Seropositivity and seasonal trend of dengue cases in Jaipur (Rajasthan), Western India (2010-2016)

Dr Sakshee Gupta[1§], Dr Nitya Vyas[2], Dr Rameshwari Bithu[3], Dr Rajeev Yadav[4], Dr Babita Sharma[5]

[1]Senior Demonstrator, Department of Microbiology& Immunology, SMS Medical College, Jaipur (Rajasthan) India.
[2]Senior Professor, Department of Microbiology& Immunology, SMS Medical College, Jaipur (Rajasthan) India
[3]Professor, Department of Microbiology& Immunology, SMS Medical College, Jaipur (Rajasthan) India
[4]Associate Professor, Department of Community Medicine, SMS Medical College, Jaipur (Rajasthan) India
[5]Assistant Professor, Department of Microbiology& Immunology, SMS Medical College, Jaipur (Rajasthan) India

Abstract— *Dengue virus infection has emerged as a notable public health problem in recent decades in terms of its increased transmission to urban and semi urban areas. Study was conducted on samples of suspected dengue cases with the aim to find out seropositivity and seasonal pattern of dengue, which is important for effective control of a disease. For this study, samples were received in department of Microbiology, SMS Hospital Jaipur (Rajasthan) for Dengue IgM & IgG during 1st January 2010 to 31st December 2016. Blood samples collected in plain vials were tested for IgM and IgG antibodies for dengue virus serotype DENV-1, 2, 3 and 4 by a solid phase in vitro immunochromatographic test. It was observed that out of 86,538 serum samples tested, 5011 (5.76 %) were found to be positive for dengue infection. Among these seven years, maximum numbers of dengue cases were identified in year 2013(33.12%). Seropositivity ranged from 0.73% in year 2016 to 13.1% in year 2010. Likewise when seasonal trend was explored it was found that 83.87% of total cases were found from September to November with peak in October. In rest of months around 1% of cases were there in each month except few more cases in August and December i.e. 4.23% and 6.25% respectively. It can be concluded that Dengue has become an endemic disease in this area. Occurrence of most of the cases in post-monsoon period indicates a need for acceleration of vector control programme prior to monsoon.*

Keywords: Dengue, Seropositivity, Seasonal Trends

I. INTRODUCTION

Dengue an important arthropod – borne viral infection, has become a major public health concern. It is spreading to new geographical areas, with a 30-fold increase in global incidence over the past 50 years.[1] Each year, 50-100 million cases occur worldwide and hospitalizations for the infection have reached 5,00,000 and the global death toll is >20,000 persons.[1] As per WHO criteria for dengue endemicity in South-East Asia region, India falls into Risk category 'A' i.e. high endemic area.

The first epidemic of clinical dengue-like illness was recorded in Chennai (1780), dengue fever (DF) in Kolkata, India (1963-1964) and dengue hemorrhagic fever (DHF) in Philippines (1953-54).[2] Dengue cases were subsequently reported from Kolkata (1963), Vishkapattanam (1964), Vellore (1968), Ajmer (1969), Kanpur (1969), Jalore of Rajasthan (1985), Chandigarh (2002), Mumbai (2004), Ludhiana (2007), New Delhi (1996, 2003, 2006, 2010), Chennai (2006-2008), Kerala (2008) and Odisha State in 2010.[3-5] Recurring outbreaks of DF/DHF were also reported in the years 2005–2008 from other states like Andhra Pradesh, Goa, Haryana, Gujarat, Karnataka, Uttar Pradesh, Pondicherry and West Bengal .[5]

According to the estimates of National Vector Borne Disease Control Programme (NVBDCP), 50,202 dengue cases were reported in India in the year 2012, increasing to 75,808 cases in 2013, 40,571 in 2014, 99,913 in 2015 and 1,11, 880 cases in 2016. There was an average of 178.5 deaths from 2010-2012 and 227 deaths in the year 2016 alone.[6] Among 18 endemic states the most affected are Delhi, West Bengal, Kerala, Tamil Nadu, Karnataka, Maharashtra, Rajasthan, Gujarat and Haryana.

Most of the parts of Rajasthan receive a low average annual rainfall of 57.5 cm and have a high temperature regime.[7] High levels of precipitation and low temperature are most strongly associated variables for elevated risk of dengue transmission, although low precipitation was not found to strongly limit transmission.[8] Dengue cases in Rajasthan are showing a constant increase in last few years despite harsh climatic conditions as compared to rest of India.

A Global strategy for dengue prevention and control (2012- 2020) has been devised by WHO with an aim to reduce the mortality from dengue by at least 50% by 2020.[9] India has launched National Vector Borne Disease Control Programme (NVBDCP) in year 2003 to control vector born diseases including dengue. Timely detection and management of dengue is essential for aversion of hemorrhagic complications like DHF and dengue shock syndrome (DSS). Study of seasonal trend may give some clue for prevention of this disease. So this study was conducted to find out seropositivity and seasonal trend of dengue in Rajasthan during year 2010-2016.

II. METHODOLOGY

This retrospective study was carried out on samples of clinically suspected dengue patients attending the indoor/outpatient/emergency departments of a tertiary care hospital, Jaipur, Rajasthan. The primary dengue infection is characterized by dengue virus-specific IgM antibodies appearing as early as 3 days of dengue viral fever and persisting up to 2-12 weeks. Secondary infection is marked by rapid rise of IgG antibody titers that peak at 2–3 weeks, and persisting for life.

A total of 86,538 blood samples, received in microbiology section of the Central Laboratory, over a period of seven years from January 2010 to December 2016 were reviewed. Sera were separated from whole blood and subjected for detection of IgG and IgM antibodies to dengue virus serotype DENV-1, 2, 3 and 4 by a solid phase in vitro immunochromatographic test Kit. (SD BIOLINE dengue IgG/IgM Ab Kit, Standard Diagnostics Inc, Korea). Laboratory criterion for confirmation of dengue fever included demonstration of positive IgM antibodies to one or more dengue viral antigens in serum samples.

Statistical analysis: Statistical Trial Package SPSS for Windows version 17.0 (SPSS Inc., Chicago, IL, USA) was used for data entry, processing and statistical analysis. Descriptive statistics were used to calculate all the relevant variables.

III. RESULTS

In these seven years of study (i.e. from January 2010 to December 2016), total 86,538 samples were processed. Out of these 86,538 samples, 5011 (5.79%) were found to be positive for dengue. Among these positive cases, dengue IgM antibodies were detected in 1192 (1.37%) and IgM+IgG+ antibodies in 3819 (4.41%) cases. (Figure 1&2)

Figure 1

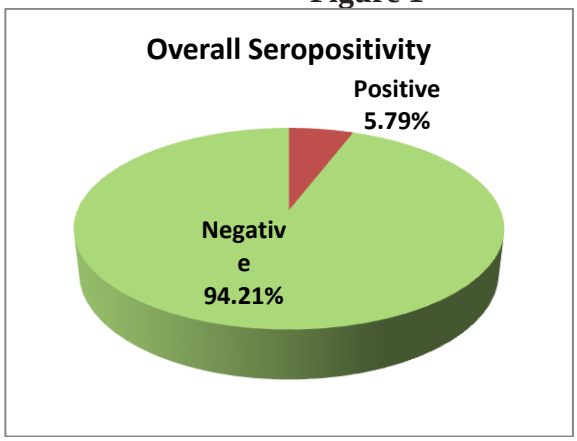
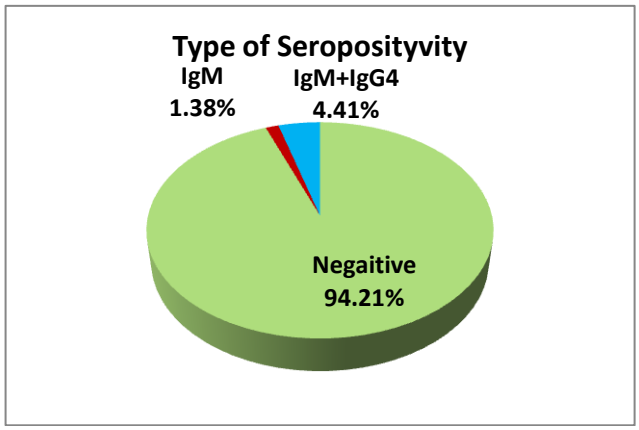


Figure 2



Out of total dengue cases, maximum (1659 i.e. 33.12%) were identified in year 2013(33.12%). Seropositivity was ranging from 0.73% in year 2016 to 13.1% in year 2010. Year wise distribution of primary and secondary cases over the period of seven years is shown in Table 1.

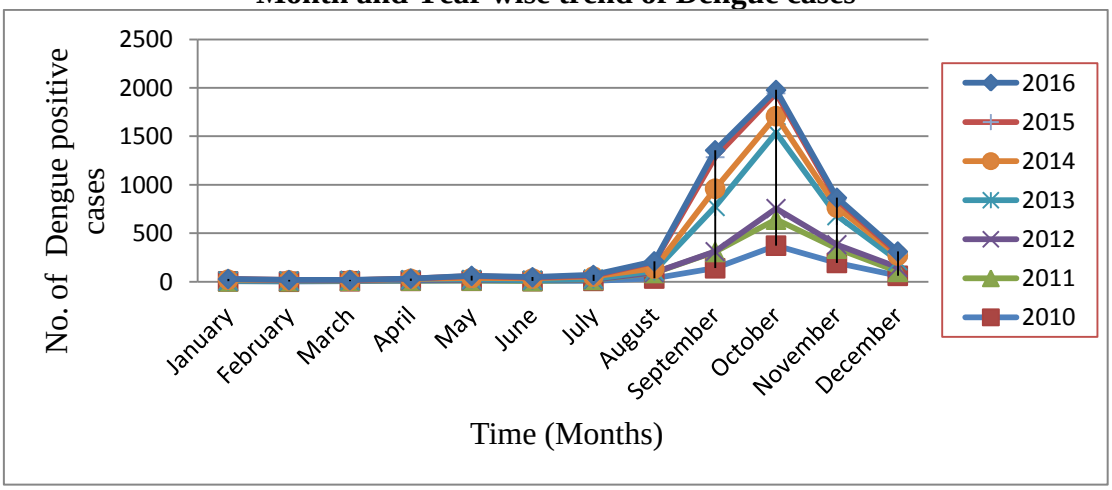
Table 1
Year wise Dengue cases positivity during 2010-2016

Year	Total no of Samples processed	Primary cases IgM + (%)	Secondary cases IgM+ IgG+(%)	Total no of cases testing DENV positive (%)
2010	6560	182(2.77)	683 (10.41)	865 (13.1)
2011	6850	185 (2.70)	522 (7.62)	707 (10.3)
2012	7182	104 (1.44)	127 (1.76)	231(3.21)
2013	13,685	287 (2.09)	1372 (10.02)	1659(12.12)
2014	9755	159 (1.62)	441 (4.52)	600(6.15)
2015	18,576	177 (0.95)	598 (3.22)	775(4.17)
2016	23,930	98 (0.40)	76 (0.31)	174(0.73)

† Percentages are indicated in parentheses*

On analysis, a set seasonal trend was found in all the seven years i.e. maximum dengue cases were falling in September to November. Out of total cases, 83.87% were found from September to November with peak in October. In rest of the months around 1% of cases were there in each month except few more cases in August and December i.e. 4.23% and 6.25% respectively. *(*Figure 3)

Figure 3
Month and Year wise trend of Dengue cases



IV. DISCUSSION

In the present study, an abrupt increase in dengue positive cases was observed in 2013 with numbers reaching to almost three times as compared to period from 2010-2012. One of the potential causes of this resurgence may be lowering of herd immunity after the elapse of few years which resulted in sudden illness by infections with heterozygous DENV serotypes.[10] Seroprevalence of primary (IgM+) dengue infections varied from 0.40- 2.77% whereas secondary infections (IgM+ IgG+) ranged from 0.31-10.41% from 2010-16. Another study from a different setting in Jaipur conducted on 2169 sampled over a period of four years (i.e. 2008-2011) reported seropositivity 18.99%.[11] Studies from other parts of Rajasthan have also observed variable results for this *i.e.* 13.67% from Kota[12] during 2013 and 3.55% from Ajmer[13] during 2014-15. Seroprevalence of dengue infection at other teaching hospitals from northern India was reported to be 19.7% from Kanpur,[3] 64.9% from Lucknow,[14] 19.66-44.56% from Delhi[15-16] 31.3% from Nagpur, Maharastra[17] and 21.05% from Odisha.[18] Such a variation may be attributable to the changing serotypes from year to year. Dengue positive cases increase in a particular area each time with the change in either of the four serotypes or genotypes prevalent in that area.[19] Higher percentage of secondary dengue cases reported in our study as compared to primary ones is in concordance with other Indian studies.[11,20] (Table 2)

This represents an alarming situation that in future outbreaks of dengue there may be higher number of secondary dengue cases with complications like DHF and DSS.[21]

Table 2
Seropositivity comparison of findings of various authors from various regions of India

Authors	Place, State	Study period	No. of Sample	Primary Dengue (IgM+)	Secondary Dengue (IgM+ IgG+)
Chakravarti A et al[21]	New Delhi	2002-2008	7846	30.15 %	-
Gupta E et al[16]	New Delhi	2003-2005	8120	44.56 %	-
Ukey PM et al[17]	Nagpur, Maharastra	2005-2006	131	-	31.3 %
Sharma Y et al[15]	New Delhi	2006-2010	8138	19.66 %	-
Garg A et al[3]	Kanpur, UP	2006-2010	242	-	19.7 %
Pandey N et al[14]	Lukhnow, UP	2008-2010	2599	60.29 %	
Sood S[11]	Jaipur, Rajasthan	2008-2011	2169	5.67 %	13.32 %
Ahmed NH et al[22]	New Delhi	2010	4370	38.9 %	-
Padhi S et al[18]	Berhampur,Odisha	2010-2012	5102	21.05 %	-
Bhat SK et al[8]	Kanchipuram, Tamil Nadu	2010-2012	1170	25.5 %	6.7 %
Maheshwari D et al[12]	Kota,Rajasthan	2013	13,077	13.67 %	-
Kumar M et al[13]	Ajmer, Rajasthan	2015	10,706	1.44 %	1.09 %
Present study	Jaipur, Rajasthan	2010-2016	86,538	1.37 %	4.41 %

In present study, seasonal trend was observed in distribution of dengue cases i.e. maximum dengue cases in September to November. Other studies from various regions of country like Rajasthan (Jaipur and Ajmer),[11,13] Lucknow,[14] Nagpur,[15] Chandigarh,[23] New Delhi[21,22] and Karnataka[24] also reported their

findings well in resonance with the present study. However a study from Odisha reported majority(47.86%) of cases limited in the month of September.[18] This can be explained by the stagnant water sources following heavy rainfall, which favor breeding of the mosquito vector resulting in an increased post-monsoon incidence of dengue.

NVBDCP also reported maximum number of confirmed positive cases in 2013 in Rajasthan (29.75%) and Gujrat (26.26%) experienced and Maharastra (27.33%) in 2014. However, Delhi (46.59%), D&N Haveli (17.98%) and Daman & Diu (36.02%) had maximum number of confirmed positive cases in 2015.[6] This reveals that there is a constant endemicity of the disease in western India.

Serum samples were not tested for dengue NS1 antigen due to limitations which would have detected more number of cases at an earlier stage. Secondly, the serotypes (DENV- 1, DENV -2, DENV-3 and DENV- 4) of dengue could not be studied. Other studies done on outbreak investigations in Ajmer city (in 1969) have reported DENV- 1& DENV- 3 whereas those in Jalore town (in 1985) reported DENV- 3 serotypes of dengue fever respectively.[25,26] A recent study has reported DENV-3 in urban and all 4 DENV serotypes among rural settings of semiarid region (Jaipur) in Rajasthan.[27] Study of circulating serotypes and sequencing of genotypes would be helpful in predicting outbreaks and understanding changing trends in the epidemiology of dengue fever all over the country. [21]

This study reports constant presence of dengue cases in Jaipur, thus making it an endemic disease despite dry climatic conditions. Supportive treatment is recommended in absence of definitive drug regimen. Candidate live attenuated, subunit and DNA vaccines which may serve as important outbreak response tools are also in trial phases of clinical development. Several potential viral targets like NS3/NS2B protease, NS5 polymerase, E, NS3 helicase, and NS5 methyltransferase are being explored currently.[28] Hence, early case detection and vigorous vector control measures including effective urban and household water management remains the mainstay for efficient control of the endemic.

V. CONCLUSION

This study concludes that dengue is a rapidly expanding disease in this part of the country. Seropositivity was found 5.79% with a set seasonal trend having maximum cases in September to November. It is useful to predict outbreak and thus initiation of early control measures. It is suggested that vector control measures should be integrated with vaccines in monsoon months (June to September) well in advance before the peak of dengue in October.

CONFLICT OF INTEREST

None declared till now.

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