International Research Journal of Natural and Applied Sciences
ISSN: (2349-4077)
Impact Factor 7.032 Volume 10, Issue 04, April 2023
Website- www.aarf.asia, **Email** : editor@aarf.asia , editoraarf@gmail.com

A short term study on dengue incidence inthree districts of Rajasthan, India

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Abstract

Dengue fever (DF), "*Break bone*" fever or Haddi Todh Bukhar is a mosquito borne Flaviviral (an RNA virus of the family Flavividio) infection. It is one of the fastest infectious disease increasing in tropical and subtropical areas.It is now well documented that the main causal vector for the transmission of dengue fever is the mosquito *Ae*. *aegypti*.During the recent part, the number of dengue cases is increasing within the Country and the state of Rajasthan is no exception. It was therefore proposed to carry out a survey in North West Rajasthan taking into consideration three districts viz., Bikaner, Sriganganagar and Hanumangarh. The survey was aimed to study the dengue incidence from March to Novemebr.Overall, maximum cases from Bikaner were documented in October and from Hanumangarh and Sriganganagar during November. Minimum number of cases from all the three districts were reported in the month of August.

Introduction

Dengue fever (DF), "*Break bone*" fever or Haddi Todh Bukhar is a mosquito borne Flaviviral (an RNA virus of the family Flavividio) infection. It is one of the fastest infectious disease increasing in tropical and subtropical areas. According to the World Health Organization it is currently endemic and covers more than 100 countries with more than 2.5 billion populations at risk. The annual number of infection is associated with 50 million people around globally with 5,00,000 severe cases accounting for majority of approximately 12,500 deaths.

It is now well documented that the main causal vector for the transmission of dengue fever is the mosquito *Ae*. *aegypti*. The first isolation of dengue in India occurred in Kolkata in 1945-46 but India's first dengue fever epidemic was reported in 1963-64, when dengue gradually spread from the country's southern regions to its northern states and progressively to the whole country by 1968. The National Vector Borne Disease Control Program estimated that the average annual number of cases varies widely from the average annual 33 million apparent cases (Shephard et al., 2013). Understanding the economic and disease burden of dengue in India is essential to assist policy makers and public health managers to prepare for and control outbreaks and encourage international collaboration to develop and evaluate prevention, control and management measures, and technologies to control further epidemics (Kakkar, 2012; Chakravati et al., 2012).

During the recent part, the number of dengue cases is increasing within the Country and the state of Rajasthan is no exception. It was therefore proposed to carry out a survey in North West Rajasthan taking into consideration three districts viz., Bikaner, Sriganganagar and Hanumangarh. The survey was aimed to study the dengue incidence from March to November.

The incidence of dengue has increased 30 fold between 1960 and 2010. This increase is believed to be due to multiple factors like, rapid urbanization population growth, international travel from endemic areas and lastly global warming. The geographical distribution is around the equator mainly affecting Asia and Pacific regions. First outbreak was reported in Kolkata in 1963 (NVB DCP Reports, 2007). The next major outbreak of dengue fever was reported in Delhi and neighboring states in 1996. According to Srinivas & Srinivas (2015), data for the last 10 years reveal maximum number of cases (16,000) in 1996, while the next increase (12,000) was noted in 2003.

Material and method

The Study area

The present survey pertaining to dengue fever was carried out in three districts of North West Rajasthan viz. Bikaner, Sriganganagar, and Hanumangarh from March to November.

Bikaner district

Bikanerlies between 27^{0}11' & 29^{0}3' North and 71^{0}54' & 74^{0}12' East covering an area of 2744 sq. Km^{2}. The district comprises of 926 villages with 8 Tehsils,Panchayat Samities, 4 towns and 4 municipalities. The minimum temperature during summer is about 28^{0}C and maximum mean is 48^{0}C, while during winter minimum mean is generally 4^{0}C and maximum mean 22^{0}C. The annual rainfall is about 25 cm. The places/areas surveyed in this district included Bikaner city, Deshnoke, Nokha city, Nokha rural, Dungargarh and Kolayat.

Sriganganagar district

Sriganganagar lies between $28^0$4' & $30^0$6' North and $72^0$2' & $75^0$3' East covering an area of 11,15466 km^2. The district comprises of 9 Tehsils and 18 town and small villages, 8 Panchayat Samities. Theminimum mean temperature during summer is about 28^0C and maximum mean is 48^0C, while during winter minimum mean is generally 2^0C and maximum mean 21^0C. The annual rainfall is approximately 200mm.The places/areas surveyed in this district included Sriganganagar city, Suratgarh, Padampur, Sadulshahar, Keshrisinghpur.

Hanumangarh district

Hanumangarh lies in the extreme north of Rajasthan covering as are of 12,645 km^2. The district comprises of 7 Tehsils, 1907 villages, 7 Panchayat Samities. The minimum mean temperature during summer is about 25^0C and maximum mean is 47.2^0C, while, during winter minimum mean is generally 4.7^0C and maximum mean 28.1^0C. The annual rainfall is approximately 312 mm. The places/areas surveyed in this district included Hanumangarh, Hanumangarh rural, Ravatsar, Pilibanga, Tibbi.

The data related to dengue was collected from the three districts surveyed viz. Bikaner, Sriganganagar and Hanumangarh.The data thus obtainedhas beeb presented in the form of table related to dengue incidence and seasonality. The data was further analyzed, compared and interpretations were made and conclusion were reached upto.

Result

Dengue incidence and seasonality at Bikaner district

The survey was done during March to November and most number of dengue cases were noted in the month of October and minimum in the month of August as presented in Table 1.

Further, it could also be inferred that 16% of the total cases of dengue were reported during October, followed by 15% in April, 14% in May,13% in June, 12% in November,11% in March,10% in September,5% in July and 4% in August as presented in Figs.1,2.

Dengue incidence and seasonality at Sriganganagar district

The results pertaining to dengue cases from Sriganganagar district have been presented in Table 2.

From Sriganganagar district the maximum dengue cases were documented in the month of November and minimum in August. Further, it could also be inferred that 16% of dengue cases were reported during November, followed by 15% in April,14% in September, 14% in March,12% in May,11% in October,10% in June, 4% in July,4% in August as presented in Figs.3,4.

Dengue incidence and seasonality at Hanumangarh district

Of the total cases,73 caseswere reported during November followed by 68 in October and a minimum of 15 in the month of August as presented in Table 3.

Further,it could also be inferred that 18% of the total cases of dengue were reported during November, followed by 17% in October, and March, 13% in May, 12% in April, 10% in June,5% in September, 5% in July, and 4% in August as presented in Figs.5,6.

Discussion

The present survey for dengue fever was carried out in Bikaner, Sriganganagar, and Hanumangarh districts from March to November for a period of nine months. From Bikaner district the maximum number of dengue cases were reported during October (16%), followed by 15% in April, 14% in May, 13% in June, 12% in November, 11% in March, 10% in August. From Sriganganagar district the maximum number of dengue cases were reported in November (16%), followed by 15% in April, 14% in September,14% in March, 12% in May, 11% in October, 10% in June, 4% in July and August. From Hanumangarh district the maximum number of dengue cases were reported in November (18%), followed by 17 % in October and March, 13% in May,12% in April,10% in June, 5% in September and July, and 4% in August.

Pandya (1982) suggested that the vector thrives in urban and semi urban localities congested with human population. The mosquito breeds usually during rains or in any water logged containers. The author further suggested the reason to be due to rise in vector population resulting in the febrile phase to commence during July or August and perpetuate till September or October. Highest number of epidemics have been reported to occur in the month of September and lowest between December and June. According to the author an exceptionally long epidemic period in Calcutta where the fever continues from July to March. Earlier reports by Rodrigues et al. (1972) and George & Soman (1975) the epidemic season in Nagpur and Banglore also deviated from the normal. One of the possible reason for the seasonal aberration could be the fluctuating breeding habit of *Ae. aegypti* in different types of containers was suggested.

Earlier Kalra & Wattal (1970) have reported some cities of Rajasthan and Madhya Pradesh to exhibit relatively higher vector densities between July through October (Wet season), as compared to February to April (Dry season). Studies on epidemics in India indicate that the onset of an epidemic parallels the buildup of mosquito population density (Rodrigues & Dandawate, 1977; Kalra & Wattal, 1970). According to Cecilia (2004) desert is the only area where epidemics of dengue have been reported in summer season. Das et al. (2005) documented 64 dengue cases of which 23 were reported during October, 35 during November and only 6 during December. They suggested the outbreak of dengue to subside in December when the breeding condition for the vector becomes unfavourable in North India, as the temperature drops to around 30^0C.

Lall & Dhanda (1996); Ram et al. (1998) and Parida et al. (2002) have all observed occurrence of out breaks of dengue infections during the post monsoon period. Vajpayee et al. (1999) observed the peak of dengue in Delhi during the 1996 epidemic from September to November similar to the earlier reports of Broor et al. (1997) suggesting that it being the post monsoon season there is an increase in mosquito breeding which leads to increase in transmission of dengue virus.

During the present study also maximum dengue cases were documented during October-November. Many factors have been identified by different works in the spread of mosquito density and their consequent dengue fever cases in a particular region. It has been suggested that there is a strong correlation between mosquito density and temperature & relative humidity. In addition, many studies indicate that climatic changes are important in expanded geographical range for dengue fever cases (Ramchurn & Goorah, 2013; Reeves et al., 1994; Monostarsky, 1996; Patz et al., 1996; Jetten & Focks, 1997). It has been suggested that as the temperature of a region increases, the geographical range of mosquitoes reaches to higher altitudes (Hoppe & Foley, 2005) Christosphers (1960)and Rueda et al. (1990) also supported the fact that climatic condition strongly control the geographic distribution and abundance of *Ae. aegypti*. Similarly, many researchers have studied and concluded that temperature, humidity and fall rain significantly influence the mosquito density, their life cycle, breeding habitat, survival and dengue viral development (Schoof, 1967; Hales et al., 2002; Focks et al., 1993; Watts et al., 1987; Koopman et al., 1991; Dibo et al., 2008; Nicholls, 1993; Hales et al., 1996; Martens et al., 1999; Sutherst, 2004).

Alshehri (2013) from his study concluded that the favourable temperature for mosquito growth may accelerate the metabolic process in the *Aedes* mosquito resulting in the increased biting rate and there by more egg production and abundance of the adult population. In addition, the feasible temperature range may also result in escalating the number of flights and the distance for each flights that a mosquito can cover. Similarly, humidity contributes to the transmission of dengue fever by influencing the activities and survival of the mosquito vector. Low humidity causes mosquitoes to feed more frequently to compensate for dehydration, while, high RH increases the metabolic process in adult mosquitoes. Rainfall directly influences the density of mosquitoes by increasing their breeding places. However, heavy rainfall causing fluids may result in the disappearance of small ponds and there by the feasible places for mosquito breeding. Also a rise in temperature may evaporate small pond and other places for mosquito breeding, thus reducing the growth of mosquitoes.

Hopp& Foley (2001) and Tun-Lin et al. (2000) have suggested high temperature to accelerate mosquito development and increase abundance. Alshehri (2013) suggested temperature above 400C is not suitable for rapid mosquito growth. Favourable temperature for mosquito growth is between 25C to 27^0 C has been suggested by Mc Michel et al. (1996). This could be true for the present study also.

Favier et al. (2006) found that there is a relationship between RH and mosquito density. While, Russell et al. (2009) indicated that rainfall has no significant influence number the same. Chowell & Sanchez (2006) showed that while precipitation, mean temperature and minimum temperature had their highest correlation with dengue incidence without a lag period, maximum temperature and evaporation were mostly correlated with dengue fever incidence with a lag of one and three months. The significant positive correlation of temperature and rainfall with dengue cases has been reported in other studies also (Koopman et al., 1991; Schultz 1993; Mourya et al., 2004).

Depradin & Lovell (2004) showed that the increase in minimum temperature has stronger effect on mosquito density than maximum temperature, while, Rasa Freitas et al. (2006) suggested that temperature and RH have some fluctuating relation on dengue cases. However, Schultz (1993) and Chadee et al. (2007) suggested no association between rainfall and dengue fever.

A major outbreak of dengue infection in northern India from October to December was reported by Das et al. (2005). They reported outbreaks to occurs after a heavy rainy season and subsiding in December, when the breeding conditions become unfavorable, as the temperature dropped to around 30^0C.

During the present survey, besides post monsoon winter monsoon, the number of dengue cases were also quite high during summer months suggesting that in Rajasthan, owing to tendency of over storage of domestic water by the inhabitants, mosquito and vertically transmitted virus get pronounced during summer season which could precede the active transmission season of dengue during following rainy season as has been concluded by Angel & Joshi (2008) earlier. Warm temperature in night favours the survival of *Ae. aegypti*, while, cooling during night is harmful to the mosquito activity. Similarly, extreme hot temperature may also increase the rate of mosquito mortality and thus decrease dengue risk and rainfall can have long linear contrasting effects on dengue risk has been suggested by Kumar (2015).

Darbin et al. (2011) reported majority of the dengue cases during the monsoon and the post monsoon season as also observed by Ritter (2001) and in accordance with the reported pattern of dengue transmission. An increase in the number of rainy days and a decrease in relative humidity were associated with dengue incidence (Wong Koon et al., 2013). Rainfall has been found to correlate with dengue in many countries (WongKoon et al., 2011, Thammapalo et al., 2005b). Increased rain may increase larval habitats and vector population size by creating a new habitats or increase adult survival (Gubler et al., 2001).

Overall, maximum cases from Bikaner were documented in October and from Hanumangarh and Sriganganagar during November. Minimum number of cases from all the three districts were reported in the month of August.

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Table 1. Total number of dengue cases reported during different months from Bikaner district (Mar. – Nov.)

Area / Month	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Total
Bikaner district	48	65	59	54	23	19	42	67	51	428

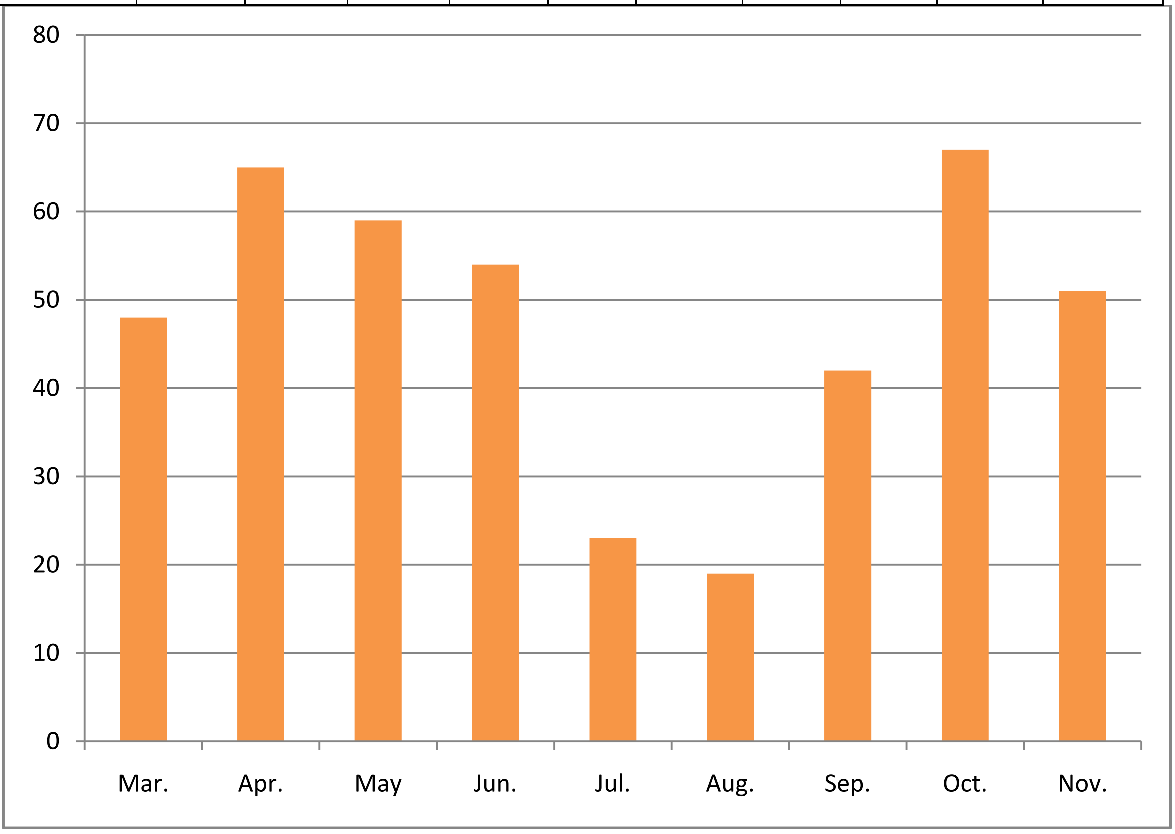

Fig. 1. Distribution of dengue cases during different months from Bikaner district (Mar. – Nov.)

Table 2. Total number of dengue cases reported during different months from Sriganganagar district (Mar. – Nov.)

Area / Month	Mar.	Apr.	May	Jun.	July	Aug.	Sep.	Oct.	Nov.	Total
Sri-ganganagar district	65	70	55	45	21	18	67	54	76	471

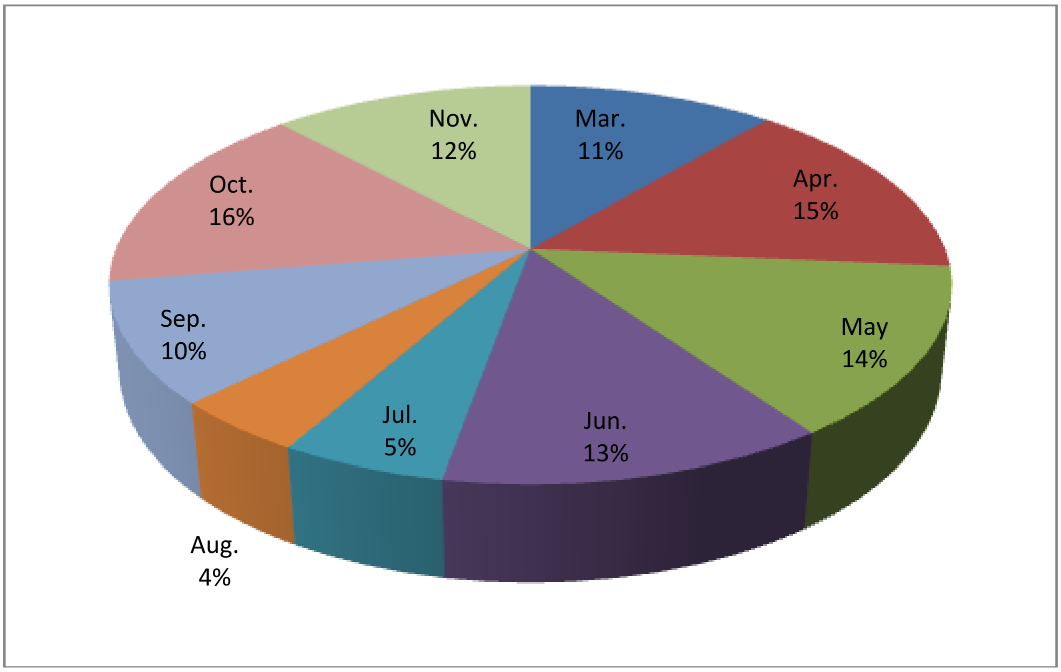

Fig. 2 Per cent month wise distribution of dengue cases from Bikaner district during March to November

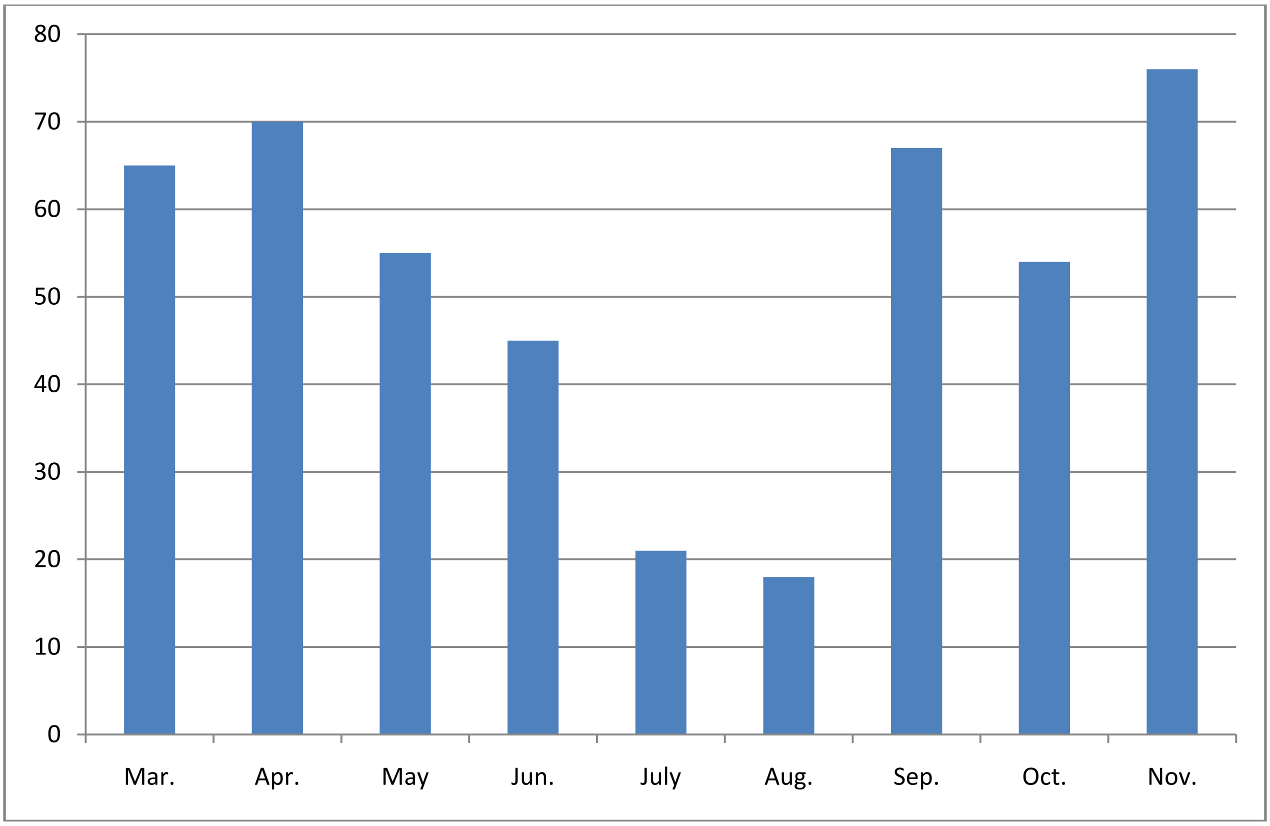

Fig.3.Distribution of dengue cases during different months from Sriganganagar district (Mar. – Nov.)

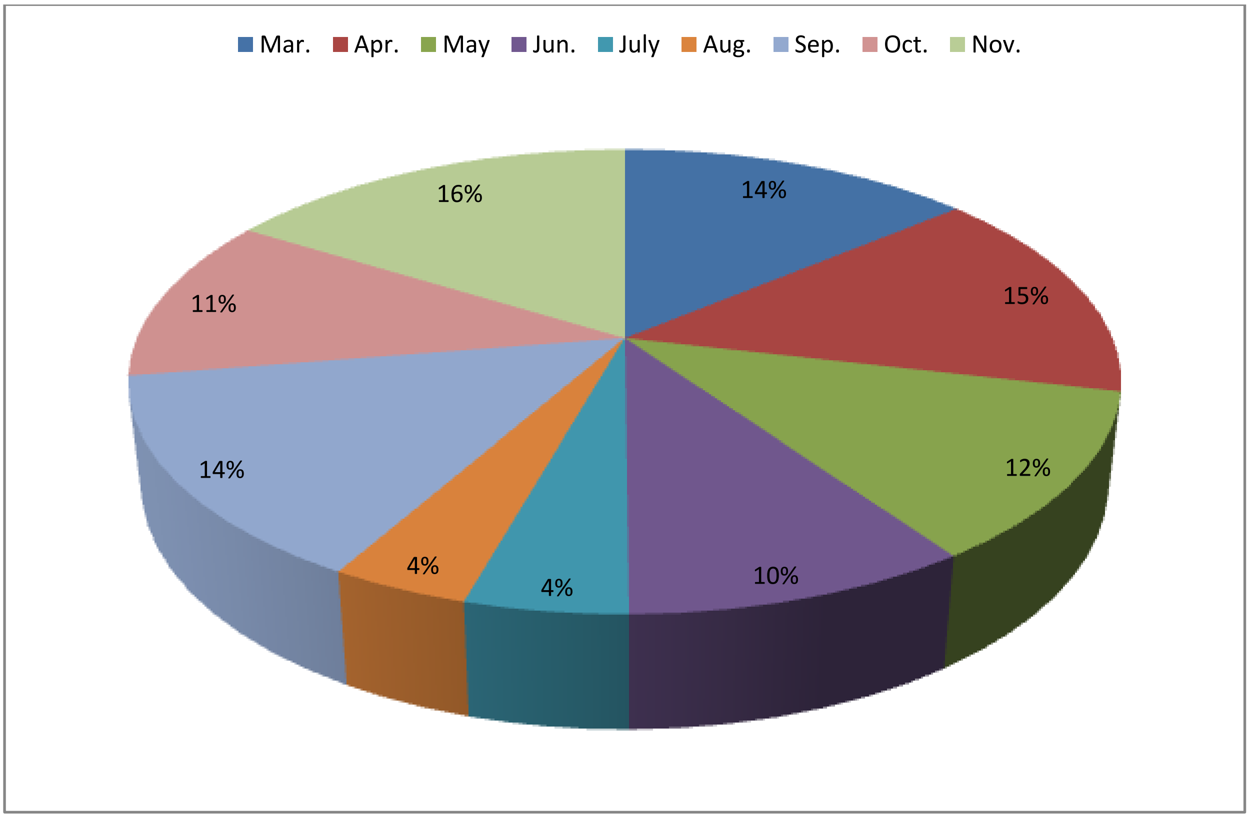

Fig. 4. Per cent distribution of month wise dengue cases reported from Sriganganagar district during March to November

Table 3. Total number of dengue cases reported during different months from Hanumangarh district (Mar. – Nov.).

Area/ Months	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Tot.
Hanumangarh district	65	47	52	42	18	15	21	68	73	401

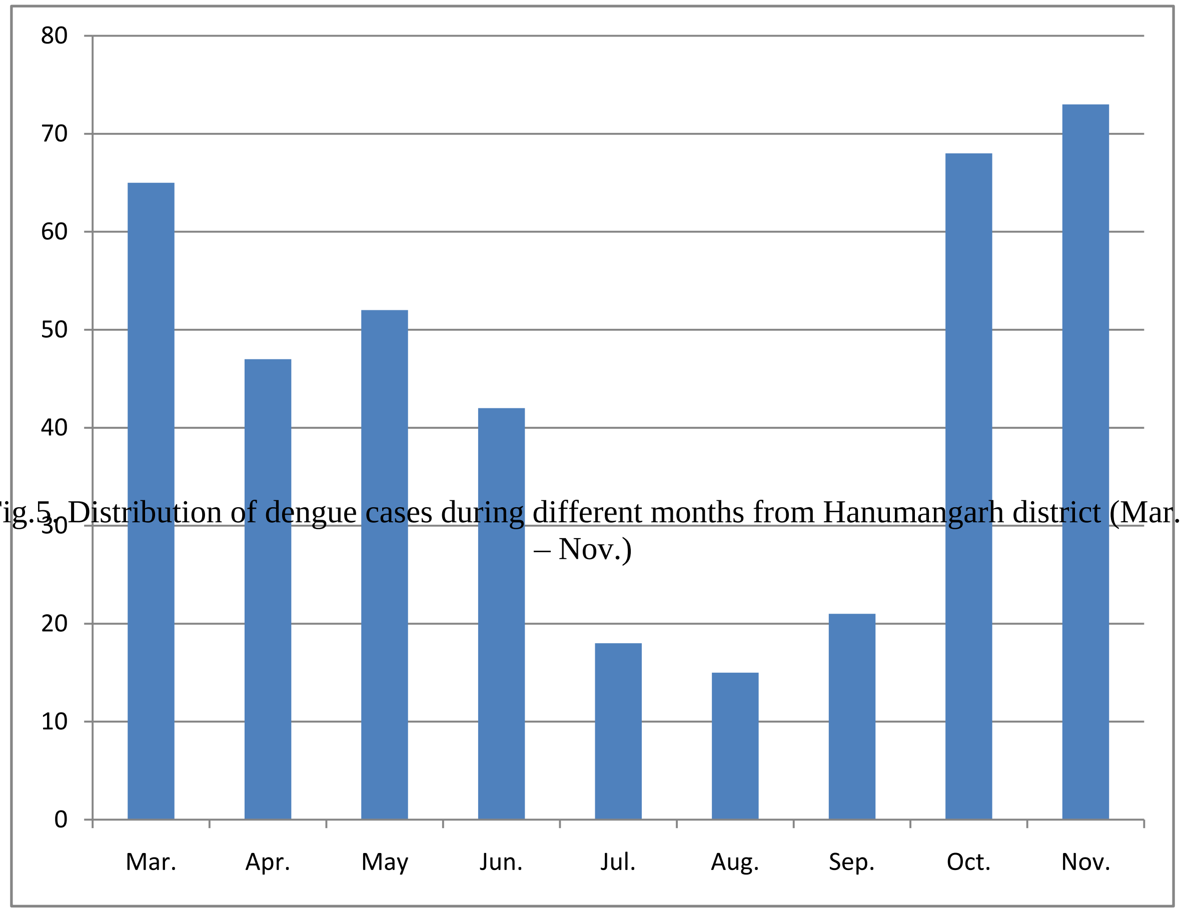

Fig.5. Distribution of dengue cases during different months from Hanumangarh district (Mar. – Nov.)

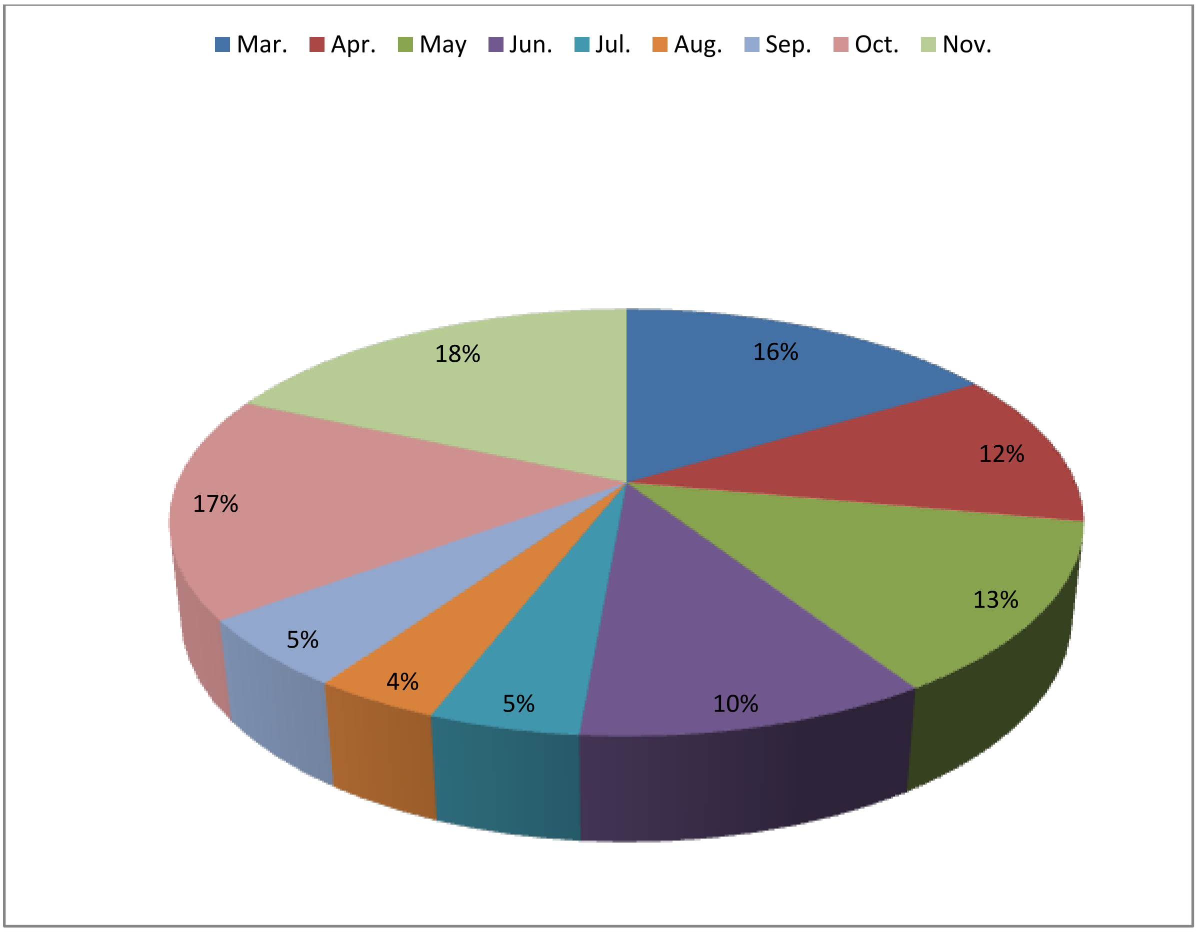

Fig. 6. Per cent month wise distribution of dengue cases reported from Hanumangarh district during March to November