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Climate changes and incidence of Dengue fever in Solapur city, Maharashtra,India

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Abstract:

Dengue fever is a viral mosquito born disease. In recent decades, the incidence of Dengue affected cases has increased. It is transmitted mainly by bite of virally infected female mosquito *Aedes aegypti*. The presence and abundance of *Aedes aegypti* is vital for the transmission of Dengue disease. Climatic variables such as temperature, humidity and rainfall determine the rate of development in the different mosquito life stages. Larvae require water for survival but pupae do not and relative humidity affect adults. This indirectly affects the occurrence of dengue fever in human population. In the present study, data regarding climatic variables temperature, humidity and rainfall during the years 2014-2019 was collected. Also data regarding number of laboratory tested confirmed Dengue fever cases reported were collected. The relation between climatic variable and incidence of Dengue fever cases were co-related. The present study concludes that there is relation between incidence of Dengue fever cases and climate changes. This will be definitely helpful in anticipating seasonal weather forecast and Dengue case loads. Prophylactic measures based on vector control, public education and awareness would be implemented timely to reduce incidence of the disease.

***Key words*:** Dengue fever, climatic variables, *Aedes aegypti*, incidence, viral.

1. INTRODUCTION

Dengue fever (DF) and dengue hemorrhagic fever (DHF), is the acute mosquito-borne viral diseases caused by dengue virus.This disease occurs mainly in tropical and subtropical regions. As per the World Health Organization (WHO) dengue infections occur annually worldwide. [Gubler DJ.,2002] Dengue fever is endemic in more than 100 countries with most cases reported from the America, South-East Asia and Western Pacific regions of WHO[WHO; 2009]. In India, dengue is endemic in almost all states and is the leading cause of hospitalization. Dengue fever had a predominant urban distribution a few decades earlier,

but is now also reported from peri-urban as well as rural areas. [Kakkar M.,2012, . Chakravarti, 2012] In India, surveillance for dengue fever is conducted through a network of more than 600 sentinel hospitals under the National Vector Borne Disease Control Program (NVBDCP). During 2016, the NVBDCP reported more than 100,000 laboratory confirmed cases of dengue .If there is large burden of dengue, it affects country's economy and imposes stress on the health systems. In India for prevention and control of dengue virus transmission focus is on case detection, case management, and vector control. [http:// nvbdcp.gov.in/DENGU1.html] There is increasing scientific interest in the potential effects on health of global climate change .It has been suggested that temperature and rainfall considerably increase the incidence of DF infections. One study that assessed climatic factors associated with DF incidence in Manila study related to association of climatic factors and incidence of dengue fever was carried out .It showed that heavy rainfall in the wet season from June to December was significantly associated with increased DF incidence over 1996–2005. In Sri Lanka, the World Health Organization performed a case study to investigate the correlation between DF and leptospirosis incidence with meteorological factors such as rainfall, temperature and relative humidity, with the aim of developing models to predict the effects of climatic variations on disease incidence. The study revealed an association between disease epidemics and meteorological factors.[http://www.who.int/kobe_centre/publications/ climatic_ factors_srilanka_2014/en/).[Bravo L, et al.,2014] In view of this, the present study was designed to shed light on the relationship between climate factors such as rainfall, temperature and relative humidity on the occurrence of dengue fever.

2. MATERIAL AND METHODS

2.1 Study area

The present study was carried out for Solapur city, Maharashtra, India

2.2 Collection of patient data

Data regarding number of laboratory confirmed dengue infected patients was collected from Malaria Department, under the programme National Vector Borne Disease and Control, Municipal Corporation of Solapur. The Data includes monthly number of laboratory confirmed dengue infected patients during the year 2014 to 2019.

2.3 Collection of weather report

Monthly weather report of climatic factors like temperature, humidity and rainfall during the year 2014 to 2019 was collected from Zonal Agricultural Research Station, Solapur.

2.3 Statistical analysis:

By using GraphPad Prism version 6, data was analyzed for correlation coefficient (Pearson's correlation) and P (significant) value.

3. RESULTS AND DISCUSSION

Year	Total no. of cases	Month showing highest no. laboratory confirmed of cases of dengue fever
2014	71	November
2015	71	November
2016	433	September
2017	425	November
2018	433	September
2019	204	November

Table 1 Year wise distribution of maximum number of dengue cases

Table 1 shows the highest number of laboratory confirmed dengue cases found in month of November and September during 2014-2019. During 2014, 2015, 2017 and 2019 maximum cases were in November while in year 2016 and 2018 maximum cases were in September. However, highest number of cases was in the year 2016 and 2018 followed by 2017.

Table 2 Month wise variation in climatic factors under study during year 2014

Month	Temperature[^{0}C]	Rainfall[mm]	Relative Humidity [%]	Number of Dengue Patients [n= 71]
January	31	0	76.24	1
February	32.5	0	63.75	2
March	35.26	7.16	63.4	2
April	39.82	3.17	49.75	1
May	39.68	6.17	64.4	0
June	37.7	13.55	74.25	0
July	32.85	25.54	82.4	3
August	32.14	19.32	65	1
September	32	26.16	87.8	2
October	33.67	7.65	77.7	6
November	**32.34**	**14.44**	**75.2**	**36**
December	30.12	0	69.8	17

Table 3 Month wise variation in climatic factors under study during year 2015

Month	Temperature [^{0}C]	Rainfall [mm]	Relative Humidity[%]	Number of dengue Patients [n=71]
January	30.1	3	75.25	1
February	33.9	0	60.2	2
March	37	1.72	50.1	2
April	38.77	1.96	54	1
May	40.14	22.65	62.25	3
June	35.32	17.6	78.6	0
July	35.62	0	76	2
August	34.06	14.6	80.5	2
September	33.6	32.54	84.2	10
October	34.9	14.37	72.5	21
November	**33.76**	**2.57**	**66**	**23**
December	33.22	0	63	4

Table 4 Month wise variation in climatic factors under study during year 2016

Month	Temperature [^{0}C]	Rainfall [mm]	Relative Humidity [%]	Number of dengue Patients [n=425]
January	31.85	0	54	15
February	35.82	0	48.5	7
March	38.32	2.25	43.2	15
April	41.8	3.12	41.5	5
May	41.57	6.9	53.75	5
June	35.92	23.87	79.2	6
July	31.74	40.94	86.75	9

August	32.2	25.97	86.4	22
September	**30.82**	**56.08**	**89.5**	**171**
October	31.45	16.85	84	105
November	32.17	0	70.2	63
December	31.84	0.24	76.5	10

Table 5 Month wise variation in climatic factors under study during year 2017

Month	**Temperature [^{0}C]**	**Rainfall [mm]**	**Relative Humidity[%]**	**Number of dengue Patients [n=433]**
January	30.97	0	71	3
February	34.47	0	59.75	5
March	37.9	1.52	45.2	3
April	41.67	0	37	4
May	41.25	2.85	53.8	1
June	35.22	37.78	86.5	4
July	33.77	4.15	81.25	13
August	33.2	30.26	86.6	61
September	31.84	24.6	91.5	76
October	33.15	27.67	87.5	83
November	**32.26**	**1.85**	**69.8**	**151**
December	31.15	0	69.75	21

Table 6 Month wise variation in climatic factors under study during year 2018

Month	**Temperature [^{0}C]**	**Rainfall [mm]**	**Relative Humidity [%]**	**Number of dengue Patients [n=433]**
January	31.2	0	65	10

February	32.95	0	57.75	2
March	37.52	0	45.4	1
April	39.9	2.9	52.25	2
May	41.17	15.47	59	5
June	35.14	51.54	83	6
July	31.27	11.45	85.25	19
August	30.86	29.4	86	87
September	**32.67**	**13.72**	**86.25**	**131**
October	34.35	20.92	74.5	96
November	32.94	4.78	66.6	65
December	30.32	0	75.75	19

Table 7 Month wise variation in climatic factors under study during year 2019

Month	**Temperature [^{0}C]**	**Rainfall [mm]**	**Relative Humidity[%]**	**Number of dengue Patients [n= 204**
January	31.27	0	65.5	18
February	33.52	0	55.75	7
March	38.26	1.52	42.6	11
April	40.85	2.15	43	4
May	42.04	0	51.75	4
June	36.15	38.27	77.02	7
July	33.12	14.3	85.5	15
August	31.84	24.68	79	8
September	31.35	38.7	89.25	39
October	30.97	72.22	92.7	30
November	**31.1**	**9.22**	**86**	**46**
December	31.3	2.4	75.2	15

Table 2 to7 show variation in climatic conditions month wise and number of dengue cases during year 2014 to 2019.

Figure 1 Graphical Correlation of Temperature with Patient

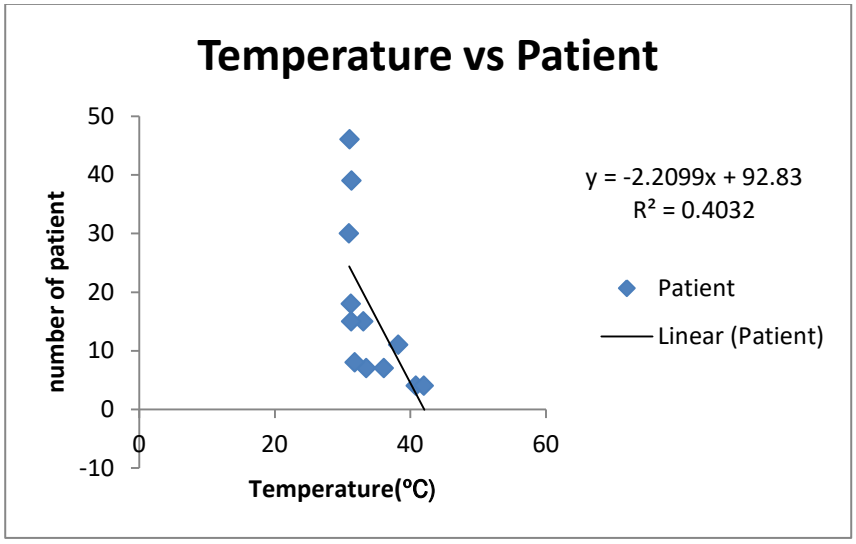


Fig 1 reveals that temperature negatively correlated significantly (P<0.05) with patient number (Pearson's r =-0.403, *P*=0.006). In fig 1 there is higher negative correlation in between both factors, they are opposite in direction. Where the temperature is going to be increases the patient number is rapidly decreases.

Figure 2 Graphical Correlation of Rainfall with Patient

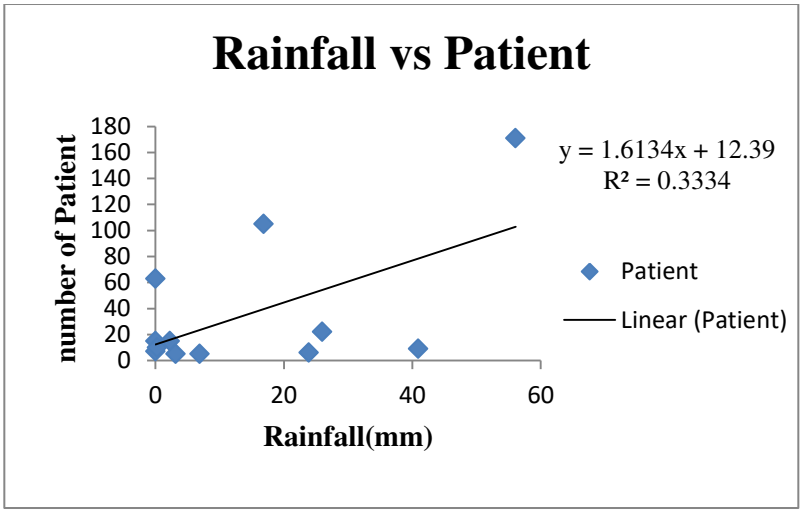


Fig 2 reveals that rainfall positively correlated significantly (*P*<0.05) with patient number (Pearson's r = 0.332, *P*=0.01).In fig 2 rainfall is positively correlated as per increasing in rainfall the patient number is going to be increases.

Figure 3 Graphical Correlation of Humidity with Patient

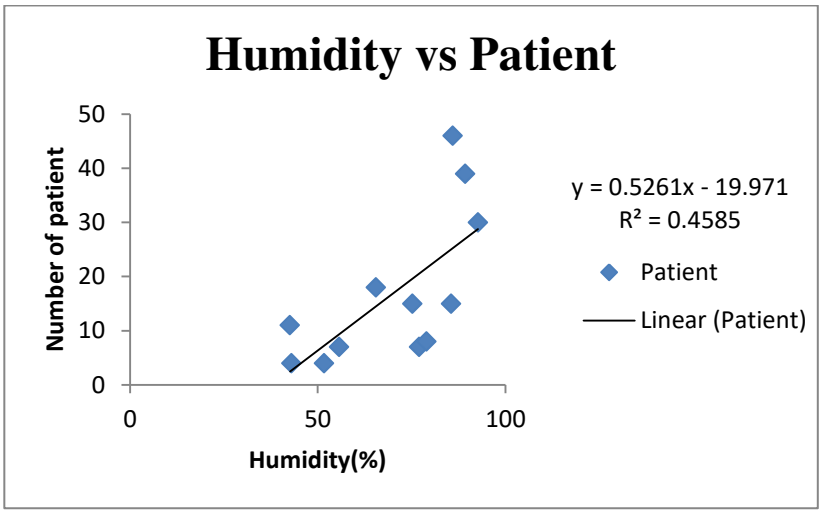


Fig 3 reveals that relative humidity positively correlated significantly (P<0.05) with patient number (Pearson's r =0.458, *P*=0.001).In fig 3 shows that the humidity increases similarly patient number is also increases which is positive correlation between them. Fig 1 to 3 shows Correlation coefficient (Pearson r) and significant value (*P*<0.05) between Temperature, rainfall and humidity with number of patient.

Figure 4 Yearly graphical analysis of climatic factors with number of patient (2014)

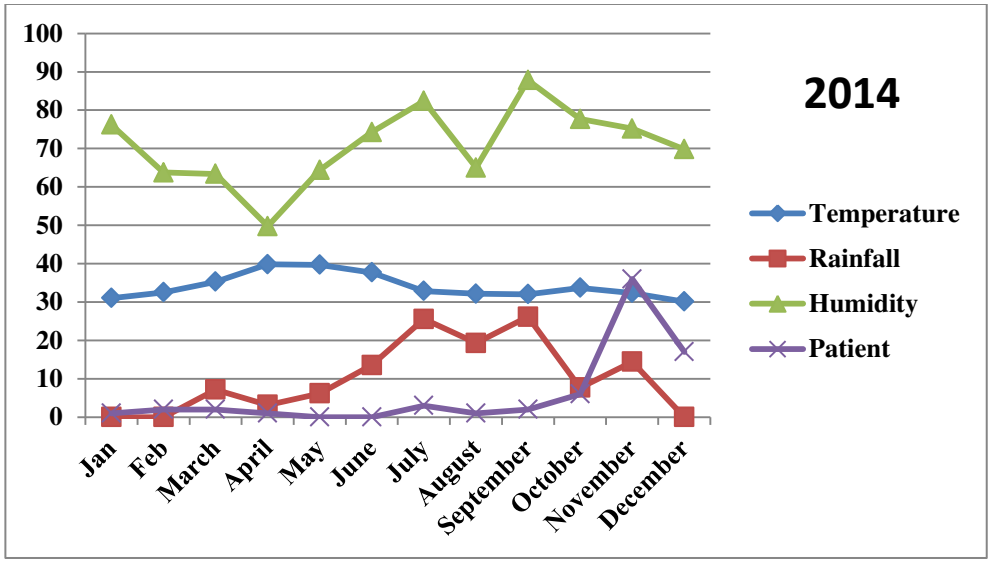


Fig 4 describes the changes in the number of Dengue patients associated with relative humidity, temperature and rainfall. However, at higher peak the maximum cases of dengue patient were in November where the temperature was 32.34^{0}C, Rainfall 14.44 mm and Relative humidity 75.2%.

Figure 5 Yearly graphical analysis of climatic factors with number of patient (2015)

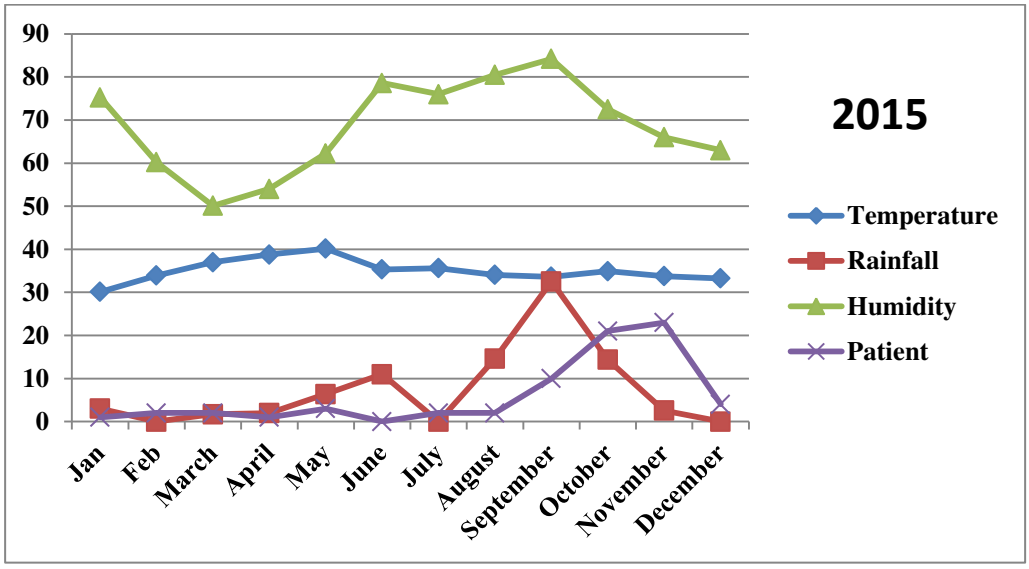
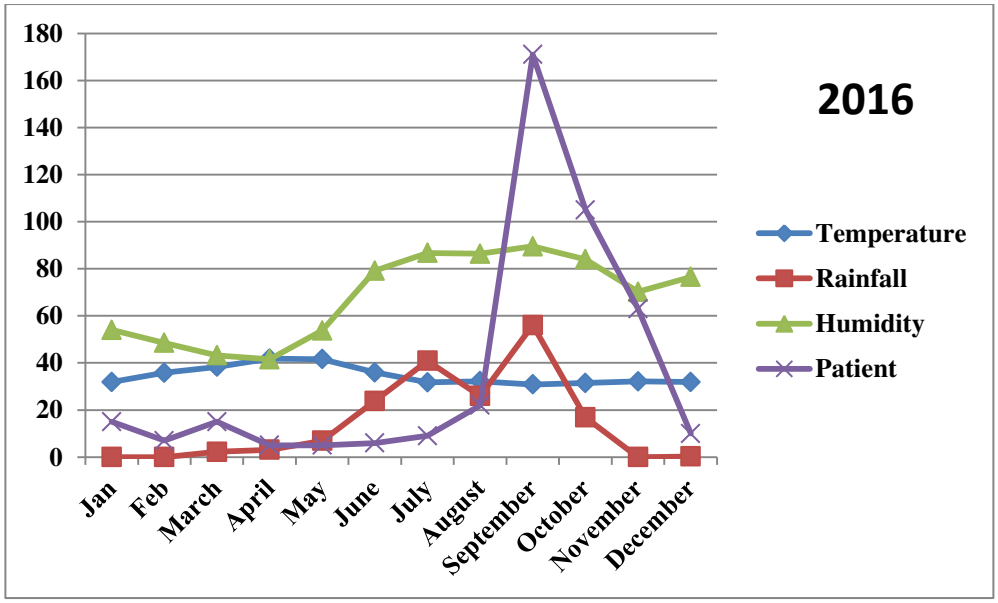


Fig 5 shows that maximum number of patient were in November, where the Temperature is 33.76^{0}C, Rainfall 2.57 mm and Relative humidity 66%.Here though rainfall is less humidity being higher and due to logging of water at different places, it favored breeding of mosquito hence resulted in more number of DF cases.

Fig 6 Yearly graphical analysis of climatic factors with number of patient (2016)



In Fig 6 the maximum number of dengue patients was in September where Temperature was 30.58^{0}C, Rainfall 56.08 mm and Relative humidity 89.5%.These climatic conditions seemed to be favorable for mosquito breeding.

Fig 7 Yearly graphical analysis of climatic factors with number of patient (2017)

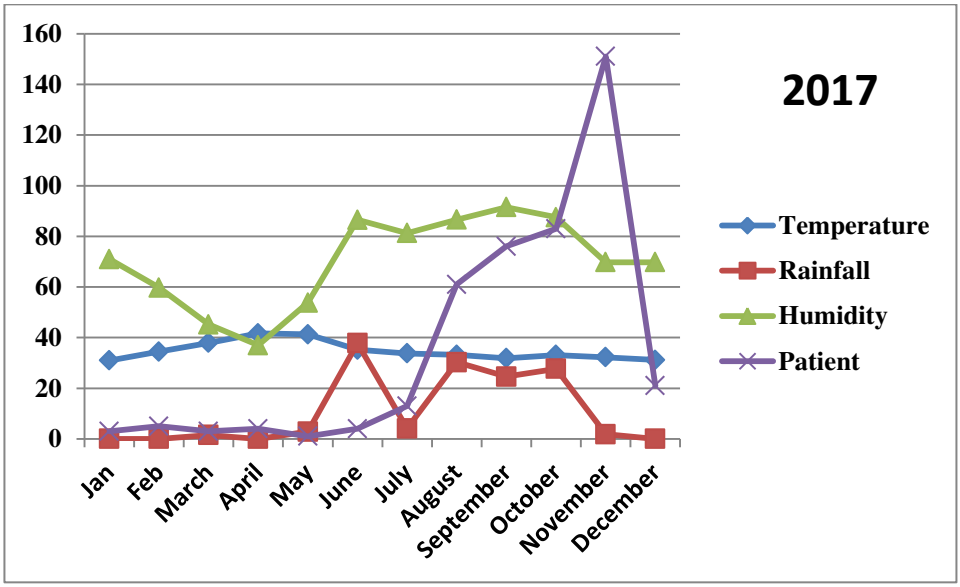
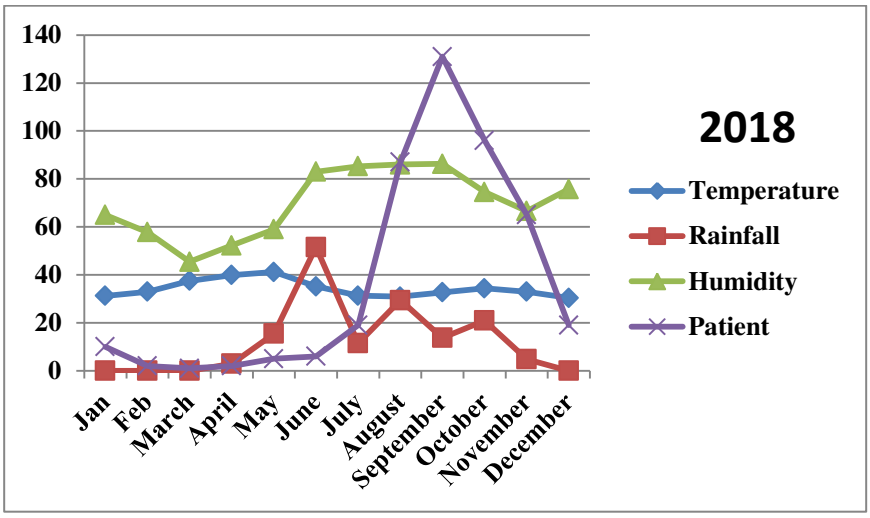


Fig 7 revealed that maximum number of dengue patients were in November where Temperature is 32.26^{0}C, Rainfall 1.85 mm and Relative humidity 69.8%.

Fig 8 Yearly graphical analysis of climatic factors with number of patient (2018)



In Fig 8 the maximum number of dengue patients were in September where Temperature is 32.67^{0}C, Rainfall 13.72 mm and Relative humidity 86.25%.

Fig 9 Yearly graphical analysis of climatic factors with number of patient (2019)

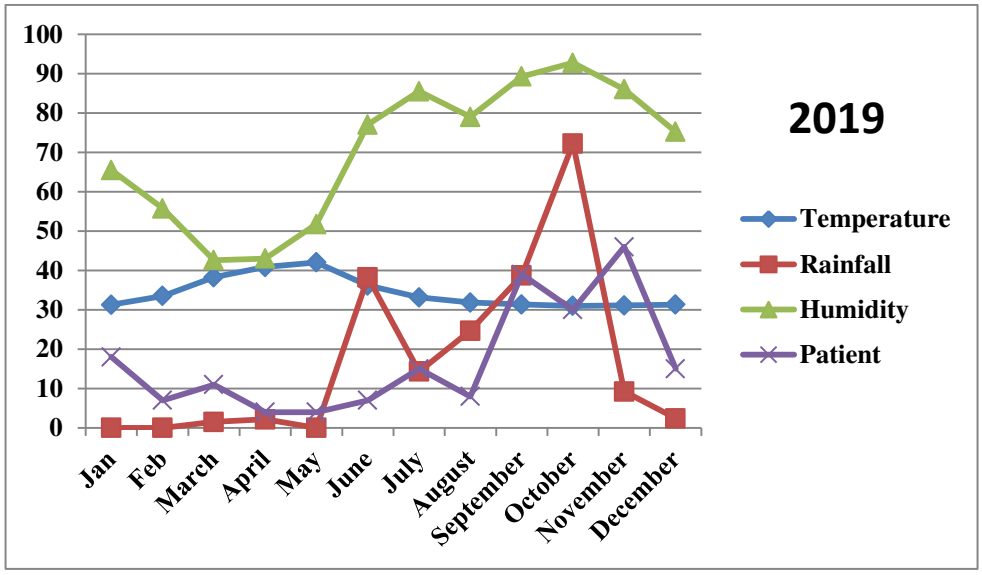


Fig 9 shows the maximum number of dengue patients were in November where Temperature is 31.1^{0}C, Rainfall 9.22 mm and Relative humidity 86%. The findings of the present study conclude that dengue fever transmission is determined by climatic factors such as temperature, relative humidity and rainfall. Humidity is high when rainfall and temperature are high and these conditions are favorable for breeding and survival of mosquito further allowing the rapid multiplication of virus in vector body.Huang et al. 2013 carried out studies with the aim to examine the impact of weather variability on autochthonous DF infection after accounting for imported DF cases and reported that local weather variables and inter-month relative humidity variability were strongly associated with incidence of monthly autochthonous DF in Cairns between January 2000 and December 2009. Further their study also indicated that increasing monthly RH fluctuation enhanced the risk of DENV transmission in Cairns. The results of present study correlate with studies carried by (Huang et al. 2013). In the present study, climatic variables and number of dengue cases were examined independent of other variables. This information is important for policy makers to understand the potential effects of climate change. This may help health authorities to apply preventive measures in advance to avoid epidemics.

CONCLUSION

Higher numbers of cases were found in month of September during the year 2016 and 2018 and in November during the year 2014, 2015, 2017 and 2019. Present study concludes that local weather factors i.e. monthly mean temperature, relative

humidity and rainfall strongly influence the number of Dengue Fever cases. Temperature & relative humidity have been demonstrated as main determinants of Dengue virus transmission.

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