, who took keen interest on my capstone work and guided me all along providing all the necessary information and direction for developing a good system such that I was able to complete this capstone.

I would not forget to remember Ayushi Rai, Avleen Kaur, Haroon Mohammed, Juby A for their encouragement and more over for their timely support and guidance till the completion of our project work.

I am thankful to and fortunate enough to get constant encouragement, support and guidance from all Teaching staffs involved in IIHMR Institute which helped me in successfully completing my capstone work. Also, I would like to extend our sincere esteems to all staff in D.A Henderson Library for their timely support.

Abiral Nidhi

Table of Contents

Executive Summary

Title: Prevalence of Chikungunya in Jaipur City between August to October 2016: Secondary Data Analysis and Report Writing

Author: Abiral Nidhi, MBBS, (MPH)

Background: Chikungunya (CHIKV) has re-emerged in India and is responsible for millions of cases worldwide. The protracted and debilitating arthritis in CHIKV epidemics pose a significant public health threat.

Objectives: To determine the prevalence of chikungunya, among the residents of Jaipur City, from August 2016 to October 2016, study the selected determinants of the disease in the study population and calculate the costs incurred due to the disease in the study population.

Design: It was a secondary data analysis of a cross-sectional study, conducted in Jaipur city by MPH students of IIHMR University, Jaipur in November, 2016 as part of the Epidemiology Field Exercise of the MPH program at IIHMR, Jaipur. Households in Jaipur were interviewed using a pre-tested semi structured questionnaire. The data collected was analysed using means, median, standard deviation and bivariate and multi variate analysis to calculate odds ratio to determine independent variables associated with Chikungunya disease.

Results: In our study we included 2464 participants from 458 households. The prevalence of Chikungunya amongst the population studied was 13% (320, n = 2564), 6.4% were females and 6.4% were males. The age group 15 – 59 with 240 patients faced a significantly increased risk compared to those less than 15 years with an odds ratio of 1.5.

Conclusion: The study estimates the prevalence of Chikungunya between 11.66 – 14.32 %(95%CI) in Jaipur city in the months of August and October in 2016. Age group is a significant factor that contributes to the occurrence of Chikungunya.

Keywords: Chikungunya, Prevalence, Water Stagnation, Vector Control

List of Tables

Background

Chikungunya (CHIKV) is a mosquito-borne virus. (1) (2) It has caused millions of cases since 2004. (2) The mosquito vectors that carry this virus are distributed globally. (3) CHIKV infection is normally self-limiting. (3) The disease is characterized by an acute onset of high fever, severe arthralgia, and skin rash. In some joint pain may persist for years. (4) The severity may cause patients to adopt a stooping posture. (3) The protracted and debilitating arthritis in the epidemics have severe impact on the populace and is a significant public health threat. (5)

History

It is believed that CHIKV originated in Africa and has caused infections there for centuries, where it still circulates in an enzootic cycle among primates transmitted by arboreal *Aedes* mosquitoes. (6) Epidemics originally thought to have been caused by dengue-associated disease may have been Chikungunya epidemics. (6) Onset of 'an acute febrile exanthema' was observed in Zanzibar that swiftly progressed into an epidemic in 1870. (7) Reports suggested a similar epidemic had occurred 48 years earlier known by the Swahili term '*kidinga pepo*', '*kidenga*' or '*kidyenga pepo*' which meant a sudden cramp-like seizure attributed to an evil spirit. (7) (8) Published reports suggested that *kiding pepo* had soon spread from Zanzibar to Gujrat and subsequently to Calcutta in India, and in 1824 to Myanmar. (7) This epidemic that reached India in 1871 from Zanzibar was termed Dengue. (9) The Swahili term *kidinga pepo* was substituted with the Spanish term dengue as "an apt name for a disease that produces a post-illness stagger." (8) Many experimental infections with the virus were studied and the clinical features recorded in the subsequent decades. All authors studied the disease as dengue. Decades later in 1952 researchers studying an outbreak of an exanthematous febrile disease isolated a virus from captive mosquitoes that fed on blood meal from patients, and wild mosquitoes and human sera in the Makonde Plateau, Southern Province,

Tanganyika Territory (now in Tanzania) and attributed it to the cause of the previous epidemics. (10) The virus was ultimately named Chikungunya, which means in the Makonde language that which bends up. (11)

The virus was first classified in Asia in 1958 in Bangkok. (12) First laboratory confirmed outbreaks in Calcutta and Madras were described in 1963. (13) (14) The outbreaks were thought to have spread from Africa. Sequencing and phylogenetic analysis verified that CHIKV strains isolated during the Asian outbreaks belonged to a geographically and genetically distinct genotype, the East, Central, South Africa (ECSA), and was termed the Asian epidemic lineage. (1) (15) The disease reemerged in the Indian subcontinent after nearly three decades of dormancy. In 2005 more than 1 million cases were reported in Gujarat, Kerala, Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra, Rajasthan, and Madhya Pradesh. In Asia outbreaks occurred in Singapore, Malaysia, Thailand (2006-2009), Yemen (2008-2010), China, Cambodia (2010-11), Japan, and Nepal (2013) Meanwhile, in India, further outbreaks occurred in Kerala in 2008, and Tamil Nadu in 2009. In the year 2016, reports of high occurrence of the disease came from many states including Karnataka, Andhra Pradesh, Maharashtra, Delhi, and Rajasthan.

Epidemiology

Chikungunya Virus belongs to the Togaviridae family and Alphavirus genus. (1) (2) It is grouped with the Semliki Forest virus antigenic complex along with Bebaru, Mayaro, O'nyong nyong, Ross River, Getah, and Semliki Forest viruses. The 11.8 kb genome of CHIKV consists of a linear, single-stranded positive sense RNA. (1) (2) Phylogenetic analysis revealed three geographically associated genotypes within two genetically different lineages that originated from Africa, the

West African lineage and the East/Central/South African lineage which includes the Asian genotype. (1)

Frequent outbreaks since 2000 CHIKV suggests evolutionary adaptation to the mosquito vector. (16) (17) It has only one serotype conferring life-long immunity to infected people and in case of an outbreak resulting in herd immunity. (16) The primary replicating site is the mosquito's midgut epithelial cells infected after a blood meal. (18) It disseminates into secondary organs when it reaches the hemolymph and is flushed throughout the hemocoel. (18) The virus must replicate in the salivary glands and be shed in the saliva to successfully transmit into a new mammalian host. (18) (19)

Urban epidemics in Asia result from the transmission cycle between mosquitoes and humans. *Aedes aegypti,* the principal vector of the outbreak in India in 2005, and *Aedes albopictus* are the main vectors. (20) (3) *A. aegypti* are found in the tropics and subtropics. They travel almost 400 meters in their life span of about 2 weeks to a month. *Aedes albopictus* are widely distributed and are also found in temperate regions. World trade is responsible for their adaptation to new territories. (3) In Africa outbreaks result when the traditional enzootic cycle of the virus is disrupted due to heavy rainfall and it transitions to an epizootic savannah or woodland cycle. (3) *Aedes furcifer-taylori*, *Aedes africanus*, *Aedes luteocephalus*, and *Aedes aegypti* are the most common vectors. The virus has been associated with other species, including *Aedes dalzieli*, *Aedes vigilax*, *Aedes camptorhynchites*, *Aedes vittatus*, and *Aedes fulgens*. (3) (21)

Mother-to-child transmission has been observed in epidemics in Reunion Island. Neonates contract the disease when mothers were infected 48 hours before delivery. (22)

CHIKV infection shares clinical similarities with dengue fever. An important contrast to dengue fever is that hemorrhagic manifestations are rare. (3) (23) (24) Average incubation period is 2-4 days (ranging between from 1 to 12 days) followed by acute onset of fever that may be low to high grade, sometimes reaching 39-40°C, with chills and rigor, and subsides with the use of antipyretics, and is associated with severe arthralgia, myalgia, headaches, photophobia, and skin rash. (3) (23) Asymptomatic infections are rare. (25) Arthralgia is often severe, symmetrical affecting more than one joint, involving usually the fingers, wrists, ankles, elbows, toes, and knees and normally subsides in 1–2 weeks after onset of disease but in some may persist for months or years. (26) Swelling is a common. (25) Joints previously damaged by underlying disorders are susceptible. (26) Persistent arthralgia is common in children and the elderly. (27) (26) It is associated with severity of pain at onset of disease. (28) Fatigue may also persist. (29) Skin lesions are common affecting about 50% of patients and most often affect the torso, limbs, and face64,65 usually manifesting as a transient maculopapular rash that may persist for 2–3 days and are occasionally accompanied by pruritus. (27) Rare skin lesions have been described manifesting as aphthous-like ulcers, vesiculo-bullous lesions with desquamation, and vasculitic lesions. (27) (30)

Other common symptoms include abdominal pain, vomiting, diarrhea, conjunctivitis cardiovascular disorders, pneumonia, pre-renal failure, and respiratory failure. (23) (25) (31) Neurological presentations are rare and include encephalopathy, acute flaccid paralysis, and Guillain-Barre syndrome. (32) (33) (34) Mortality has been reported with CHIKV epidemics. Case-fatality rate of about 1 in 1000 has been estimated but a direct causal link has not yet been established. (31) (34)

Diagnosis, Treatment and Prevention

Chikungunya is diagnosed on the basis of clinical, epidemiological, and laboratory criteria. (35) A possible case is described as "an acute onset of fever and severe arthralgia or arthritis that is not explained by other medical disorders." The case is probable if "the patient has lived in or visited an epidemic area." (WHO Guidelines) The laboratory diagnosis of Chikungunya confirms the case and is done by virus isolation, PCR, detection of IgM antibodies (through ELISA), and demonstration of rising titer of IgG antibodies against the CHIKV. (35) Performing ELISA test within the first weeks of onset of symptoms is not advisable because the IgM antibodies usually takes 2-12 weeks to appear in sufficient quantities in the patient's blood to be picked up by the test. (36) The blood picture is non-specific and shows mild leukopenia with lymphocytic predominance, mild thrombocytopenia, raised ESR, and CRP levels. Laboratory confirmation of the disease may be of little clinical significance except in severe cases but is crucial epidemiologically, to distinguish it from dengue fever, endemic malaria, other alphaviruses and arthritic diseases. (3) Only non-steroidal anti-inflammatory drugs are recommended for treatments of CHIKV-induced fever and arthralgia. Several potential treatments like CHIKV antibodies, ribavirin, and chloroquine have been studied. (37) (38) Lifelong protective immunity endowed by a single infection and with little evidence for viral antigenic variation resulting in immune escape suggest that the most cost effective method to protect populations is vaccination. (17) (38) Preventive measures target vector control, and vector-host interaction control. WHO recommends that reduction of vector breeding sites (domestic and peri-domestic water collections), resting sites (tall, shady grass), improved waste management process, clothing that minimizes skin exposure to day-biting vectors, insecticide-treated mosquito nets, and mosquito- repellent skin creams reduce the risk of mosquito-bite. Success of the mosquito(vector)-borne diseases control depends on the knowledge, awareness, and practice of the control measures by the individual, and the community.

Economic impact

Chikungunya is usually treated on an outpatient basis. Prolonged arthralgia prompts the patient to seek medical help in relieving the symptoms resulting in a high cumulative cost, including travel, consultation, lab and medication costs, and income loss. Since out-patient cases are not usually covered by public funded or private insurance schemes in the country, the expense is met by Out-Of-Pocket means. (39) A study conducted in Kerala in 2007, estimated total out-of-pocket expenditure for families affected in the Chikungunya outbreak, and the median expenditure in the study population was $7.4 US Dollars. (40) Another study estimated the immediate costs of Chikungunya and Dengue for whole of India (including costs of treatment and disease control) to be INR 61 billion per annum. (41)

Context of the study

The re-emergence of Chikungunya epidemic in India and the severe arthritic component it entails poses a significant public health threat. There is no evidence currently of the disease burden in Jaipur City, a city in a north Indian state of Rajasthan. This study seeks to estimate the prevalence of Chikungunya disease in Jaipur, in the context of the reported outbreak in 2016.

Research Question:

- What is the prevalence of chikungunya among the residents of Jaipur city, Rajasthan?
- What are the determinants of the cause of chikungunya among the population under study?
- What is financial burden of Chikungunya that affects the households?

Objectives:

This study has the following objectives:

1. To determine the prevalence of chikungunya, among the residents of Jaipur City, from August 2016 to October 2016.
2. To study the selected determinants of the disease in the study population.
3. To calculate the costs incurred due to the disease in the study population.

Methodology:

Study design: It was a secondary data analysis of a retrospective cross-sectional study, conducted in Jaipur city by IIHMR, Jaipur in November, 2016 as part of the Epidemiology Field Exercise of the MPH program at IIHMR, Jaipur.

Case Definition: Chikungunya was defined as a disease having high grade fever, associated with severe arthralgia/arthritis/myalgia and rash. In addition to residing in or having visited an epidemic area within 15 days of development of symptoms that WHO guidelines recommend as necessary for a possible case to be considered probable, the condition must have been diagnosed by a registered medical practitioner for it to be considered as a confirmed case.

Sample size calculation: Parameters for the sample size calculation were not available for the study area. Hence the sample size was calculated based on the sample required to estimate a proportion with an approximate 95% confidence level. The following formula was used:

$$n=Z^2(p-q)/d^2$$

Where, n = required sample size,

p = proportion of the population having the characteristic,

q = 1- p and d = the degree of precision.

Based on the above sampling frame the proportion was set as p= 0.5 (and therefore q= 1- 0.5= 0.5). With assumed margin of error of ± 5%, d = 0.05.

$n= (1.96)^2 * 0.5 *0.5/0.05^2$

n= 400

Assuming 25% non-response, 500 households were approached.

Data collection procedure: The secondary data was made available by MPH students at IIHMR, Jaipur that were involved in the primary study as part of their Epidemiology Field Exercise. Primary data was collected with the help of PSU listing, which was done in 2016 during NFHS-4. 15 PSU were randomly selected with the help of Epi Info software. Five teams of 15 data collectors were selected from IIHMR, Jaipur. Two days of training consisted of classroom instructions on fundamentals of data collection and study was provided. Pre-testing of questionnaire was done at IIHMR, Jaipur. A Senior Research Officer from IIHMR supervised each team and provided support. Structured one-on-one interviews were conducted on the basis of a predetermined questionnaire (included in the report) and socio demographic, clinical and epidemiological data was collected. Any member of the household older than 18 years was interviewed to obtain medical history and epidemiological data.

Selection of households: Data was collected from 514 households from 15 PSU, and thus 35 households were selected from each PSU. In each PSU, for selection of sequence of households, the collectors divided the total number of households by 35. Every 3rd household was selected for interview according to Census Enumeration Block, from NFHS-4 household listing. If a household

member in the selected household was not present for interview, the next immediate household was approached, but for consequent interviews, the initial plan was followed. The collectors considered 'non-respondent' as a household.

Inclusion & exclusion criteria were considered in the primary data collection:

- The respondent should be above the age of 18 yrs.
- The members of the household must be residing at the selected location for at least 12 weeks/3 months.
- After interviewing for demographic information, the interview was terminated unless there was at least *one* member of the household who had suffered from fever with joint pain in the last 12 weeks/3 months.
- Diagnosis made by only a registered medical practitioner was considered as a definitive case to include into the study.
- Patients with any previous history of arthritis/ any other medical condition were considered precautionary.
- Amount of work lost were considered for students, and homemakers.
- Travel history out of local station in the last 12 weeks only was considered as a contributory factor.
- Total monthly income was calculated in a cumulative way for one household, inclusive of all the earning members of the family.
- If the respondent was not willing to share any information, it was considered as 'not-disclosed' but was included in the analysis.
- If the respondent was unaware of any answer, it was considered under the category of 'don't know', but was included in the analysis.

Data Management

Data entry: The collected data have been entered into electronic database(CSPro) and SPSS have been used for storage and final analysis using Tables from Excel.

- Data identifiers were used to check validity and consistency.

Usage of table look-up systems to restrict values of categorical data to a limited number of possible values or restrict to accept only valid dates. Retaining flexibility to correct errors at the time of data entry to reduce error rate. For continuous data normal population ranges to of a variable to flag outliers.

Identifying the numerical, categorical variable.

Outcomes: In order to most accurately model the cross sectional study of CHIKV, a variety of applicable real world data will be analyzed and calibrated to determine key model parameters and variable relationships. Frequencies and proportions with 95% confidence interval has been used to interpret the data.

Data Quality Check:

Validation of values: Missing value check and subsequent imputation. Data validated using consistency and inconsistency checking.

Variable distribution: Studying the distribution of each variable.

Statistical Analysis:

Descriptive Analysis: Mean, Median, STD Dev, Range

Bivariate analysis between the dependent variable Chikungunya infection and independent variables to calculate Odds Ratio.

All statistical analyses have been performed by using, SPSS version 16.0 software (IBM, USA) and P values <0.05 considered statistical significance.

Ethical consideration: The Ethical Review Board at IIHMR, Jaipur approved this study. The secondary data made available is void of any information that can be used to identify the respondents of the primary study.

Results:

Data from a total of 458 households that represented 2464 individuals in Jaipur were studied amongst the 512 household that agreed to participate in the study. 320 [13%, n=2464] individuals suffered from Chikungunya. 192 [41.9%, n=458] households had at least one member who suffered from Chikungunya. Prevalence of Chikungunya disease in Jaipur City in 2016 was estimated to be between 11.66% – 14.32% [95%CI]

Demographic Characteristics

The study participants constituted of 1191 females [48.3%] and 1273 males [51.7%]. About 53.4% [1315] of the individuals were between the ages 15-45 years. 7.8% [192] less than 5 years old, 16.6% [410] between 5-14 years old, 13.7% [337] between 46-59 years old and 8.5% [210] more than 60 years old.

The average family size of these households is 5-6 members [Mean 5.41, SD 2.629]. On average each household had almost equal distribution of males and females, with statistically more male

members than females [Male members: Mean 2.79, SD 1.581, Female members: Mean 2.62, SD 1.532]. Heads of the household never went to school were 19.2% [88], 12.2% [56] had completed primary school, 17% [78] had completed middle school, 12.2% [56] had completed higher secondary school, 24.9% [114] were graduates and 14.4% [66] had completed post-graduate education. Amongst the data collected from 291 households who were willing to share their income information 50% of these households earned a per capita income of Rs. 42,857.

The mean age of the 320 patients who suffered from Chikungunya is 32.78 years [Median 30, Range 0 – 83]. 49.1% [157] individuals were male contributing to 6.4% of the total male population of the individuals under study, while 50.9% [163] were females that contributed to 6.6% of the total female population. 58.4% [187] individuals' place of work (School or Play in case of children) was indoors, 15% [48] was outdoors, and 26.6% had reported both indoors and outdoors. Mean duration of symptoms after acute onset was 14.76 days [Median 10, Range 1- 74]. Percentage of patients that had a previous history of arthritic/other medical condition was 18.1% [58] 18 of whom were currently under medication for the same. Patients who had traveled outside Jaipur City in the last 3 months were 0.9% [23] of the total patients, 13 of which in travelled within Rajasthan and the rest 10 to other states (UP, Delhi NCR, Gujrat, Maharashtra). 97.8% [313] individuals sought medical treatment while 2.2% [7] did not. Of the 313 individuals, 70%, [219] sought treatment in private health facilities/clinics followed by 21.4% [67] who sought treatment in government facilities while 8.6% [27] sought treatment in both government and private health facilities. Treatment costs spent upon the consultation with the doctor ranged between Rs.2 - Rs. 20,000, on hospital stay Rs.4000 - 74,000, on diagnostic tests Rs.150 – Rs 15,000, on medications Rs.20 - Rs. 23000, and between Rs. 20 - Rs. 2100 on travel. Patients complained a mean of 5.46

work/school days lost due to the disease [Median 3.00, Range 0 – 45]. Amount lost not directly linked to treatment ranged between Rs. 90 – Rs 30,000.

42.8% [196] households reported water collection inside their houses. Households that had a garden in their house contributed 39.3% [180] of total households where as 7.2% [33] households reported a pond or a pool near their vicinity, and 67.2% [308] households had an air-cooler of which 70.5% [217, n=308] households claimed they cleaned it at least once in a week. Households that collected water in an open tank were 15.5% [71] of which 47.9% [34, n=71] households claimed to clean it at least once in a week. Only 31% [142] households complained of an open drainage system in their locality. In contrast, 72.5% [332] households had a closed drainage system installed inside their houses.

It was observed that 49.3% [226] of households complained of stagnant water collection in their locality 80.6% [369] households complained of facing issues pertaining to mosquitoes. Only 6.6% [30] households had ever used indoor residual spray against mosquitoes amongst them only 3.9% [8] households had used it in the last 3 months. A high percentage i.e. 91.5% [419] households were using other preventive measures against mosquito-bites, like oil, diffusers, spray, cream, mosquito nets and natural methods like the *smoke of Neem leaves*. 253 households used only one type of preventive measure while 166 households used multiple types of preventive measures against mosquitoes.

Bivariate Analysis

Age groups were significantly associated with chikungunya disease. The odds ratio was 1.5 for the age group 15 – 59 [95%CI – 1.165 – 3.493] compared to individuals less than 15 years old. There were no significant association between other independent factors such as the gender of the

individual, the education status of the head of the household, the per capita income of the household and the risk of Chikungunya disease. Family size showed significant association. The odds ratio when considering individuals at risk in a family with 7 members or more was 0.7 [95%CI – 0.525 – 0.905] compared to family sizes with 1 – 6 members. Independent variables that represented water stagnation, that are, water collection inside the house, gardens inside house, using air coolers, frequency of cleaning air coolers, using open water tanks, frequency of cleaning open water tanks, presence of pools or ponds in the locality, type of household drainage system, presence of open drainage in the locality and water collection in the locality did not show any significant association with Chikungunya disease when analysed for both individual risk and household risk. Usage of other preventive measures besides indoor residual spray against mosquito bites did not show a significant relationship.

Multivariate Regression Analysis

Analysis did not result in any statistically significant finding to determine any independent factor that was associated with Chikungunya risk in individuals.

Discussion

This cross-sectional study was conducted to determine the prevalence of Chikungunya in Jaipur City of Rajasthan, and to estimate the burden of the disease on the residents of this city. Results indicate that of the 458 households, 41.9% [192] had at least one members that suffered from Chikungunya. Of 2464 individuals who were members of these households 13% [320] individuals suffered from Chikungunya. From these numbers the estimated prevalence of Chikungunya cases in Jaipur City was between 11.66 – 14.32% in the months of August to October 2016. The average family size in India is 4-5 members. Correspondingly, the average size of the population in this study was between 5-6 members. Results of this study show a significant relationship between

large families and chikungunya infection with families that have more than 7 members associated with increased risks when households were considered as a single unit but showed reduced risk when assessing for individuals. The odds ratio for these families when bivariate analysis was conducted for households resulted in odds ratio of 1.977 compared with those that had a smaller family (1-7 members). This may be because, mathematically, individual risks may be diluted amongst larger families. This study reported an almost equal distribution of male and female members in each household. Also, this study did not reveal any significant association of gender with Chikungunya infection. A study which was conducted in Chennai and in an outbreak at Vellore, South India revealed that, more females were affected than males. The maximum number of family members in this study were in the age group of 15-59 years [67%]. This age group was associated with 50% more risk of contracting the disease with an odds ratio of 1.5, compared to the reference age group of those who were less than 15 years old. This is possibly corresponding to the fact that most individuals in these age-groups are working, hence are more predisposed to being outdoors, and thus having a higher chance of contracting the disease due to an increased risk of exposure to the mosquito bites. Results for the propensity to travel and chikungunya were insignificant in this study. According to an outbreak investigation done in South India in 2006, the cases of Chikungunya were fewer in households with a lower socioeconomic status, with no water storage facility. This study sought to identify similar results based on factors corresponding to water stagnation. Bivariate analysis of these independent factors with Chikungunya infection did not result in significant statistical associations, however, there is enough literature published to attribute the disease with an increase in breeding sites for the diseases vector, *Aedes aegypti* as a result of water stagnation and the incidence of this disease. The non-significant statistical results

may be attributed to the low prevalence [13%] of the disease in the studied population and therefore demands a future study with a larger sample size.

Socio-economic indicators of a household like the education level of the head of the household and the per capita income seem to show no significant association with Chikungunya. This may be due to the vector population in Jaipur City and the territory each mosquito covers (almost a 500-meter radius), the close proximity of houses that belong to families of vastly different socio-economic status and the city's climate during August to October that overwhelm the effect of such factors.

Cases were determined based on the reported history of fever along with arthralgia or myalgia or arthritis and/or skin rash by patients. The median duration of symptoms were 10 days ranging from 1 – 75 days. A study in Maharashtra reported median duration for fever as 3 days, and for joint pain as 4 days. (42) The study shows that, 97.8% cases sought medical treatment, of which 21.4% preferred government health care facilities, while 70% preferred private medical facilities for their treatment. Similar studies in Maharashtra and Tamil Nadu show the preference of 40.3% and 27% among the cases to go for the public health care. (43) The mean costs incurred for a doctor's consultation was Rs. 1079. Those reported for hospital stay is Rs. 281, Rs. 282 for a diagnostic test, Rs. 608 for medicines, Rs. 66 for travel and Rs. 722 in other costs are unlikely to represent the population of Jaipur due to insufficient amount of responses collected during primary data collection. Chikungunya is treated mostly with NSAIDs and oral fluids and other treatment modalities are purely experimental. Also the nature of the disease is self-limiting and hospital admission is rare. Laboratory confirmation is not advised unless the disease manifests with severe symptoms. In this regard the average costs incurred may be summed as those involving medical

consultation, buying medicine, travel and other costs such as buying fluid supplements. A study conducted in Kerala in 2007, estimated total OOP expenditure for families affected in the Chikungunya outbreak with the median expenditure in the study population at US$7.4 (Rs. 300, $1 = Rs. 40.565 August 15,2007). Other studies reported about the perceptions among the respondents about the disease and the vector of the responsible virus, which was not included in this study. Complications of post chikungunya infection were not included in this study. Moreover, different studies incorporated diagnostic tests including- serological tests and molecular techniques. These are few limitations of this study in addition to the usual limitations of a secondary data analysis that warrants for further investigations in the same context. The primary data collection of this study was intended to principally determine the prevalence of Chikungunya in Jaipur and thus further analysis of determinants resulted in mostly statistically insignificant outcomes.

Conclusion

Chikungunya has re-emerged in India in 2005 and was responsible for epidemics in this country as far back as 1824. The prevalence of the disease in the population studied is 13% (n=2464) and that the prevalence in Jaipur is estimated to be between 11.66% to 14.32%. The working population between the ages 15 – 59 seem to be at an increased risk, which is biologically plausible because they are exposed to higher chances of getting bitten by the vector *Aedes aegypti* mosquito during the humid months of August to October in Jaipur City as they transition from indoor spaces to outdoors compared to individuals that belong to the dependent population that is 0-14 years and the elderly 60 years and above. Households with 7 or more members face an increased risk compared to those with fewer members. Water stagnation and ineffective vector control measure increases breeding of mosquitoes, increasing the risk of vector – host contact resulting in an

increased prevalence of the disease. Although this study does not show significant statistical relationship between factors related to water stagnation or vector control and Chikungunya disease, currently, due to the absence of specific treatments or a vaccine against Chikungunya and the proven causal relationship between *Aedes aegypti* bite and transmission of this viral infection, it is only possible to protect the population by strengthening vector control measures and improving household drainage systems such that the chances of water stagnation and the resultant increase in vector populations is minimized to prevent further epidemics.

Tables:

Table 1. Baseline characteristics of individuals

Characteristics		Frequency	%
Gender	Male	1273	51.7
	Female	1191	48.3
Age	Under 15 years	602	24.4
	15-60 years	1652	67
	Above 60 years	210	8.5
Chikungunya Status	Chikungunya Present	320	13
	Chikungunya Absent	2144	87

Table 2. Baseline characteristics of households

Characteristics		Frequency	%
Family Size (n=458)	1-4 Members	189	41.3
	5-6 Members	161	35.2
	More than 7 Members	108	23.6
Level of Education of the Head of the Household (n=458)	Post-Graduation	66	14.4
	Graduation	114	24.9
	Higher Secondary	56	12.2
	Middle School	78	17
	Primary	56	12.2
	No Schooling	88	19.2
Per Capita Income (n=291)	Less than Rs. 13000	24	8.2
	More than Rs. 13000	267	91.8
Water collection inside household	Absent	262	57.2
	Present	196	42.8
Garden in around the household	Absent	278	60.7
	Present	180	39.3
Pools/Ponds near the household	Absent	425	92.8
	Present	33	7.2
Using Air Coolers in the household	No	150	32.8
	Yes	308	67.2
Frequency of air cooler cleaning	Less than a week	217	47.4
	More than a week or never	91	19.9
	Household without cooler	150	32.8
Using an open water tank	No	387	84.5

	Yes	71	15.5
Frequency of cleaning Open water tank	In less than a week	34	7.4
	More than a week or never	37	8.1
	Households without open water tank	387	84.5
Presence of Open Drainage in the locality	No	316	69
	Yes	142	31
Type of Drainage System used in the household	Covered	332	72.5
	Open	126	27.5
Water Collection in the locality	No	232	50.7
	Yes	226	49.3
Households facing issues pertaining to mosquitoes	No	89	19.4
	Yes	369	80.6
Households ever used indoor residual spray	Used	30	6.6
	Never used	428	93.4
Indoor Residual Spray used in the last 3 months	Yes	18	3.9
	No	12	2.6
	Never Used	428	93.4
Using other preventive measures against mosquito bites	Yes	419	91.5
	No	39	8.5
Using Single or Multiple type of preventive measure against mosquitos	Single	253	55.2
	Multiple	166	36.2
	Not using	39	8.5
Chikungunya patient in household	Yes	192	41.9
	No	266	58.1

Table 3.1 Patient Description

Characteristics N=320		Frequency	%
Gender	Male	157	49.1
	Female	163	50.9
Age	Under 15 years	51	15.9
	15-59 years	240	75
	60 years and above	29	9.1
Place of Work	Indoors	187	58.4
	Outdoors	48	15
	Both	85	26.6

Medical Treatment Sought	Yes	313	97.8
	No	7	2.2
Type of Medical Facility Utilized (n=313)	Government	67	21.4
	Private	219	70
	Both	27	8.6

Table 3.2 Patient Description

	Mean	Median	Standard Deviation	Minimum	Maximum
Duration of Symptoms (in days)	14.76	10.00	14.612	1	75
Costs in Doctor Consultation (in Rs.)	1079.48	200.00	2547.518	0	20000
Work/school days lost due to Disease	5.46	3.00	7.003	0	45

Table 4. Bivariate analysis between prevalence of Chikungunya and factors studied

Factor		Chikungunya Present	Chikungunya Absent	Odds Ratio	95% CI
Gender	Female	163	1028	1	
	Male	157	1116	0.887	(0.701 – 1.122)
Age	Under 15 years	51	551	1	
	15-59 years	240	1412	1.525	1.143 - 2.033
	60 years and above	29	181	1.033	0.778 - 1.372
Education of Head of Household	Post-Graduation	39	239	1	
	Graduation	80	486	1.009	(0.668 – 1.524)
	High School (9-12)	31	233	0.815	(0.492- 1.351)
	Middle School (6-8)	70	389	1.103	(0.722-1.684)
	Primary School (1-5)	35	298	0.72	(0.442- 1.171)
	No Schooling	65	499	0.798	(0.521-1.222)
Family Size	1-4 Members	103	515	1	
	5-6 Members	103	760		
	7 or more Members	114	869	0.69	(0.525-0.905)

Water collection inside household	Absent	162	1207	1	
	Present	158	937	1.256	(0.993 – 1.589)
Garden in around the household	Absent	201	1301	1	
	Present	119	843	0.914	(0.717 – 1.165)
Pools/Ponds near the household	Absent	305	1981	1	
	Present	15	163	0.598	(0.347 – 1.028)
Using Air Coolers in the household	No	103	692	1	
	Yes	217	1452	1.004	(0.781 – 1.291)
Frequency of air cooler cleaning	Less than a week	148	1021	1	
	More than a week or never	69	431	1.104	(0.812 – 1.501)
	In Households without cooler	103	692		
Using an open water tank	No	265	1821	1	
	Yes	55	323	1.17	(0.855 – 1.601)
Frequency of cleaning Open water tank	In less than a week	28	163	1	
	More than a week or never	27	160	1.018	(0.575 – 1.803)
	Households without open water tank	265	1821		
Presence of Open Drainage in the locality	No	215	1344	1	
	Yes	105	800	0.82	(0.639 – 1.053)
Type of Drainage System used in the household	Covered	225	1460	1	
	Open	95	684	0.901	(0.697 – 1.165)
Water Collection in the locality	No	165	982	1	
	Yes	155	1162	0.794	(0.628 – 1.004)
Households ever used indoor residual spray	Never used	304	2007	1	
	Used	17	136	1.297	(0.762 – 2.207)
Using other preventive measures against mosquito bites	Yes	307	1998	1	
	No	13	146	0.579	0.325 – 1.035)

References

(1) Powers AM, Logue CH. Changing patterns of chikungunya virus: re-emergence of a zoonotic arbovirus. J Gen Virol 2007;88(9):2363-2377.

(2) Rossini G, Landini MP, Sambri V. Evolution and Epidemiology of Chikungunya Virus. Chikungunya Virus: Methods and Protocols 2016:3-10.

(3) Burt FJ, Rolph MS, Rulli NE, Mahalingam S, Heise MT. Chikungunya: a re-emerging virus. The Lancet 2012;379(9816):662-671.

(4) Mohan A, Kiran DH, Manohar IC, Kumar DP. Epidemiology, clinical manifestations, and diagnosis of Chikungunya fever: lessons learned from the re-emerging epidemic. Indian J Dermatol 2010;55(1):54-63.

(5) Weaver SC, Lecuit M. Chikungunya virus and the global spread of a mosquito-borne disease. N Engl J Med 2015;372(13):1231-1239.

(6) Carey DE. Chikungunya and dengue: a case of mistaken identity? J Hist Med Allied Sci 1971;26(3):243.

(7) Christie J. Remarks on "Kidinga Pepo": A Peculiar Form of Exanthematous Disease. Br Med J 1872 Jun 1;1(596):577-579.

(8) Halstead SB. Reappearance of chikungunya, formerly called dengue, in the Americas. Emerg Infect Dis 2015 Apr;21(4):557-561.

(9) Lahariya C, Pradhan S. Emergence of chikungunya virus in Indian subcontinent after 32 years: a review. Journal of vector borne diseases 2006;43(4):151.

(10) Lumsden W. An epidemic of virus disease in Southern Province, Tanganyika territory, in 1952–1953 II. General description and epidemiology. Trans R Soc Trop Med Hyg 1955;49(1):33-57.

(11) Robinson MC. An epidemic of virus disease in Southern Province, Tanganyika territory, in 1952–1953. Trans R Soc Trop Med Hyg 1955;49(1):28-32.

(12) Hammon WM, Sather G. Virological findings in the 1960 hemorrhagic fever epidemic (dengue) in Thailand. Am J Trop Med Hyg 1964;13(4):629-641.

(13) Myers R, Carey D, Reuben R, Jesudass E, De Ranitz C, Jadhav M. The 1964 epidemic of dengue-like fever in South India: isolation of chikungunya virus from human sera and from mosquitoes. Indian J Med Res 1965;53(8).

(14) SHAH KV, GIBBS CJ,Jr, BANERJEE G. Virological Investigation of the Epidemic of Haemorrhagic Fever in Calcutta: Isolation of Three Strains of Chikungunya Virus. Indian J Med Res 1964 Jul;52:676-683.

(15) Volk SM, Chen R, Tsetsarkin KA, Adams AP, Garcia TI, Sall AA, et al. Genome-scale phylogenetic analyses of chikungunya virus reveal independent emergences of recent epidemics and various evolutionary rates. J Virol 2010 Jul;84(13):6497-6504.

(16) Ng LC, Hapuarachchi HC. Tracing the path of Chikungunya virus—evolution and adaptation. Infection, Genetics and Evolution 2010;10(7):876-885.

(17) Tsetsarkin KA, Vanlandingham DL, McGee CE, Higgs S. A single mutation in chikungunya virus affects vector specificity and epidemic potential. PLoS pathogens 2007;3(12):e201.

(18) Wong HV, Chan YF, Sam I, Sulaiman WYW, Vythilingam I. Chikungunya virus infection of Aedes mosquitoes. Chikungunya Virus: Methods and Protocols 2016:119-128.

(19) Ang SK, Lam S, Chu JJH. Propagation of Chikungunya Virus Using Mosquito Cells. Chikungunya Virus: Methods and Protocols 2016:87-92.

(20) Yergolkar PN, Tandale BV, Arankalle VA, Sathe PS, Sudeep AB, Gandhe SS, et al. Chikungunya outbreaks caused by African genotype, India. Emerg Infect Dis 2006 Oct;12(10):1580-1583.

(21) Diallo M, Thonnon J, Traore-Lamizana M, Fontenille D. Vectors of Chikungunya virus in Senegal: current data and transmission cycles. Am J Trop Med Hyg 1999;60(2):281-286.

(22) Gérardin P, Barau G, Michault A, Bintner M, Randrianaivo H, Choker G, et al. Multidisciplinary prospective study of mother-to-child chikungunya virus infections on the island of La Reunion. PLoS medicine 2008;5(3):e60.

(23) Borgherini G, Poubeau P, Staikowsky F, Lory M, Moullec NL, Becquart JP, et al. Outbreak of chikungunya on Reunion Island: early clinical and laboratory features in 157 adult patients. Clinical Infectious Diseases 2007;44(11):1401-1407.

(24) Filipe AF, Pinto MR. Arbovirus studies in Luanda, Angola. 2. Virological and serological studies during an outbreak of dengue-like disease caused by the Chikungunya virus. Bull World Health Organ 1973;49(1):37-40.

(25) Queyriaux B, Simon F, Grandadam M, Michel R, Tolou H, Boutin J. Clinical burden of chikungunya virus infection. The Lancet infectious diseases 2008;8(1):2-3.

(26) Manimunda SP, Vijayachari P, Uppoor R, Sugunan AP, Singh SS, Rai SK, et al. Clinical progression of chikungunya fever during acute and chronic arthritic stages and the changes in joint morphology as revealed by imaging. Trans R Soc Trop Med Hyg 2010;104(6):392-399.

(27) Robin S, Ramful D, Zettor J, Benhamou L, Jaffar-Bandjee M, Rivière J, et al. Severe bullous skin lesions associated with Chikungunya virus infection in small infants. Eur J Pediatr 2010;169(1):67.

(28) Sissoko D, Malvy D, Ezzedine K, Renault P, Moscetti F, Ledrans M, et al. Post-epidemic Chikungunya disease on Reunion Island: course of rheumatic manifestations and associated factors over a 15-month period. PLoS neglected tropical diseases 2009;3(3):e389.

(29) Soumahoro M, Gérardin P, Boëlle P, Perrau J, Fianu A, Pouchot J, et al. Impact of Chikungunya virus infection on health status and quality of life: a retrospective cohort study. PLoS One 2009;4(11):e7800.

(30) Inamadar AC, Palit A, Sampagavi V, Raghunath S, Deshmukh N. Cutaneous manifestations of chikungunya fever: observations made during a recent outbreak in south India. Int J Dermatol 2008;47(2):154-159.

(31) Economopoulou A, Dominguez M, Helynck B, Sissoko D, Wichmann O, Quenel P, et al. Atypical Chikungunya virus infections: clinical manifestations, mortality and risk factors for severe disease during the 2005–2006 outbreak on Reunion. Epidemiology & Infection 2009;137(4):534-541.

(32) Rampal, Sharda M, Meena H. Neurological complications in Chikungunya fever. J Assoc Physicians India 2007 Nov;55:765-769.

(33) Wielanek AC, Monredon JD, Amrani ME, Roger JC, Serveaux JP. Guillain-Barre syndrome complicating a Chikungunya virus infection. Neurology 2007 Nov 27;69(22):2105-2107.

(34) Singh S, Manimunda S, Sugunan A, Vijayachari P. Four cases of acute flaccid paralysis associated with chikungunya virus infection. Epidemiology & Infection 2008;136(9):1277-1280.

(35) Gaibani P, Landini MP, Sambri V. Diagnostic Methods for CHIKV Based on Serological Tools. Chikungunya Virus: Methods and Protocols 2016:63-73.

(36) Yap G, Pok K, Lai Y, Hapuarachchi H, Chow A. Evaluation of Chikungunya Diagnostic Assays: Differences in Sensitivity of Serology. 2010.

(37) Lamballerie XD, Boisson V, Reynier J, Enault S, Charrel RN, Flahault A, et al. On chikungunya acute infection and chloroquine treatment. Vector-Borne and Zoonotic Diseases 2008;8(6):837-840.

(38) Schilte C, Couderc T, Chretien F, Sourisseau M, Gangneux N, Guivel-Benhassine F, et al. Type I IFN controls chikungunya virus via its action on nonhematopoietic cells. J Exp Med 2010 Feb 15;207(2):429-442.

(39) Jayakrishnan T, Jeeja M, Kuniyil V, Paramasivam S. Increasing out-of-pocket health care expenditure in India-due to supply or demand. Pharmacoeconomics 2016;1(105):2.

(40) Vijayakumar K, George B, Anish T, Rajasi R, Teena M, Sujina C. Economic impact of chikungunya epidemic: out-of-pocket health expenditures during the 2007 outbreak in Kerala, India. Southeast Asian J Trop Med Public Health 2013;44(1):54.

(41) Murtola TM, Vasan S, Puwar TI, Govil D, Field RW, Gong H, et al. Preliminary estimate of immediate cost of chikungunya and dengue to Gujarat, India. 2010.

(42) Patil SS, Patil SR, Durgawale PM, Patil AG. A study of the outbreak of Chikungunya fever. Journal of clinical and diagnostic research: JCDR. 2013 Jun;7(6):1059.

(43) Balasubramaniam SM, Krishnakumar J, Stephen T, Gaur R, Appavoo NC. Prevalence of Chikungunya in urban field practice area of a private medical college, Chennai. Indian journal of community medicine: official publication of Indian Association of Preventive & Social Medicine. 2011 Apr;36(2):124.