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ORIGINAL ARTICLE

Seroprevalence of Chikungunya Virus Infection in an Urban Slum Population of Bangladesh: A Cross-Sectional Study

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Abstract

Background: Chikungunya virus is common in Bangladesh. **Objective:** The aim of the study was to estimate the post-outbreak seroprevalence of chikungunya virus infection in a Bangladeshi urban slum population. **Methodology:** This cross-sectional study was conducted from April to May 2018, a in Bauniabadh, an underprivileged slum area in Mirpur Thana (subdistrict), Dhaka, Bangladesh. Randomly selected residents of this area were interviewed and screened for chikungunya IgM and IgG antibodies in sera using the immunochromatographic process. **Results:** Randomly selected 403 residents were recruited of which 200 cases were male and 203 cases were female. Chikungunya seroprevalence was 4.7% cases with males being more vulnerable than females (6.5% vs. 3.0%). People over the age of 60 years were found to be infected at a higher rate (7.2%) than those in the pediatric age group (1.0%). During the outbreak, 22.0% of patients with joint pain and 17.0% with fever were diagnosed as having chikungunya. **Conclusion:** Urban slum elderly people are affected by chikungunya outbreak characterized by fever and joint pain. [*Journal of Current and Advance Medical Research, January 2022;9(1):3-8*]

Keywords: Seroprevalence; Chikungunya; slum area; IgM; IgG; Bangladesh

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Introduction

Chikungunya virus (CHIKV) infection is a major global public health issue due to its rapid spread, high attack rates, high morbidity[1-2]. The first chikungunya outbreak in Bangladesh occurred in the northern districts of Rajshahi and Chapainawabganj in 2008, which was investigated by the Institute of Epidemiology, Disease Control and Research (IEDCR) and the International Centre for Diarrhoeal Disease Research Bangladesh[3]. Later, in 2011, an outbreak of fever with persistent joint pain was reported in Dohar, Dhaka, and the suspected cases were identified through house-to-house surveys. According to the survey, around 29% of the village residents experienced symptoms associated with chikungunya fever during the outbreak[4]. Following that episode, six further confirmed cases of chikungunya were recorded in 2014. In 2017, an outbreak of chikungunya fever emerged in Dhaka, affecting over a million people, where 2314 were confirmed cases[5].

CHIKV infection is generally described as a self-limiting febrile illness with sudden onset, usually accompanied by headache, myalgia, rash, and characteristic polyarthralgia[6], and immunity to CHIKV protects patients from reinfection with another CHIKV lineage[7]. Empirical studies revealed that CHIKV is prevalent globally, ranging from 10.0% to 75.0% cases[8-10]. Data on the seroprevalence of CHIKV in Bangladesh are only available from blood samples of clinically suspected individuals. Rashid et al[11] found the presence of CHIKV in blood samples of 77.0% clinically suspected patients in a diagnostic center at Dhaka, while Mahmud[12] found 75.0% in another community-based study conducted on the suspected patient only.

Clinical manifestations such as fever and polyarthralgia are being used to suspect CHIKV infection, but laboratory tests are the only way to confirm the diagnosis. Three key laboratory tests are used to confirm CHIKV infection: virus culture, genomic identification utilizing the RT-PCR technique, and serological assays to demonstrate virus-specific antibodies. These tests are performed based on the length of time the patient has been suffering symptoms. IgM antibody for CHIKV, like those found in other viral infections, become detectable around the fifth day of sickness and remain for 3 to 6 months, although IgG antibodies can be identified after 10 to 14 days[6].

Like other re-emerging tropical viral illnesses, chikungunya has a propensity to appear periodically[13]. As a result, periodic seroprevalence surveys are essential for assessing immunity in a population to measure the disease burden. There is a knowledge gap regarding the CHIKV disease burden in Bangladesh as the country lacks seroprevalence and epidemiological data on Chikuguniya. Furthermore, none of the community-based studies in Bangladesh have been undertaken on the urban slum population, where the environment is very conducive to disease transmission, and people lack access to testing and treatment. As a result, we looked for pre-existing antibodies (IgM and IgG) to CHIKV in adults from a disadvantaged urban slum community in Bangladesh to see if they had been exposed to the virus before.

Methodology

Study Design and Population: This cross-sectional population-based survey was conducted from April to May 2018 in Bauniabadh of Mirpur (a sub-district), an underprivileged slum area of Dhaka city, using household interviews and a serologic survey. Since 2014, a noncommunicable disease surveillance system has been in place in this area by the Department of Public Health and Informatics of Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka[14]. In 2014, there were 8,604 houses and 34,170 people in this area. The study population comprised residents of all ages and genders. Every person in this monitoring area has an identity number, and these numbers served as the basis for the sampling frame for this study.

Sample and Sampling: The sample size was calculated using the formula described by Lwanga and Lemeshow[15]. Since there is no community-based seroprevalence rate of chikungunya in Bangladesh, 50.0% prevalence was used to achieve the maximum sample size. The degree of error was set at 5% and the non-response rate was set at 10.0%. As a result, the estimated sample size was 424. A simple random sampling technique was used to recruit participants. Participants were drawn at random from the pre-existing sampling frame using a computer random number generator.

Data Collection: A semi-structured pretested questionnaire was used to collect data on socio-demographics and health status on self-reported chikungunya infection. Five data collectors, two professional phlebotomists and one supervisor were recruited and trained through a three-day training session. They visited households, explained to the participants about study objectives, and, when allowed, collected signatures of the participants in

the informed consent form and carried out the interviews. For child participants, the term of assent was used where an adult was responsible for signing the document.

A total of 403 respondents consented to participate with a 95.0% response rate. Data were collected through face to face approach in an isolated place. Along with sociodemographic data, data were also collected relevant to chikungunya, such as, fever, joint pain and others. After collecting data, 5-cc blood was taken aseptically from the antecubital vein in sterile glass test tubes and sent to the Department of Virology, BSMMU for analysis to determine the presence of CHIKV antibodies (IgM and IgG).

Laboratory Procedure: All collected blood samples were tested for CHIKV IgM and IgG antibodies using a rapid diagnostic kit (STANDARD Q chikungunya IgM/IgG, manufactured by SD BIOSENSOR, Republic of Korea). This kit qualitatively analyzes IgM and IgG antibodies specific to CHIKV in whole blood using imunochromatography method. This test kit is approved by European Commission and Food and drug administration (FDA), USA and has been proven effective in detecting CHIKV[16]. The test procedure and result interpretation were made according to the manufacturer's instruction (SD BIOSENSOR). We considered those who had positive tests for CHIKV IgM or IgG antibody to calculate the proportion of chikungunya infected patients[17].

Statistical analysis: We reported the prevalence of CHIKV infection as percentages with a 95% confidence interval (CI). Descriptive analysis was performed on demographic and reported symptoms data. We used the Pearson Chi-square test to assess statistically significant differences for categorical variables. Data were analyzed using the Statistical Package for Social Sciences (SPSS) windows version 22. A *P*-value of <.05 was considered statistically significant.

Results

The respondents' median age was 37, with a range of 2 to 95 years. Children made up about one-quarter of the study population. None of the study participants were found to be IgM positive in this study. The overall seroprevalence of chikungunya was 4.7% (95% CI 2.9-7.3%). However, seroprevalence in male (6.5%) was higher than that of female (3%). Chikungunya has been diagnosed more in elderly people aged 60 years and above (7.2%), followed by adults aged 18 to 60 years (5.5%), and children (1%), although the difference is statistically non-significant (*P*-value=0.125). There was no significant association between the respondent's occupation and seroprevalence. Only 17.0% of those who had a fever during the outbreak tested positive for CHKV antibodies. Furthermore, 22.0% of patients with joint pain were diagnosed with chikungunya. Around 32.0% of chikungunya patients were found to be asymptomatic (Table 1).

Table 1: Distribution of Socio-Demographic Characteristics and Clinical Features of The Study Population

Variables	Sero-Positivity (IgG)		P value
	Yes	No	
Gender			
• Male	13 (6.5%)	187(93.5%)	0.093
• Female	6 (3.0%)	197(97.0%)	
Age Group (Years)			
• Less Than 18	1(1.0%)	95(99.0%)	0.125
• 18 to 59	13(5.5%)	225(94.5%)	
• ≥60	5(7.2%)	64(92.8%)	
Education			
• Illiterate to Primary	14(3.9%)	342(96.1%)	0.057
• Secondary and above	5(10.6%)	42(89.4%)	
Occupation			
• Service	3(12.5%)	21(87.5%)	0.126
• Business	5(7.6%)	61(92.4%)	
• Day labour	1(2.0%)	48(98.0%)	
• Others	10(3.8%)	266(96.2%)	
Fever			
• Yes	13(17.2%)	62(82.7%)	<0.001
• No	6(1.8%)	322(98.2%)	
Joint Pain			
• Yes	13(22.0%)	46(78.0%)	<0.001
• No	6(1.7%)	338(98.3%)	

*Figures within parenthesis denoted corresponding row percentage; Others=housewife, student, toddler

Discussion

In 2017, Bangladesh observed the largest outbreak of chikungunya[7]. There were previous outbreaks of chikungunya, however, with no estimation of community prevalence. A year after the outbreak, this study intended to measure the post-outbreak prevalence of chikungunya in the community and estimate the future risks of the disease. The present study is the first community-based seroprevalence study on chikungunya in Bangladesh. A total of 403 slum dwellers were tested for chikungunya, and approximately 5.0% were positive. All participants

were tested for CHIKV IgM and IgG, but only IgG positivity among participants suggests past infection[18].

The post-outbreak seroprevalence of chikungunya in the present study is lower in comparison with some studies conducted in South East Asian countries. In a Malaysian study, Azami et al[19] found that 5.9% of adults tested positive for CHIKV IgG by ELISA aged 35 to 74 in 2008. Salje et al[20] revealed 22% of individuals across all ages were seropositive for CHIKV from a cross-sectional study in the Philippines with a sample of 150, while 28.3% infection rate was estimated among the susceptible population in a prospective fever cohort of the same authors. In a study from Thailand, Vongpunsawad et al. reported approximately 27% of individuals aged between 6 months to 60 years were seropositive for CHIKV infection. Rashid et al[11] and Mahmud[12] reported 75.0% and 77.0% seroprevalence, respectively, in their studies in Bangladesh, where both studies included only suspected cases[14,21].

The low prevalence (4.7%) of chikungunya in the present study might be due to the methodological difference from other studies conducted only on susceptible or symptomatic populations. The differences might also be caused by population immunity and genetic susceptibility, time and intensity of the virus circulation, vector competence, environmental settings, and effectiveness of outbreak control measures[22].

However, in a Singaporean study, Ang et al. estimated only 1.9% seroprevalence of CHIKV from a community-based study[23]. One reason for this rate is lower than the present study results might be due to the differences in the study site. The present study was conducted in a typical urban slum area with a dense population and an environment conducive to mosquito breeding and chikungunya infection. In many places of the world, studies have found a link between chikungunya infection and poverty. Studies have stated that poverty induces malnutrition, which enhances individuals' susceptibility to infectious disease[24-26].

In this study, higher numbers of positive chikungunya cases were found in the elderly people, where only one case was from the pediatric age group. In comparison with the present study's findings, Ang et al. reported the highest seroprevalence was 11.5% among the elderly aged 70 to 79 years in Singapore[23]. On the contrary, Kawle et al[27] found maximum infectivity among the age group from 19 to 49 years in a study conducted in Maharashtra, India.

There was no significant gender difference in chikungunya cases; however, the number was higher in males. Male has been identified as a risk factor for chikungunya infection in numerous studies, though any biological reason was not found for this, higher outside exposure as well as behavior pattern are thought to be associated with this[8,28-30]. The percentage of individuals who were asymptomatic in this study (32%) is consistent with prior studies[26,31]. Eight out of ten patients exhibited fever and joint pain in the current study but were negative for chikungunya antibodies. This evidence supports the existence of other viral diseases with clinical signs comparable to chikungunya.

This study is one of the first population-based studies to look at chikungunya seroprevalence and its clinical symptoms in an urban slum community in Bangladesh. This type of study would be important for tracking future outbreaks and may aid in disease management.

There are some limitation of this study. The current study recruited a specific group of people from a selective slum area who were living in poor socioeconomic status; hence the results are not generalizable for the whole population of Bangladesh. Again, the comparatively low response rate was most likely owing to the study's required venipuncture, which was not a favored step by the supposedly healthy group. Furthermore, there might have been a possibility of selection bias because those who were more concerned about their previous infection were more likely to participate in the study. Moreover, the immunochromatographic assay was used in this study, a screening tool, whereas ELISA is a standardized test for CHIKV. Due to the high cost and time-consuming nature of the ELISA, the immunochromatographic assay was used in this study.

Conclusion

Relatively low seroprevalence of approximately 5% in the poor urban community of Dhaka reflects that a large proportion of individuals are particularly susceptible to chikungunya. The majority of those affected were elderly people, with fever and joint pain being prominent clinical manifestations. A significant number of patients were found to be asymptomatic. Periodic disease surveillance and vector control are required. This kind of sero-

surveillance could help with the containment of any infectious disease outbreaks in Bangladesh.

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