Publisher homepage: www.universepg.com, ISSN: 2663-7529 (Online) & 2663-7510 (Print)

https://doi.org/10.34104/ejmhs.021.01030110

European Journal of Medical and Health Sciences

Journal homepage: www.universepg.com/journal/ejmhs

Exploring Socio-Economic Impact of Chikungunya Fever in Dhaka: A Statistical Modeling Approach

Mohammad Ahsan Uddin*

Department of Statistics, University of Dhaka, Dhaka, Bangladesh.

*Correspondence: munna_stat@yahoo.com (Dr. Mohammad Ahsan Uddin, Associate Professor, Department of Statistics, University of Dhaka, Dhaka, Bangladesh).

ABSTRACT

The study mainly focused on the socio-economic impact rather than the biological significance of Chikungunya fever in Dhaka city. The socio-economic impact had been measured mainly upon family cost and absence in the working place. It had been investigated whether a percentage of monthly family income spend on monthly expenditure changes due to Chikungunya incidence. Also, another inquiry was made about the productivity of the respondents, which had been measured by the number of absences in working place. The study considered primary data of 272 affected and 272 unaffected respondents from Dhaka city and found no significant association of family cost with Chikungunya incidence but the loss of productivity turned out as statistically significant. Another important objective was to explore potential determinants of Chikungunya. It is found that some patients use no preventive approach, while the majority uses mosquito nets as a preventive approach. The respondents suggest themselves mostly to keep the drain free from blockage, regular changing water from plant containers, and use mosquito repellent and net. They seek from the government mostly to provide regular mosquito spray, develop drainage systems, and remove blocked water sources. Chikungunya has no direct economic impact on a family. But, as it affects productivity, it affects the national economy to a great extent.

Keywords: Socio-economic impact, Productivity, Potential determinants, Risk factors, Multiple responses.

INTRODUCTION:

In the developing and under-developed countries, contagious diseases are main indicating factors of poor health status and poverty (Kumar *et al*., 2007). The recent Chikungunya viral epidemic in Bangladesh affected the strength and ability of working populations to carry on with regular activities which resulted in damaging socioeconomic back grounds. Chikungunya is a mosquito-borne (*Aedes species)* disease caused by Chikungunya virus (CHIKV), which is transmitted through the bite of an infected mosquito. It creates an acute infection of sudden onset, characterized by high fever, headache, joint swelling, photophobia, rash and retro-orbital pain (Abedin *et al*., 2021; Hossain *et al.*, 2018). Chikungunya virus was first identified in 1953, in Tanzania (Goh *et al.,* 2015). After that, Chikungunya disease caused many large-scale outbreaks in India, Southeast Asia, Western Pacific, America, and Africa (Burt *et al*., 2017; Nunes *et al*., 2015; Thiberville *et al*., 2013). In Bangladesh, Chikungunya was first recognized and reported in 2008 (Icddr, 2009). In 2011 and 2012, rural Bangladesh experienced outbreaks of Chikungunya (Grainger, 2008; Khatun *et al.*, 2015).

The peak time of Chikungunya outbreak as identified by IEDCR is between early May and end of July (Hossain *et al.*, 2018). Capital city Dhaka had experienced a large-scale Chikungunya outbreak in 2017.

The main objective of this study was to determine the socio-economic impact of Chikungunya in Dhaka City. The socio-economic impact was considered through the absence in working place of the affected people and percentage of monthly family income spends to monthly family expenditure due to Chikungunya disease. The risk factors of disease were also identified. Various suggestions for knocking the disease off had been analyzed and then a concluding remark ended the study.

MATERIALS AND METHODS:

For the study, primary data was collected; a questionnaire was designed cautiously with respect to study objectives. Direct interview (face-to-face) method was used in this study, the study covered a total of 272 Chikungunya affected and 272 unaffected respondents. Data on economic variables were collected from only the earning members of the families. The questionnaire covered eight major sections: personal (demographic) information of the respondent's, economic condition, environmental condition, disease incidence, treatment, preventive measure, knowledge on Chikungunya, suggestions.

Two most popular regression models, multiple linear regression and binary logistic regression, had been employed. When there is more than one covariate and the response variable is of continuous type having linear relation to the covariates and follows some other specific assumptions then multiple linear regression is used (Nathans *et al*., 2012). For the vector of response variable $\boldsymbol{Y}$ and vector of covariates$\boldsymbol{x}$, the functional form of the model in matrix notation becomes (Brown, 2009)

$$\boldsymbol{Y} = \boldsymbol{x}'\boldsymbol{\beta} + \boldsymbol{\epsilon},$$

Where $\boldsymbol{\beta}$ and $\boldsymbol{\epsilon}$ be the vector of regression coefficient and random error term, respectively. Now, if the response vector $\boldsymbol{Y}$ be of binary type i.e. referring to whether an event has occurred or not, binary logistic regression is used for modeling purpose, which has the form (Sarkar & Midi, 2010)

$$\pi(\boldsymbol{x}) = \frac{e^{\boldsymbol{x}'\boldsymbol{\beta}}}{1 + e^{\boldsymbol{x}'\boldsymbol{\beta}}}$$

Where $\pi(\boldsymbol{x})$ represents the conditional mean of $\boldsymbol{Y}$ given $\boldsymbol{x}$ i.e., $E(\boldsymbol{Y}|\,\boldsymbol{x})$. For both model, the unknown parameters ($\boldsymbol{\beta}$) are estimated by the method of maximum likelihood estimation (Albert & Anderson, 1984; Myung, 2003). The former model has been used for relating family cost and productivity to Chikungunya incidence, while the factors behind occurring Chikungunya disease was identified by the later model. Also, multiple response analysis had been incorporated in this paper to assess various suggestions from the study participants to reduce the disease in future.

Model 1

The first model was a multiple linear regression model that determined, primarily, the effect of Chikungunya infection on the monthly expenditure of the patient. Here, dependent variable *family cost* [percentage of monthly income spent on expenditure] was used as a proxy for the measure of monthly expenditure of the patient. The main independent variable was Chikungunya *incidence* and some other independent variables related to spend on expenditure were considered in this model. The model took the form as –

$$\begin{aligned} family\ cost_{\,i} = {} & \beta_0 + \beta_1 incidence_i + \beta_2 living\ status_i \\ & + \beta_3 family\ size_i + \beta_4 marital\ status_i \\ & + \beta_5 age_i + \beta_6 gender_i \\ & + \beta_7 treatment\ cost_i + \epsilon_i, \\ & i = 1, 2, \cdots, n; \end{aligned}$$

Where β denotes regression coefficient and ϵ_i is the random error term of the i^{th} respondent.

Model 2

The second model was again a multiple linear regression model that was used to determine the effect of Chikungunya infection on the productivity of the patient. Here, dependent variable absence [number of days absent from work] was used as a proxy for the measure of productivity of the patient. The same independent variables from model 1 were accommodated in this model, where the main independent variable was Chikungunya incidence. The model had the expression as

$$\begin{aligned} absence_{\,i} = {} & \beta_0 + \beta_1 incidence_i + \beta_2 living\ status_i \\ & + \beta_3 family\ size_i + \beta_4 marital\ status_i \\ & + \beta_5 age_i + \beta_6 gender_i \\ & + \beta_7 treatment\ cost_i + \epsilon_i, \\ & i = 1, 2, \cdots, n; \end{aligned}$$

Where β and ϵ_i bear the same meaning as before.

Model 3

Binary logistic regression model had been used to identify the factors which were responsible for occur-

ring Chikungunya disease. The acting response variable in this model was *incidence* [whether Chikungunya disease occurred or not], which was of binary type. The relationship between these response variable and related covariates took the functional form as –

$$incidence_i = \beta_0 + \beta_1 providing\ spray_i + \beta_2 water\ existence_i + \beta_3 area_i + \beta_4 gender_i + \beta_5 age_i + \beta_6 education\ status_i + \beta_7 marital\ status_i + \beta_8 living\ status_i + \beta_9 drainage\ system_i + \epsilon_i, \quad i = 1, 2, \cdots, n;$$

Where β and ϵ_i bear the same meaning as before.

RESULTS AND DISCUSSIONS:

Multiple linear regression and binary logistic regression models had been employed in this paper for analyzing Chikungunya patients' data in Dhaka city. Family cost related factors are presented in **Table 1**. The obtained significant variables are living status, family size, age, gender, and treatment cost, while incidence and marital status are insignificant at 5% level of significance.

Table 1: Multiple linear regression model estimates of the selected covariates for family cost in Dhaka city along with standard error (SE) and p-value.

Covariates	Coefficient	SE	p-value
Constant	66.681	4.362	<0.001
Incidence			
no	-	-	-
yes	0.899	1.425	0.529
Living status			
alone	-	-	-
with family	4.284	2.730	0.117
with friends	4.141	3.074	0.179
others	13.055	5.222	0.013
Family size	1.377	0.398	0.001
Marital status			
single	-	-	-
married	1.324	2.086	0.526
widowed	5.420	6.169	0.380
Age			
0-15	-	-	-
15-30	6.218	3.126	0.047
30-45	-5.216	3.620	0.148
45-60	3.182	3.702	0.390
60+	-0.561	5.842	0.924
Gender			
male	-	-	-
female	-3.657	1.330	0.006
Treatment	0.001	<.001	<0.001

Living "with others" increases the percentage of monthly income spent on expenditure by 13.055 percent compared to living "alone" keeping all other covariates constant. Living with family and friends has no significant effect compared to living alone at 5% level of significance. Extra one person increase of family member increases expenditure by 1.377 percent. Percentage of monthly income spent on expenditure increases by 6.218 percent in 15-30 age group than0-15 age groups keeping all other independent variables constant. Expenditure decreases by 3.657 percent in the female patient group compared to the male patient group keeping all other independent variables constant. For one-unit increase in treatment cost, Percentage of monthly income spent on expenditure increases by 0.001 percent, keeping all other variables constant. So, treatment cost has significance here.

Table 2: Multiple linear regression model estimates of the selected covariates for productivity in Dhaka city along with standard error (SE) and p-value.

Covariates	Coefficient	SE	p-value
Constant	6.894	1.445	<0.001
Incidence			
no	-	-	-
yes	4.903	0.472	<0.001
Living status			
alone	-	-	-
with family	-1.056	0.905	0.244
with friends	-2.982	1.018	0.004
others	-5.053	1.730	0.004
Family size	0.062	0.132	0.650
Marital status			
single	-	-	-
married	-0.432	0.691	0.532
widowed	-2.871	2.044	0.161
Age			
0-15	-	-	-
15-30	-3.157	1.036	0.002
30-45	-3.066	1.199	0.011
45-60	-3.576	1.226	0.004
60+	-2.527	1.935	0.187
Gender			
male	-	-	-
female	-0.416	0.441	0.345
Treatment cost	<0.001	<.001	0.769

The covariates which affect productivity of the respondents are shown in **Table 2**, it reflects that the

covariates incidence, living status, and age are significantly affecting productivity of the respondents. Incidence has a significant effect on productivity with p-value less than 0.001. Chikungunya incidence hampers approximately 5 working days, keeping all other variables constant. Patients living with friends/colleagues and others remain approximately 3 and 5 days respectively, less absent from workplace than patients living alone, keeping all other variables constant. So, living status has significance in the model. Patients having age group 15-30, 30-45 and 45-60 remain approximately 3 days on an average less absent from workplace than 0-15 aged patients, keeping all other variables constant. So, age is a significant factor to the productivity of the respondents. The variables family size, marital status, gender, and treatment cost do not affect productivity significantly.

The potential determinants that are acting to occur Chikungunya disease are shown in **Table 3**. The variables marital status, living status, providing spray, and area are found significant; while gender, age, education status, and drainage system are insignificant in the model.

Table 3: Binary logistic regression model estimates of the selected covariates for chikungunya incidence in Dhaka city along with standard error (SE), hazard ratio (HR), and p-value.

Covariates	Coefficient	SE	HR	p-value
Constant	0.541	1.207	1.717	0.654
Gender				
male	-	-	-	-
female	0.056	0.239	1.057	0.815
Age				
0-15	-	-	-	-
15-30	0.352	0.597	1.422	0.555
30-45	0.069	0.640	1.072	0.914
45-60	0.904	0.663	2.470	0.173
60+	-0.144	1.073	0.866	0.893
Marital status				
single	-	-	-	-
married	-0.517	0.341	0.596	0.119
widowed	-3.231	1.263	0.040	0.011
Education status				
illiterate	-	-	-	-
primary	-0.168	0.919	0.846	0.855
secondary	0.924	0.829	2.520	0.265
higher secondary	0.206	0.802	1.229	0.797
graduate	-0.020	0.801	0.980	0.980
Living status				
alone	-	-	-	-
with family	-0.720	0.537	0.487	0.180
with friends	-0.989	0.596	0.372	0.097
others	-1.697	0.848	0.183	0.045
Drainage system				
bad	-	-	-	-
medium	0.124	0.313	1.132	0.692
good	0.301	0.381	1.352	0.429
Providing spray				
no	-	-	-	-
yes	0.979	0.252	2.662	<0.001
Area				
slum	-	-	-	-

residential	0.379	0.385	1.460	0.325
university	0.651	0.438	1.918	0.137
crowded	-20.231	16112.004	<0.001	0.999
VIP	0.291	0.417	1.337	0.486
commercial	0.502	0.979	1.652	0.608
industrial	-2.774	0.823	0.062	0.001
hostel	-1.212	0.600	0.298	0.044

Multiple response analysis is a frequency analysis, when there can be more than one response from each participant of a survey question. Multiple responses are arranged into three portions: analysis of preventive approach of the patients, analysis of suggestions about people's steps on prevention of Chikungunya, and analysis of suggestions about government's steps on prevention of Chikungunya. **Table 4** shows that 7.5% of patients who are affected by Chikungunya don't use any approach such as coil, aerosol, liquid, mosquito racket, net, etc. 34.0% of patients use coil, 37.4% of patients use aerosol, 20.8% of patients use liquid, 23.8% of patients use Mosquito racket and 52.1% of the patients use net as a preventive approach to protect themselves from Chikungunya.

Table 4: Multiple response analysis of used preventive approach of the Chikungunya affected respondents in Dhaka city.

Preventive approach	Percentage (%)
Nothing	7.5
Coil	34.0
Aerosol	37.4
Liquid	20.8
Mosquito racket	23.8
Net	52.1

It is observed from **Table 5** that 6.5% people have no suggestions to prevent Chikungunya fever, 35.4% people prefer that they can cover tightly all water containers, 39.5% people have opinion that they can bury unused tiers, 58.2% people want to keep drain free from blockage, 58.6% people said that they can change water in plant container, 41.4% people prefer to change water in trays under the fridge, 35.4% people said that they can destroy/ burn unused containers, 63.9% people also said that they can use mosquito repellent and mosquito net when sleeping and also further 23.6% of people prefer to take others steps to prevent Chikungunya fever transmission during outbreak.

Table 5: Multiple response analysis of the suggestions regarding necessary steps that people might take to prevent Chikungunya disease.

Necessary steps	Percenta
Burring unused tires	39.5
Keeping drain free from blockage	58.2
Regular changing water from plant container	58.6
Covering all water container tightly	35.4
Changing water from trays under the fridge	41.4
Destroying unused containers	35.4
Use mosquito repellent and net when sleeping	63.9
Other steps	23.6
No step	6.5

From **Table 6**, 44.5% people think that government can repair open manhole, 62% people want that government can develop the drainage system, 51.3% people prefer that government can remove blocked water source, 64.6% people want that government can provide regular mosquito spray, and 48.3% people think that government can keep the locality clean.

Table 6: Multiple response analysis of the suggestions regarding necessary steps that government might take to prevent Chikungunya disease.

Necessary steps	Percentage (%)
Repairing open manhole	44.5
Developing drainage	62.0
Removing blocked water	51.3
Providing regular mosquito	64.6
Keeping the locality clean	48.3

This study initially measures the impact of Chikungunya both on society and economy of Dhaka city. It is found that occurrence of Chikungunya has no significant effect on family expenditure. It may be the case that the treatment of Chikungunya is not that expensive to affect the total family cost. But, this result contradicts a previous work in India (Gopalan & Das, 2009; Vijayakumar *et al*., 2013). However, Chikun-

gunya badly affects productivity of the patients, which is similar to a previous work on this disease (Gopalan & Das, 2009). So, Chikungunya has no direct economic impact in a family. But, as it affects productivity, it affects the national economy to a great extent. Again, living status and age have significant effect on productivity, while family size, gender, treatment cost, age, living status is significant to the family cost of the respondents. Family size, gender, treatment cost, and marital status have no significance to productivity, while incidence of Chikungunya fever, marital status, and living status are insignificant to the family cost of the respondents (Shazeed-Ul-Karim, 2019).

CONCLUSION AND RECOMMENDATIONS:

People living in slum areas are at higher risk of having Chikungunya disease, which might be happen due to the unawareness of the residents and the dirty environment of these areas that grows and reserves mosquitoes (Rashid & Zzaman, 2017). The chance of being affected varies significantly by marital status (Panato *et al.*, 2019). The disease is more likely to occur to the single people. Similarly for the variable living status, it shows high risk of Chikungunya incidence in the alone living group (Gérardin *et al.*, 2014). It might be case that those who are single and/or living alone don't take enough protection against mosquito bite, as a result, experience the disease. An unexpected result is found for providing mosquito spray. The result says that providing mosquito spray increases the risk of Chikungunya incidence which contradicts previous literature (Lahariya & Pradhan, 2006). But, in multiple response analysis, majority respondents have suggested to provide regular mosquito spray. It may happen that the hidden mosquitoes come out into houses from bushes and drains, which indirectly increasing the disease. From the multiple response part, it is found that few patients use no preventive approach, while majority use mosquito net as use preventive approach. It is an effective practice to using mosquito net as in literature (Yazdani & Kaushik, 2007). To the respondents, they suggest themselves mostly to keep drain free from blockage, regular changing water from plant container, and use mosquito repellent and net. They seek from the government mostly to provide regular mosquito spray, develop drainage system, and remove blocked water source. Chikungunya disease had no direct effect on family cost, though it affected productivity to a great extent.

ACKNOWLEDGMENT:

First and foremost, the author is grateful to Almighty Allah. The author is also thankful to anonymous reviewers and editors for their helpful comments and suggestions.

CONFLICTS OF INTEREST:

The author declares no conflict of interest.

REFERENCES:

1) Abedin MZ, Ahmad T, Maruf MAA, Aktar MB, Imran MAS, and Uddin ME. (2021). Analysis of the Dengue infection, occurrence and hematological profile of Dengue patients in Dhaka city, *European Journal of Molecular & Clinical Medicine*, **8**(3), 1572-1574. https://ejmcm.com/article_10118.html
2) Albert, A., & Anderson, J. A. (1984). On the existence of maximum likelihood estimates in logistic regression models. *Biometrika,* **71**(1), 1-10. https://doi.org/10.1093/biomet/71.1.1
3) Brown, S. H. (2009). Multiple linear regression analysis: a matrix approach with MATLAB. *Alabama Journal of Mathematics,* **34**, 1-3. http://www.ajmonline.org/wp-content/uploads/2019/04/brown.pdf
4) Burt, F. J., Chen, W., Miner, J. J., Lenschow, D. J., Merits, A., Schnettler, E., Herrero, L. J. (2017). Chikungunya virus: an update on the biology and pathogenesis of this emerging pathogen. *The Lancet infectious diseases,* **17** (4), e107-e117. https://doi.org/10.1016/S1473-3099(16)30385-1
5) Gérardin, P., Sampériz, S., Ramful, D., Boumahni, B., Bintner, M., Alessandri, J.-L.,Boya, I. (2014). Neurocognitive outcome of children exposed to perinatal mother-to-child Chikungunya virus infection: the CHIMERE cohort study on Reunion Island. *PLoS neglected tropical diseases,* **8**(7); e2996. https://doi.org/10.1371/journal.pntd.0002996
6) Goh, L. Y., Hobson-Peters, J., Prow, N. A., Gardner, J., Bielefeldt-Ohmann, H., Suhrbier, A., & Hall, R. A. (2015). Monoclonal antibodies specific for the capsid protein of chi-

kungunya virus suitable for multiple applications. *Journal of General Virology,* **96**(3), 507-512. https://doi.org/10.1099/jgv.0.000002

7) Gopalan, S. S., & Das, A. (2009). Household economic impact of an emerging disease in terms of catastrophic out-of-pocket health care expenditure and loss of productivity: investigation of an outbreak of chikungunya in Orissa, India. *Journal of vector borne diseases,* **46**(1), 57. https://pubmed.ncbi.nlm.nih.gov/19326709/
8) Grainger, A. (2008). Difficulties in tracking the long-term global trend in tropical forest area. *Proceedings of the National Academy of Sciences,* **105**(2), 818-823. https://doi.org/10.1073/pnas.0703015105
9) Hossain, M. S., Hasan, M. M., Islam, M. S., Islam, S., Mozaffor, M., Khan, M. A. S., Arafat, S. Y. (2018). Chikungunya outbreak (2017) in Bangladesh: Clinical profile, economic impact and quality of life during the acute phase of the disease. *PLoS neglected tropical diseases,* **12**(6), e0006561. https://doi.org/10.1371/journal.pntd.0006561
10) Icddr, B. (2009). First identified outbreak of chikungunya in Bangladesh, 2008. *Health Sci Bull,* **7**(1), 1-6. http://dspace.icddrb.org/jspui/bitstream/123456789/4865/1/2009-ICDDRBHealthScienceBulletin-Vol7%281%29-English.pdf
11) Khatun, S., Chakraborty, A., Rahman, M., Banu, N. N., Rahman, M. M., Hasan, S. M., Gurley, E. S. (2015). An outbreak of chikungunya in rural Bangladesh, 2011. *PLoS neglected tropical diseases,* **9**(7); e0003907. https://doi.org/10.1371/journal.pntd.0003907
12) Kumar, C. J., Baboo, C.A., Krishnan, B. U., Kumar, A., Joy, S., Jose, T., Hegde, B. M. (2007). The socioeconomic impact of the chikungunya viral epidemic in India. *Open Medicine*, **1**(3), e150. https://pubmed.ncbi.nlm.nih.gov/21673944/
13) Lahariya, C., & Pradhan, S. (2006). Emergence of chikungunya virus in Indian subcontinent after 32 years: a review. *Journal of vector borne diseases,* **43**(4), 151. https://pubmed.ncbi.nlm.nih.gov/17175699/
14) Myung, I. J. (2003). Tutorial on maximum likelihood estimation. *Journal of mathematical Psychology,* **47**(1), 90-100. https://doi.org/10.1016/S0022-2496(02)00028-7
15) Nathans, L. L., Oswald, F. L., &Nimon, K. (2012). Interpreting multiple linear regressions: A guidebook of variable importance. *Practical Assessment, Research, and Evaluation,* **17**(1), 9. https://doi.org/10.7275/5fex-b874
16) Nunes, M., Faria, N., de Vasconcelos, J., Golding, N., Kraemer, M., de Oliveira, L., & Azevedo, R. d. S. (2015). Emergence and potential for spread of Chikungunya virus in Brazil, *BMC Medicine*, **13**, 102. http://dx.doi.org/10.1186/s12916-015-0348-x
17) Panato, C. S., Figueredo, E. D., Bassi, D., Felipe, I. M. A., Firmo, W. d. C. A., Rêgo, A. S., & Silva, F. d. M. A. M. (2019). Evaluation of functional disability after Chikungunya infection. *Revista da SociedadeBrasileira de Medicina Tropical,* **52**, e20190112. https://doi.org/10.1590/0037-8682-0112-2019
18) Rashid Md, H., Sultana, H., & Zzaman Md, T. (2017). Knowledge and awareness regarding Chikungunya among urban community people of selected area of Dhaka city Bangladesh. *Journal of Infectious Diseases and Therapy,* **6**(1), 1-5. https://doi.org/10.4172/2332-0877.1000355
19) Ravi, V. (2006). Re-emergence of chikungunya virus in India. *Indian journal of medical microbiology,* **24**(2), 83. https://doi.org/10.4103/0255-0857.25175
20) Sarkar, S., & Midi, H. (2010). Importance of assessing the model adequacy of binary logistic regression. *Journal of Applied Sciences,* **10**(6), 479-486. https://doi.org/10.3923/jas.2010.479.486
21) Shazeed-Ul-Karim, (2019). Dengue and recent mosquito-borne viral fever outbreak in Bangladesh: concern, causes and control, *Am. J. Pure Appl. Sci*., **1**(6), 44-48. https://doi.org/10.34104/ajpab.019.01944048
22) Thiberville, S.-D., Moyen, N., Dupuis-Maguiraga, L., Nougairede, A., Gould, E. A., Roques, P., & de Lamballerie, X. (2013). Chikungunya fever: epidemiology, clinical syn-

drome, pathogenesis and therapy. *Antiviral research,* **99**(3), 345-370. https://doi.org/10.1016/j.antiviral.2013.06.009

23) Vijayakumar, K., George, B., Anish, T., Rajasi, R., Teena, M., &Sujina, C. (2013). Economic impact of chikungunya epidemic: out-of-pocket health expenditures during the 2007 outbreak in Kerala, India. *Southeast Asian J. of Tropical Medicine & Public Health,* **44**(1), 54-61. https://www.tm.mahidol.ac.th/seameo/2013-44-1-full/8-5415-2.pdf

24) Yazdani, R., & Kaushik, V. (2007). Chikungunya fever. *Rheumatology*, **46**(7), 1214–1215 https://doi.org/10.1093/rheumatology/kem059

Citation: Uddin MA. (2021). Exploring socio-economic impact of Chikungunya fever in Dhaka: a statistical modeling approach. *Eur. J. Med. Health Sci.*, **3**(5), 103-110. https://doi.org/10.34104/ejmhs.021.01030110