

Economic burden estimation associated with dengue and chikungunya in Gujarat, India

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ABSTRACT

Background: Dengue and chikungunya have been emerging as major vector-borne diseases. The global burden of the diseases is rising as a public health problem. The complexity of disease is governed by multiple constraints including only symptomatic treatment and inflicts heavy social and economic burden on society. The present study is designed to assess the economic burden of dengue and chikungunya infection by calculating cost per patient in Gujarat, India. **Methods:** A total of 210 patients were enrolled in the study from Ahmedabad and Kheda district of Gujarat from May 2018 to December 2019 of which 150 had dengue and 60 chikungunya infections, subject to the willingness of participation in the survey. Information on wage loss days, cost associated with medicines, diagnosis, special food and travel cost, etc., for the calculation of the direct and indirect costs associated with dengue and chikungunya were collected from these participants using a structured questionnaire. Informed consent was taken before including any participant in the study. **Results:** In the dengue sample, 86 were males (57.3%) and the rest were females, and in the chikungunya sample, 31 were males (51.7%) and the rest females. The median age of the participants with dengue and chikungunya was 18 (p25 to p75: 8 to 26) and 30 (p25 to p75: 21 to 45) years respectively. Median family income was recorded as Rs 15,000 (p25 to p75: 9000 to 25500) and Rs 12,000 (p25 to p75: 9000 to 18500) for the dengue and chikungunya cases, respectively. The average duration of the illness was observed to be higher in chikungunya (median days (P25 to p75): 15 (7–45)) than dengue (median days (P25 to p75): 10 (5–15)). The median indirect cost in the case of dengue was Rs 1,931 (p25 to p75: 300 to 4500) while Rs 2,550 (p25 to p75: 0 to 5250) was observed for chikungunya cases. Two types of direct cost, namely, direct cost related to medical expenses and direct cost related to other expenses were calculated. Direct cost related to medical expenses was observed to be higher in dengue (Md (P25 to p75): Rs 2,450 (400–5000)) than chikungunya (Md (P25 to p75): Rs 1,500 (150–5200)) while indirect cost related to other expenses were comparable between dengue (Md (P25 to p75): Rs 1,575 (1300–2600)) and chikungunya (Md (P25 to p75): Rs 1500 (850–2850)). The average total cost for one dengue episode was estimated to be Rs 6,860 (3700–12525) whereas it was Rs 7,000 (2550–14000) for one episode of Chikungunya. **Conclusions:** Overall, patients have to bear high costs while suffering from dengue and chikungunya infections. Furthermore, the duration of illness while suffering from viral diseases also contributes to the substantial economic burden. Improved knowledge about the impact of the cost and the economic burden associated with dengue and chikungunya will help policymakers allocate and appropriate resources accordingly.

Keywords: Chikungunya, dengue, direct cost, economic burden, indirect cost, medical cost

Introduction

Dengue and chikungunya are mosquito-borne viral diseases that are major causes of morbidity due to infectious diseases worldwide.^[1,2] In India, *Ae. aegypti* is considered as primary and *Ae. albopictus* as secondary vector for transmission of dengue

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and chikungunya viruses. The disease is not limited to urban areas but has lately invaded the rural settings as well.^[3] The country is endemic for both dengue and chikungunya, except a few areas. In India, both dengue and chikungunya are known to exist since long^[4,5] and there have been several outbreaks and cases country-wide.^[6,7] Dengue/DHF has emerged as a severe public health problem in several rural and urban areas of India, causing several deaths every year.^[8] Both dengue and chikungunya cases reported by the National Vector Borne Disease Control Programme (NVBDCP) have shown an increasing trend in the past few years.^[9]

In 2018, 101,192 dengue cases, 172 deaths due to dengue, and 8,499 chikungunya confirmed cases were reported in India. In terms of the most number of dengue and chikungunya cases, Gujarat is in the third position in India. An increase in dengue and chikungunya cases during the past few years in Gujarat has been observed. In Gujarat, there were more than 5,500 cases of dengue and 42 of chikungunya cases in 2015, as per the NVBDCP report. In 2018, more than 7,500 dengue and 997 chikungunya cases were reported in Gujarat.^[9]

Both the viral diseases result in vast morbidity and also cause major economic burden in the endemic countries.^[10,11] The disease burden is not only on the patient and their family, but the government also bears the cost in terms of diagnosis, treatment, and vector control strategies.^[12] Various studies have been reported from America^[13–19] and other countries in Asia and South Asia including Thailand,^[20] Malaysia,^[21,22] India,^[23] Singapore,^[24] Cambodia,^[25] and the Philippines.^[26] Further, several studies have estimated the burden of dengue illness in India.^[27,28] In the Surat district of Gujarat, the average cost of dengue per episode was estimated to be US\$ 585.57.^[29]

The government provides free or low-cost treatment facilities for dengue and chikungunya patients, but patients still pay huge amounts of money on medical and non-medical bills. Various studies have been reported about dengue regarding its epidemiology and treatment. But there are very few studies on the economic burden of dengue and chikungunya in India. These studies are essential to attract the attention of the policymaker and health care system, and also to raise awareness in the community. There is heterogeneity in the socioeconomic level countrywide; the best way to estimate economic burden is to conduct a prospective study, use data from multiple sites and treatment facilities, and take a broad economic perspective. However, few studies are available from India regarding the economic burden of dengue and chikungunya. Furthermore, with a change in the overall social and economic scenario of the general population in a region, and also due to the wide distribution of the dengue and chikungunya vectors from urban to rural areas, and the ever increasing number of patients, there is a constant need to assess and update the available information on the cost and the economic burden due to these diseases. The current study was planned to assess the economic burden of dengue and chikungunya infections in two districts of Gujarat, India.

Material and Methods

Gujarat state is located in the western region of the country and has 33 districts. The study was conducted in the Ahmedabad and Kheda districts from May 2018 to December 2019. Ahmedabad is the largest city in the state and every year, it contributes a major chunk to the reported cases of dengue and chikungunya in the state. Kheda is the adjoining district of Ahmedabad, also reporting a large number of cases annually. In the present study, a total of 210 cases of two major vector-borne viral diseases from Ahmedabad and Kheda district were enrolled. A total of 150 dengue and 60 chikungunya cases were surveyed after taking their informed consent. All information was collected using a good designed and tested questionnaire. The questionnaire had three basic components: demographical information, socioeconomic information, and information related to different costs associated with dengue and chikungunya, whether associated directly or indirectly.

Enrollment

Line listing of dengue and chikungunya patients had been collected from the District Malaria Office/private hospital/laboratory. A dedicated project team visited the place of these individuals and were asked for their consent to participate in the survey; in the case of children, consent was taken from their guardians. The consent form was in the local language so that people understood the possible pros and cons to participating in the study.

Ethical Clearance: Clearance of Institutional Ethical Committee approval was obtained for the study vide letter No. ECR/NIMR/EC/2018/35 dated 26th Feb 2018.

Economic burden estimation

There are several costs which are either directly or indirectly associated with dengue and chikungunya. For the appropriate estimation of economic burden due to dengue and chikungunya, the data on all possible costs were collected.

Indirect cost

The time cost of the ill person and respective caretaker had been considered as an indirect cost which was calculated by total wage loss days of the ill person and caretaker due to illness and multiplied by the per day average income of that person.

Direct cost

The direct cost included the expenses incurred by the patient which may be the medical cost or non-medical cost. Medical cost involved doctor consultancy charges, medicine charges, diagnosis charges, hospitalization charges, and other medical charges such as physiotherapy, while non-medical cost involved transportation cost (from home to hospital/clinic), special food cost (supplements), general food for indoor treatment, and lodging of caretaker.

Other information

Some other information was also collected which included the use of family savings during illness, family consumption expenditure gets reduced, a family has to sell the assets for the treatment to meet day-to-day expenditure, a family has to borrow money for the treatment.

Data analysis

Collected data were entered in Microsoft Excel sheet and analyzed using statistical software Stata 15.0 (Stata Corp) and R 3.6. All categorical variables were expressed in number percentage while continuous variables were expressed in median (P25 to p25).

Results

Distribution of socio-economic and demographic indicators

Two hundred ten cases were enrolled (dengue 150 (71.4%) and chikungunya 60 (28.6%)) for economic burden estimation. The majority of dengue patients were from the 5–18 years age group (43.3%), while a majority of chikungunya cases belonged to the age category of 19–30 years (38.3%). Out of 150 dengue cases, 86 were male (57.33%), and among the 60 chikungunya cases, 31 were male (51.7%). Around 61.8% of dengue cases (i.e., 92/150) belonged to the general category followed by 21.5% and 16.7% from OBC and SC/ST/Primitive tribes' category respectively. In the case of chikungunya, 37.3% (i.e., 22/60) were from the general and OBC categories each, followed by 25.4% were from SC/ST/Primitive tribes. Average (median) family income of dengue cases and chikungunya cases were Rs 15,000 (p25 to p75: 9000 to 25500) and Rs 12,000 (p25 to p75: 9000 to 18500), respectively. The median duration of illness in dengue and chikungunya was 10 days (p25 to p75: 5 to 15) and 15 days (p25 to p75: 7 to 45) respectively. The average (median) number of wage loss days in dengue was 8 days (p25 to p75: 5 to 15) while in chikungunya it was 15 days (p25 to p75: 7 to 45). The average (median) number of wage loss days of family members due to illness in dengue was 6 days (p25 to p75: 4 to 10) while in chikungunya it was 7 days (p25 to p75: 4 to 15) [Table 1].

Cost estimation due to dengue and chikungunya

Indirect cost

The cost incurred due to wage loss days of the patient as well as their caretaker was considered as an indirect cost, which was calculated by multiplying the average income per day with number of wage loss days. Calculation of indirect cost was done for the patient and their caretaker separately, and the total indirect cost was calculated by summing these two costs [Tables 2 and 3].

Indirect cost due to wage loss days of the patient

The average (median, and mean \pm SD) indirect cost due to wage loss days of the patient itself was Rs 0 (p25 to p75: 0 to 800), (1751 \pm 5179), and Rs 0 (p25 to p75: 0 to 3150), (3235 \pm 8028) for dengue and chikungunya respectively. The overall range of indirect cost due to wage loss days of dengue

Table 1: Baseline Information

Variables	Dengue (n=150)	Chikungunya (n=60)
Gender		
Male	86 (57.3%)	31 (51.7%)
Female	64 (42.7%)	29 (48.3%)
Social category		
SC/ST/Primitive tribes	25 (16.7%)	15 (25.4%)
OBC	32 (21.5%)	22 (37.3%)
General	92 (61.8%)	22 (37.3%)
Religion		
Hinduism	78 (52.0%)	47 (79.7%)
Islam	68 (45.3%)	12 (20.3%)
Others	4 (2.7%)	0
Economic category		
BPL	22 (16.2%)	15 (25.0%)
APL	76 (55.9%)	40 (66.7%)
Antyodaya	7 (5.1%)	0
None	31 (22.8%)	5 (8.3%)
Patient age (yrs.)		
(Md. (IQR))	18 (8-26)	30 (21-45)
<5	17 (11.3%)	3 (5.0%)
5-18	65 (43.3%)	7 (11.7%)
19-30	45 (30.0%)	23 (38.3%)
31-50	16 (10.7%)	18 (30.0%)
51 and above	7 (4.7%)	9 (15.0%)
Total family income		
(Rs) (Md (IQR))	15,000 (9,000-25,500)	12,000 (9,000-18,500)
<10000	40 (26.7%)	24 (40.0%)
10,000-19,999	59 (39.3%)	22 (36.7%)
20,000-39,999	20 (13.3%)	5 (8.3%)
40,000-49,999	16 (10.7%)	7 (11.7%)
50,000 and above	15 (10.0%)	2 (3.3%)
Number of family members (Md (IQR))	5 (4-6)	4 (4-5)
≤6	129 (86.0%)	56 (93.3%)
>6	21 (14.0%)	4 (6.7%)
Illness duration (days)		
(Md (IQR))	10 (5-15)	15 (7-45)
≤7 days	63 (42.0%)	15 (26.3%)
>7 days	87 (58.0%)	42 (73.7%)
Wage loss days due to illness (Md (IQR))	8 (5-15)	15 (7-45)
≤7 days	72 (48.0%)	15 (26.3%)
>7 days	78 (52.0%)	42 (73.7%)
Wage loss days of family members due to illness (Md (IQR))	6 (4-10)	7 (4-15)
≤7 days	90 (63.8%)	20 (54.0%)
>7 days	51 (36.2%)	17 (46.0%)

and chikungunya patients itself was Rs 0–44,000 and Rs 0–54,000 respectively [Table 2]. There was no indirect cost involved in 72.7% of dengue and 56.7% of chikungunya cases. There were around 10.7% of dengue cases and 18.3% of chikungunya cases in which indirect cost due to wage loss days was more than Rs 5,000 [Table 3].

The average (median, and mean \pm SD) indirect cost due to wage loss days of dengue patient who took treatment at a private hospital ($N = 67$) and a government hospital ($N = 83$) was Rs 0 (p25 to p75: 0 to 750), (2511 \pm 7229) and Rs 0 (p25 to p75: 0

Table 2: Quantification of different costs associated to illness

	Dengue			Chikungunya		
	Treatment from private hospital (n=67)	Treatment from govt. hospital (n=83)	Overall (n=150)	Treatment from private hospital (n=24)	Treatment from govt. hospital (n=36)	Overall (n=60)
Indirect Cost						
Time cost of patient						
Mean±SD	2511±7229	1137±2415	1751±5179	6033±11839	1369±2751	3235±8028
Median (p25 to p75)	0 (0-750)	0 (0-1500)	0 (0-800)	250 (0-6000)	0 (0-1550)	0 (0-3150)
Min. to Max.	0-44000	0-12950	0-44000	0-54000	0-12000	0-54000
Time cost of caretaker						
Mean±SD	2677±3393	1529±2331	2042±2901	2817±4670	1033±1676	1747±3308
Median (p25 to p75)	1600 (0-3710)	800 (0-2100)	1200 (0-2750)	450 (0-4500)	0 (0-2000)	0 (0-2100)
Min to Max	0-19800	0-12500)	0-19800	0-18000	0-6000	0-18000
Total indirect cost						
Mean±SD	5188±8010	2805±4431	3869±6375	8850±11583	2403±3381	4982±8320
Median (p25 to p75)	2500 (930-6720)	1500 (0-3000)	1931 (300-4500)	4750 (3000-12500)	1300 (0-4100)	2550 (0-5250)
Min. to Max.	0-50400	0-30000	0-50400	0-54000	0-12000	0-54000
Direct Cost-Medical Cost						
Consultancy Cost						
Mean±SD	3486±12494	1.4±11.0	1558±8495	921±2049	0	368±1358
Median (p25 to p75)	0 (0-305)	0 (0-0)	0 (0-0)	300 (200-500)	0 (0 to 0)	0 (0-200)
Min. to Max.	0-85000	0-100	0-85000	0-10000	0-0	0-10000
Diagnosis Cost						
Mean±SD	3541±6528	475±962	1844±4661	2971±8169	197±487	1307±5294
Median (p25 to p75)	1300 (550-4000)	0 (0-600)	500 (0-1500)	900 (0-2250)	0 (0-50)	0 (0-800)
Min to Max	0-40000	0-5000	0-40000	0-40000	0-2000	0-40000
Medicine cost						
Mean±SD	6149±10074	996±1305	3298±7246	9896±16117	742±1028	4403±11060
Median (p25 to p75)	2500 (1000-6000)	400 (0-1500)	1000 (200-3000)	5000 (2000-7000)	500 (0-1000)	900 (100-3000)
Min to Max	0-58500	0-5000	0-58500	0-60000	0-4000	0-60000
Hospitalization cost	n=12	n=0		n=3	n=0	-
Mean±SD	18175±14441		-	7667±5859		
Median (p25 to p75)	16500 (7000-25000)			10000 (1000-12000)		
Min. to Max.	1500-50000			1000-12000		
Total Direct Medical cost						
Mean±SD	16595±25363	1493±1917	8238±18540	11958±17355	939±1391	5347±12174
Median (p25 to p75)	5000 (3000-19000)	500 (0-2500)	2450 (400-5000)	58500 (2750-9150)	500 (0-1500)	1500 (150-5200)
Min. to Max.	0-130000	0-8000	0-130000	0-61000	0-6000	0-61000
Direct Non-Medical Cost						
Transportation cost						
Mean±SD	1039±884	725±655	865±779	635±531	528±492	569±506
Median (p25 to p75)	800 (500-1500)	500 (400-1000)	600 (500-1000)	500 (0-1000)	500 (200-500)	500 (200-1000)
Min. to Max.	0-5000	0-3800	0-5000	0-2000	0-2000	0-2000
Special food cost						
Mean±SD	1361±1383	894±598	1100±1045	1308±698	703±495	945±651
Median (p25 to p75)	1000 (800-2000)	1000 (500-1000)	1000 (500-1500)	1000 (1000-1750)	500 (500-1000)	1000 (500-1000)
Min. to Max.	0-10000	0-3000	0-10000	0-3000	0-2000	0-3000
General food cost while staying						
Mean±SD	85±499	94±441	90±467	520±983	211±405	335±706
Median (p25 to p75)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-1000)	0 (0-250)	0 (0-500)
Min. to Max.	0-4000	0-3300	0-4000	0-3500	0-1500	0-3500
Other cost						
Mean±SD	13±69	120±1098	73±817	0	0	0
Median (p25 to p75)	0 (0-0)	0 (0-0)	0 (0-0)	0	0	0
Min. to Max.	0-500	0-10000	0-10000	0	0	0
Total Non-medical Cost						
Mean±SD	2777±2981	1812±1393	2243±2288	2458±1562	1469±1205	1865±1432
Median (p25 to p75)	2000 (1500-3000)	1500 (1200-2000)	1575 (1300-2600)	2000 (1350-3500)	1000 (700-2050)	1500 (850-2850)
Min. to Max.	0-20000	0-10000	0-20000	0-7000	0-5500	0-7000
Total cost due to illness						
Mean±SD	24396±32123	6134±5920	14289±23651	31492±43877	4783±4757	15467±30627
Median (p25 to p75)	10100 (6000-27000)	4100 (2700-7500)	6860 (3700-12525)	16000 (10400-27950)	4050 (1500-6750)	7000 (2550-14000)
Min. to Max.	0-149450	400-38500	0-149450	1600-204500	0-22000	0-204500

Table 3: Categorization of different indirect cost associated to illness

	Dengue			Chikungunya		
	Treatment from Private hospital (n=67)	Treatment from Govt hospital (n=83)	Overall (n=150)	Treatment from Private hospital (n=24)	Treatment from Govt hospital (n=36)	Overall (n=60)
Time Cost of patient						
Nil	49 (73.1)	60 (72.3)	109 (72.7) [65-79]	12 (50.0)	22 (61.1)	34 (56.7) [43-69]
<1000	2 (3.0)	2 (2.4)	4 (2.7) [1-7]	1 (4.2)	2 (5.6)	3 (5.0) [1-15]
1000-1999	4 (5.9)	3 (3.6)	7 (4.7) [2-9]	0	4 (11.1)	4 (6.7) [2-17]
2000-4999	3 (4.5)	11 (13.2)	14 (9.3) [5-15]	4 (16.6)	4 (11.1)	8 (13.3) [7-25]
5000-Above	9 (13.4)	7 (8.4)	16 (10.7) [7-17]	7 (29.2)	4 (11.1)	11 (18.3) [10-30]
Time cost of caretaker						
Nil	20 (29.8)	36 (43.4)	56 (37.3) [30-45]	12 (50.0)	23 (63.9)	35 (58.30) [45-70]
<1000	4 (6.0)	7 (8.4)	11 (7.3) [4-13]	1 (4.2)	0	1 (1.7) [0.1-11]
1000-1999	14 (20.9)	17 (20.5)	31 (20.7) [15-28]	1 (4.2)	3 (8.3)	4 (6.7) [0.2-17]
2000-4999	16 (23.9)	16 (19.3)	32 (21.3) [15-29]	5 (20.8)	8 (22.2)	13 (21.7) [13-34]
5000-9999	11 (16.4)	5 (6.0)	16 (10.7) [7-17]	3 (12.5)	2 (5.6)	5 (8.3) [3-19]
Above 10000	2 (3.0)	2 (2.4)	4 (2.7) [1-7]	2 (8.3)	0	2 (3.3) [0.1-13]
Total indirect cost (patient + caretaker)						
Nil	14 (20.9)	22 (26.5)	36 (24.0) [18-31]	3 (12.5)	15 (41.6)	18 (30.0) [19-43]
<1000	4 (6.0)	8 (9.6)	12 (8.0) [5-14]	2 (8.3)	1 (2.8)	3 (5.0) [1-15]
1000-1999	11 (16.4)	16 (19.3)	27 (18.0) [13-25]	0	6 (16.7)	6 (10.0) [4-21]
2000-4999	17 (25.4)	22 (26.5)	39 (26.0) [19-34]	7 (29.2)	9 (25.0)	16 (26.7) [17-40]
5000-9999	11 (16.4)	11 (13.2)	22 (14.7) [10-21]	5 (20.8)	2 (5.6)	7 (11.7) [5-23]
Above 10000	10 (14.9)	4 (4.8)	14 (9.3) [5-15]	7 (29.2)	3 (8.3)	10 (16.7) [9-29]

to1500), (1137 ± 2415) respectively. The minimum to maximum range of indirect cost due to wage loss days of dengue patient itself was Rs (0–12,950) and Rs (0–44,000) in a government and private hospital respectively [Table 2].

The average (median, and mean ± SD) indirect cost due wage loss days of chikungunya patient who took treatment at a private hospital (N = 24) and a government hospital (N = 36) was Rs 250 (p25 to p75: 0 to 6000), (6033 ± 11839) and Rs 0 (p25 to p75: 0 to1550), (1369 ± 2751) respectively. The minimum to maximum range of indirect cost due to wage loss days of chikungunya patient itself was Rs (0–12,000) and Rs (0–54,000) in a government and private hospital respectively [Table 2].

Indirect cost due to wage loss days of the caretaker(s)

Average (median) indirect cost due to wage loss of caretaker was 1200 (p25 to p75: 0 to 2750) and 0 (p25 to p75: 0 to 2100) for dengue and chikungunya, respectively [Table 2]. There was no indirect cost involved in around 37.3% of dengue and 58.30% of chikungunya cases. There were around 2.7% of dengue cases and 3.3% of chikungunya cases in which indirect cost due to wage loss days was more than Rs 10,000 [Table 3].

Total Indirect cost

On average total indirect cost incurred in the case of dengue were Rs 1,931 (with IQR 300–4500) and chikungunya was Rs 2,550 (with IQR 0–5250) [Table 2]. There was no indirect cost involved in one-fourth of cases irrespective of dengue and chikungunya. There were around 9.3% of dengue and 16.7% of chikungunya cases where the total indirect cost involved was more than Rs 10,000 [Table 3].

The average (median, and mean ± SD) total indirect cost of dengue patient who took treatment at a private hospital (N = 67) and a government hospital (N = 83) was Rs 2,500 (p25 to p75: 930 to 6720), (5188 ± 8010) and Rs 1,500 (p25 to p75: 0 to 3000), (2805 ± 4431) respectively. The minimum to maximum range of indirect cost due to wage loss days of dengue patient itself was Rs (0– 30,000) and Rs (0–50,400) in government and private hospital respectively [Table 2].

The average (median, and mean ± SD) total indirect cost of chikungunya patient who took treatment at a private hospital (N = 24) and a government hospital (N = 36) was Rs 4,750 (p25 to p75: 3000 to 12500), (8850 ± 11583) and Rs 1,300 (p25 to p75: 0 to 4100), (2403 ± 3381) respectively. The minimum to maximum range of indirect cost due to wage loss days of chikungunya patient itself was Rs (0–12,000) and Rs (0–54,000) in a government and private hospital respectively [Table 2].

Direct cost

Two types of direct costs (viz., direct cost related to medical expenses and direct cost due to other expenses) were estimated in this study [Tables 2 and 4].

Direct Cost related to medical expenses

Consultancy Cost: 82% of cases (123/150) did not spend even a single rupee for consultancy of a doctor in case of dengue infection, while in chikungunya it was 63.3% (38/60). 9.3% of dengue cases and 28.3% of chikungunya cases spent less than Rs 1,000 for the doctor consultation, a very small percentage (5.3% in dengue and 1.7% in chikungunya) spent more than Rs 5,000 on doctor consultation. Median consultation cost in both dengue and chikungunya cases was estimated to be zero [Table 4].

Table 4: Categorization of different direct (medical and non-medical) costs associated to illness

	Dengue			Chikungunya		
	Treatment from private hospital (n=67)	Treatment from govt hospital (n=83)	Overall (n=150)	Treatment from private hospital (n=24)	Treatment from govt hospital (n=36)	Overall (n=60)
Consultancy cost						
Nil	43 (64.2)	80 (96.4)	123 (82.0) [75-87]	2 (8.3)	36 (100)	38 (63.3) [50-75]
<1000	11 (16.4)	3 (3.6)	14 (9.3) [5-15]	17 (70.8)	0	17 (28.3) [18-41]
1000-1999	4 (6.0)	0	4 (2.7) [1-7]	2 (8.3)	0	2 (3.3) [1-13]
2000-4999	1 (1.5)	0	1 (0.7) [0.01-5]	2 (8.3)	0	2 (3.3) [1-13]
Above 5000	8 (11.9)	0	8 (5.3) [3-10]	1 (4.2)	0	1 (1.7) [0.2-11]
Diagnostic cost						
Nil	9 (13.4)	53 (63.9)	64 (42.7) [34-49]	10 (41.6)	27 (75.0)	37 (61.7) [48-73]
<1000	17 (25.4)	16 (19.3)	33 (22.0) [16-29]	2 (8.3)	7 (19.4)	9 (15.0) [8-27]
1000-1999	13 (19.4)	8 (9.6)	21 (14.0) [9-21]	5 (20.8)	0	5 (8.3) [3-19]
2000-4999	12 (17.9)	5 (6.0)	17 (11.3) [7-17]	5 (20.8)	2 (5.6)	7 (11.7) [5-23]
5000-9999	11 (16.4)	1 (1.2)	12 (8.0) [4-14]	0	0	0
Above 10000	5 (7.46)	0	4 (3.3) [1-8]	2 (8.3)	0	2 (3.3) [0.8-13]
Medicine cost						
Nil	5 (7.5)	27 (32.5)	32 (21.3) [15-29]	1 (4.2)	14 (38.9)	15 (25.0) [15-38]
<1000	8 (11.4)	26 (31.3)	34 (22.7) [17-30]	3 (12.5)	12 (33.3)	15 (25.0) [15-38]
1000-1999	9 (13.4)	11 (13.2)	20 (13.3) [9-20]	1 (4.2)	4 (11.1)	5 (8.3) [3-19]
2000-4999	23 (34.3)	17 (20.5)	40 (26.7) [20-34]	6 (25.0)	6 (16.7)	12 (20.0) [11-32]
5000-9999	11 (16.4)	2 (2.4)	13 (8.7) [5-14]	9 (37.5)	0	9 (15.0) [8-27]
Above 10000	11 (16.4)	0	11 (7.3) [4-13]	4 (16.7)	0	4 (6.7) [2-17]
Total medical cost						
Nil	2 (3.0)	24 (28.9)	26 (17.3) [12-24]	1 (4.2)	13 (36.1)	14 (23.3) [14-36]
<1000	1 (1.5)	21 (25.3)	22 (14.7) [10-21]	1 (4.2)	13 (36.1)	14 (23.3) [14-36]
1000-1999	7 (10.4)	13 (15.6)	20 (13.3) [9-20]	1 (4.2)	3 (8.3)	4 (6.7) [2-17]
2000-4999	22 (32.8)	17 (20.5)	39 (26.0) [19-34]	5 (20.8)	6 (16.7)	11 (18.3) [10-30]
5000-9999	12 (17.9)	8 (9.6)	20 (13.3) [9-20]	10 (41.6)	1 (2.8)	11 (18.3) [10-30]
Above 10000	23 (34.3)	0	23 (15.3) [10-22]	6 (25.0)	0	6 (10.0) [4-21]
Hospitalization, yes	12 (17.9)	0	12 (8.0)	3 (12.5)	0	3 (5.0)
Other cost, yes	0	2 (2.4)	2 (1.3)	2 (8.3)	0	2 (0.3)
Transport cost						
Nil	3 (4.5)	7 (8.4)	10 (6.7) [4-12]	6 (25.0)	5 (13.9)	11 (18.3) [10-30]
<1000	31 (46.3)	53 (63.8)	84 (56.0) [5-64]	8 (33.3)	25 (69.4)	33 (55.0) [42-67]
1000-1999	24 (35.8)	4 (22.9)	43 (28.7) [22-36]	8 (33.3)	4 (11.1)	12 (20.0) [11-32]
2000-4999	8 (11.9)	4 (4.8)	12 (8.0) [4-14]	1 (4.2)	2 (5.6)	3 (5.0) [1-15]
Above 5000	1 (1.5)	0	1 (0.7) [0.1-5]	1 (4.2)	0	1 (1.7) [0.2-11]
Special food cost (Md. (IQR))						
Nil	5 (7.5)	7 (8.4)	12 (8.0) [4-14]	1 (4.2)	5 (13.9)	6 (10.0) [4-21]
<1000	14 (20.9)	28 (33.7)	42 (28.0) [21-36]	3 (12.5)	16 (44.4)	19 (31.7) [21-45]
1000-1999	29 (43.3)	41 (49.4)	70 (47.0) [39-55]	14 (58.3)	13 (36.1)	27 (45.0) [33-58]
2000-4999	16 (23.8)	7 (8.4)	23 (15.3) [10-22]	6 (25.0)	2 (5.6)	8 (13.3) [7-25]
Above 5000	3 (4.5)	0	3 (2.0) [0.6-6]	0	0	0
General food cost (Md. (IQR))						
Nil	62 (92.5)	78 (94.0)	140 (93.2) [88-96]	17 (70.8)	27 (75.0)	44 (73.3) [60-83]
<1000	4 (6.0)	1 (1.2)	5 (3.3) [1-8]	0	4 (11.1)	4 (6.7) [2-17]
1000-1999	0	3 (3.6)	3 (2.0) [0.6-6]	5 (20.8)	5 (13.9)	10 (16.7) [9-29]
2000-4999	1 (1.5)	1 (1.2)	2 (1.3) [0.3-5]	2 (8.3)	0	2 (3.3) [8-13]
Above 5000	0	0	0	0	0	0
Other cost (Md. (IQR))						
Nil	64 (95.5)	82 (98.8)	146 (97.3) [93-99]	24 (100)	36 (100)	60 (100)
<1000	3 (4.5)	0	3 (2.0) [0.6-6]	0	0	0
1000-1999	0	0	0	0	0	0
2000-4999	0	0	0	0	0	0
Above 5000	0	1 (1.2)	1 (0.7) [0.09-5]	0	0	0

Contd...

Table 4: Contd...

	Dengue			Chikungunya		
	Treatment from private hospital (n=67)	Treatment from govt hospital (n=83)	Overall (n=150)	Treatment from private hospital (n=24)	Treatment from govt hospital (n=36)	Overall (n=60)
Total Non-medical						
Nil	2 (3.0)	3 (3.6)	5 (3.3) [0.1-8]	1 (4.2)	4 (11.1)	5 (8.3) [3-19]
<1000	4 (6.0)	12 (14.5)	16 (10.7) [7-17]	1 (4.2)	10 (27.8)	11 (18.3) [10-30]
1000-1999	23 (34.3)	42 (50.6)	65 (43.3) [36-51]	8 (33.3)	12 (33.3)	20 (33.3) [22-46]
2000-4999	32 (47.8)	23 (27.7)	55 (36.7) [29-45]	13 (54.2)	9 (25.0)	22 (36.7) [25-50]
Above 5000	6 (9.0)	3 (3.6)	6 (6.0) [3-11]	1 (4.2)	1 (2.8)	2 (3.3) [0.8-13]
Total cost due to illness						
<1000	1 (4.3)	5 (6.0)	6 (4.0) [2-9]	0	7 (19.4)	7 (11.7) [5-23]
1000-1999	1 (4.3)	10 (12.0)	11 (7.3) [4-13]	1 (4.2)	4 (11.1)	5 (8.3) [3-19]
2000-4999	9 (13.4)	34 (41.0)	43 (29.7) [22-36]	1 (4.2)	12 (33.3)	13 (21.7) [13-34]
5000-9999	21 (31.3)	21 (25.3)	42 (28.0) [21-36]	3 (12.5)	10 (27.8)	13 (21.7) [13-34]
10000-19999	15 (22.4)	10 (12.0)	25 (16.7) [11-23]	9 (37.5)	2 (5.6)	11 (18.3) [10-30]
20000-39999	7 (10.5)	3 (3.6)	10 (6.7) [4-12]	6 (25.0)	1 (2.8)	7 (11.7) [5-23]
Above 40000	13 (19.4)	0	13 (8.74) [5-14]	4 (16.7)	0	4 (6.7) [2-17]

The average (median, and mean \pm SD) consultancy cost of dengue patient who took treatment at a private hospital ($N = 67$) and a government hospital ($N = 83$) was Rs 0 (p25 to p75: 0 to 305), (3486 \pm 12494) and Rs 0 (p25 to p75: 0 to 0), (1.4 \pm 11.4) respectively. The minimum to maximum range of consultancy cost for the dengue patient itself was Rs (0–100) and Rs (0–85,000) in a government and private hospital respectively [Table 2].

The average (median, and mean \pm SD) direct cost due to wage loss days of chikungunya patient who took treatment at a private hospital ($N = 24$) and a government hospital ($N = 36$) was Rs 300 (p25 to p75: 200 to 500), (921 \pm 2049) and Rs 0 (p25 to p75: 0 to 0), (0) respectively. The minimum to maximum range of consultation cost of chikungunya patient itself was Rs (0) and Rs (0–10,000) in a government and private hospital respectively [Table 2].

Diagnosis Cost: 42.7% of dengue cases and 61.7% of chikungunya cases got the diagnosis done free of cost. 22.7% of dengue and 25.0% in chikungunya cases got the diagnosis done for Rs < 1000. Only a small proportion (3.3% in dengue and 3.3% in chikungunya) spent more than Rs 10,000 on the diagnosis [Table 4].

The average (median, and mean \pm SD) diagnosis cost of dengue patient who took treatment at a private hospital ($N = 67$) and a government hospital ($N = 83$) was Rs 1,300 (p25 to p75: 550 to 4000), (3541 \pm 6528) and Rs 0 (p25 to p75: 0 to 600), (475 \pm 962) respectively. The minimum to maximum range of diagnosis cost of dengue patient itself was Rs (0–5,000) and Rs (0–40,000) in a government and private hospital respectively [Table 2].

The average (median, and mean \pm SD) indirect cost due to wage loss days of chikungunya patient who took treatment at a private hospital ($N = 24$) and a government hospital ($N = 36$) was 900 0 (p25 to p75: 0 to 2250), (2971 \pm 8169) and 0 (p25 to p75: 0 to 50), (197 \pm 487). The minimum to maximum range of

diagnosis cost of chikungunya patient itself was Rs (0–2,000) and Rs (0–40,000) in a government and private hospital respectively [Table 2].

Medicine Cost: Median medicine cost was estimated to be Rs 1,000 (IQR 200–3000) in dengue and Rs 900 (IQR 100–3000) in chikungunya [Table 2]. Around 21.3% (i.e., 32/150) of dengue cases and 25% (i.e., 15/60) of chikungunya cases did not spend anything on medicine cost, 22.7% of dengue and 25% of chikungunya cases spent Rs <1000 on medicine cost, 26.7% of dengue and 20% of chikungunya cases spent Rs 2,000 to Rs 4,999 on medicine cost. Relatively a lower percentage (dengue: 7.3% and chikungunya: 6.7%) spent more than Rs 10,000 on medicine cost and hospitalization. Twelve among 150 cases (i.e., 8%) of dengue and 3 among 60 cases (i.e., 5%) of chikungunya required hospitalization [Table 4].

The average (median, and mean \pm SD) medicine cost of a dengue patient who took treatment at a private hospital ($N = 67$) and a government hospital ($N = 83$) was Rs 2,500 (p25 to p75: 1000 to 6000), (6149 \pm 10074) and Rs 400 (p25 to p75: 0 to 1500), (996 \pm 1305) respectively. The minimum to maximum range of diagnosis cost of dengue patient itself was Rs (0–5,000) and Rs (0–58,500) in a government and private hospital respectively [Table 2].

The average (median, and mean \pm SD) medicine cost of a chikungunya patient who took treatment at a private hospital ($N = 24$) and a government hospital ($N = 36$) was Rs 5,000 (p25 to p75: 2000 to 7000), (9896 \pm 16117) and Rs 500 (p25 to p75: 0 to 1000), (742 \pm 1028) respectively. The minimum to maximum range of diagnosis cost of chikungunya patient itself was Rs (0–4,000) and (0–6,0000) in a government and private hospital respectively. Table 2.

Total Medical Cost: The total medical cost was the sum of consultation cost, diagnosis cost, medicine cost, and

other medical expenses. On average, dengue cases spent Rs 2,450 (p25 to p75: 400 to 5000) as a total medical expenditure while chikungunya cases spent relatively less money, that is, Rs 1,500 (p25 to p75: 400 to 5200) on medical expenses [Table 2]. A majority of the dengue cases (i.e., 39/150 or 26.0%) spent Rs 2,000 to 4,999 as a total medical expenditure while the majority of chikungunya cases (i.e., 14/60 or 23.3%) spent less than Rs 1,000 as a total medical expense [Table 4].

The average (median, and mean \pm SD) total medical cost for a dengue patient who took treatment from a private hospital ($N = 67$) and a government hospital ($N = 83$) was Rs 5,000 (p25 to p75: 3000 to 19000), (16595 \pm 25363) and Rs 500 (p25 to p75: 0 to 2500), (1493 \pm 1917) respectively. The minimum to maximum range of indirect cost due to wage loss days of a dengue patient itself was Rs (0–8,000) and Rs (0–1,30,000) in a government and private hospital, respectively [Table 2].

The average (median, and mean \pm SD) total medical cost for a chikungunya patient who took treatment at a private hospital ($N = 24$) and a government hospital ($N = 36$) was Rs 58,500 (p25 to p75: 2750 to 9150), (11958 \pm 17355) and Rs 500 (p25 to p75: 0 to 1500), (939 \pm 1391) respectively. The minimum to maximum range of indirect cost due to wage loss days of a chikungunya patient itself was Rs (0–6,000) and Rs (0–61,000) in a government and private hospital, respectively [Table 2].

Direct Cost including non-medical expenses

Along with medical costs, there were some other costs as well, such as transportation cost, special food cost, etc., which were directly involved with the dengue and chikungunya cases [Tables 2 and 4].

Transportation Cost: Transportation costs incurred due to dengue and chikungunya were more or less similar. While the average transportation cost in dengue was Rs 600 (p25 to p75: 500 to 1000), the average transportation cost was Rs 500 (p25 to p75: 200 to 1000) in chikungunya [Table 2]. The majority of cases in either of the situations (dengue and chikungunya) spent less than Rs 1,000 on transportation costs [Table 4].

Special food cost: The average food cost in both the conditions was observed to be the same, that is, Rs 1,000 (500 to 1500) [Table 2]. 8% in dengue and 10% in chikungunya did not spend any amount on special food but a majority of cases in either condition (dengue and chikungunya) spent Rs 1,000–1,999 on special food [Table 4].

General food cost: In dengue infection, general food cost was less than Rs 1,000 (3.3%) followed by Rs 1,000–1,999 (2.0%), and Rs 2,000–4,999 (1.3%). In the case of chikungunya infection, general food cost was Rs 1,000–1,999 (16.7%), followed by less than Rs 1,000 (6.7%), and Rs 2,000–4,999 (3.3%) [Table 4].

Total non-medical cost: In dengue infection, non-medical cost was Rs 1,000–1,999 (43.3%) followed by Rs 2,000–4,999 (36.7%), less than Rs 1,000 (10.7%), and more than Rs 5,000 (6.0%). In the case of chikungunya infection, non-medical cost amounted to Rs 2,000–4,999 (36.7%) followed by Rs 1,000–1,999 (33.3%), less than Rs 1,000 (18.3%), and more than Rs 5000 (3.3%) [Table 4].

The average (median, and mean \pm SD) total non-medical cost of a dengue patient amounted to Rs 1,575 (p25 to p75: 1300 to 2600), (2243 \pm 2288) while a chikungunya patient spent relatively lesser money, that is, Rs 1,500 (p25 to p75: 850 to 2850), (1865 \pm 1432) on such expenses [Table 2].

The average (median, and mean \pm SD) total non-medical cost of a dengue patient who received treatment at a private hospital ($N = 67$) and a government hospital ($N = 83$) was Rs 2,000 (p25 to p75: 1500 to 3000), (2777 \pm 2981) and Rs 1,500 (p25 to p75: 1200 to 2000), (1812 \pm 1393) respectively [Table 2]. The minimum to maximum range of indirect cost due to wage loss days of a dengue patient itself was Rs (0–10,000) and Rs (0–20,000) in a government and private hospital, respectively [Table 2].

The average (median, and mean \pm SD) total non-medical cost of a chikungunya patient who received treatment at a private hospital ($N = 24$) and a government hospital ($N = 36$) was Rs 2,000 (p25 to p75: 1350 to 3500), (2458 \pm 1562) and Rs 1,000 (p25 to p75: 700 to 2050), (1469 \pm 1205) respectively. The minimum to maximum range of indirect cost due to wage loss days of a chikungunya patient itself was Rs (0–5,500) and Rs (0–7,000) in a government and private hospital, respectively [Table 2].

Total cost

Total cost due to illness included total medical and non-medical costs. The total cost incurred due to dengue and chikungunya was Rs 6,860 (p25 to p75: 3700 to 12525) and Rs 7,000 (2550–14000) respectively [Table 2]. In both the infections, the total cost was in a range of less than Rs 1,000 to more than Rs 40,000 [Table 4]. In dengue infection, the total cost due to illness was more than Rs 40,000 (8.74%) and in Chikungunya infection it was more than Rs 40,000 (6.74%) [Table 4].

The average (median, and mean \pm SD) total cost of a dengue patient who received treatment at a private hospital ($N = 67$) and a government hospital ($N = 83$) was Rs 10,100 (p25 to p75: 6000 to 27000), (24396 \pm 32123) and Rs 4,100 (p25 to p75: 2700 to 7500), (6134 \pm 5920) respectively [Table 2]. The minimum to maximum range of indirect cost due to wage loss days of a dengue patient itself was Rs (400–38,500) and Rs (0–1,49,450) in a government and private hospital, respectively [Table 2].

The average (median, and mean \pm SD) total cost of a chikungunya patient who received treatment at a private hospital ($N = 24$) and a government hospital ($N = 36$) was Rs 16,000 (p25 to p75: 10400 to 27950), (31492 \pm 43877) and Rs 4,050 (p25 to p75: 1500 to 6750), (4783 \pm 4757) respectively [Table 2]. The

minimum to maximum range of indirect cost due to wage loss days of a chikungunya patient itself was Rs (0–22,000) and Rs (1,600–2,04,500) in a government and private hospital, respectively [Table 2].

Other information

During the treatment of dengue and chikungunya infection, 11.3% and 13.3% of the families were used to saving money. Family consumption expenditure was reduced by 6.7% and 1.7% in dengue and chikungunya, respectively. Assets were sold by the families, for treatment (5.3% in dengue and 1.7% in chikungunya cases) and day-by-day expenditure (2.0% in dengue and 1.7% in chikungunya cases). Families (34% in dengue and 23.3% in chikungunya cases) had to borrowed money for the treatment. The source of borrowing in dengue infection was family and friends (16%), followed by money lender (8%), and relatives (8%), while in Chikungunya infection, it was the money lender (18.3%) followed by family and friends (8.3%) [Table 5].

Discussion

The present study analyzed the cost of illness among two major vector-borne viral diseases: dengue and chikungunya. The recurrent outbreaks and the increasing number of patients with these viral diseases impose heavy costs on the infected people, their families as well as on the health system. Identifying and unraveling the economic burden of vector-borne viral diseases such as dengue and chikungunya can generate valuable evidence for policy making. Dengue is an important cause of acute febrile illness globally as well as in India, with several outbreaks being reported every year.

Table 5: Coping strategies and social resources

	Dengue (n=150)	Chikungunya (n=60)
Family use saving during illness		
No	133 (88.7)	52 (86.7)
Yes	17 (11.3)	8 (13.3)
Family consumption expenditure got reduced		
No	140 (93.3)	59 (98.3)
Yes	10 (6.7)	1 (1.7)
Family has to sale assets for treatment		
No	142 (94.7)	59 (98.3)
Yes	8 (5.3)	1 (1.7)
Family has to sale assets for to meet day to day expenditure		
No	147 (98.0)	59 (98.3)
Yes	3 (2.0)	1 (1.7)
Did your family has to borrow for treatment		
No	99 (66.0)	46 (76.7)
Yes	51 (34.0)	14 (23.3)
Source of borrowings		
Nil	96 (64.0)	39 (65.0)
Family and Friends	24 (16.0)	5 (8.3)
Relatives	12 (8.0)	2 (3.3)
Money lender	12 (8.0)	11 (18.3)
Any other private source	2 (1.3)	3 (5.0)
Co-operative bank	1 (0.7)	0
Commercial bank	2 (1.3)	0
Help from any of Govt. Scheme	1 (0.7)	0

The disease is widening its area and its economic burden is growing day by day. In 2018, 101,192 dengue cases, 8,499 chikungunya cases, and 172 deaths due to dengue were reported in India.^[30] The state of Gujarat contributed 5.77% of dengue and 11.73 % of chikungunya cases to overall cases in the country during the year of 2018. In Gujarat, 7,579 dengue cases, 4 deaths due to dengue, and 997 chikungunya cases were reported in 2018.

Earlier studies on costs of dengue in Surat, 2010,^[29] Karnataka, 2016^[31] and Haryana, 2014^[32] included direct and indirect costs, but only a few factors were included in calculating the direct and indirect costs in those studies. In other studies, conducted in Surat, 2017^[33] only direct cost was included and there was no information on non-medical costs such as food and transportation and exact indirect costs such as wage loss to patients and relatives.

In the present study, the economic burden is calculated by the addition of indirect cost (time cost of the ill person and their caretaker) and direct cost (expenses incurred by patients which may be the medical cost or non-medical cost). Medical cost involves doctor consultation fees, medication and diagnostics charges, hospitalization cost and other medical charges such as physiotherapy while non-medical cost includes transportation cost (from home to hospital/clinic/laboratory/testing center), special food cost (supplements), general food for indoor treatment, and lodging of a caretaker.

A majority of the dengue and chikungunya patients were in the age group of 6–20 and 31–80 years, respectively. Our results are consistent with earlier studies that have also reported that the most affected age group due to dengue majorly fall in younger age groups such as 15–24 years,^[34] 21–30 years,^[35,36] and 17–40^[37] years. In the case of chikungunya cases, most of the reported cases were in older age groups such as 46–60 years,^[38] 20–30 years,^[39] and 47–56 years.^[40] Results indicate that dengue mainly affects the younger age groups as compared to chikungunya, which usually affects individuals at a later age.

The total medical cost of dengue and chikungunya patients in the present study was higher than that reported in the earlier study from Surat^[31] which was USD 14.8 (IQR 7.3–65.9)/INR (IQR 465–4194) and the average cost was USD (86.9 ± 170.7)/INR (5530 ± 10837). Another study from Surat^[29] reported a direct medical cost of USD 439.44/INR 20407 which was similar to our study. In other studies, the average direct cost per household for treatment of dengue reported from Karnataka was INR 9484,^[31] Haryana was INR 10022.85,^[32] Vietnam was USD 32.7 (INR 2027),^[41] Cambodia was USD32 (INR 1887),^[25] and Bangkok was USD 102 (INR 6364)^[42] which was less than our present study.

The total indirect cost of dengue and chikungunya patients in the present study was higher than that reported in the earlier study from Surat^[29] which was USD 146.13/INR 6786. In other studies, the average indirect cost per household for treatment of dengue

reported from Karnataka was INR 1540.65,^[31] Haryana was INR 1840,^[32] and from Vietnam was USD 28.7/INR 1693^[41] which was less than our present study. The total direct and indirect cost of dengue and chikungunya patients was higher than the earlier reported study from Karnataka (INR 11278),^[31] Haryana (INR 11563),^[32] and Vietnam (USD 61.3/INR 3720).^[41]

Duration of illness and duration of wage loss of the patients in case of dengue and chikungunya was 5–15 days and 7–45 days, respectively, in the present study. A previous study from Vellore,^[43] India reported a duration of illness of 4 days (IQR 3–7 days) for children and adults in case of dengue infection, which was less than that reported in the present study. Overall, it has been observed that in chikungunya infection, duration of illness and duration of wage loss was more, and days of disabilities were more as compared to dengue infection. The total cost due to illness was high due to the patient's preferred private treatment as compared to the government setup.

The current study demonstrated that both dengue and chikungunya have a substantial financial impact on not only patients but associated families. The study provides insight into the economic costs associated with the two major vector-borne viral diseases. Timely economic evaluation studies need to be done to provide evidence-based policy making decisions. Such studies also help in allocation of limited resources appropriately in urban and rural areas to help alleviate their associated economic burden.

Conclusion

In most of the studies, the economic burden of dengue infection has been based on the hospital. The current study was a prospective study and patients were followed up for collection of data. Furthermore, we addressed the total cost including the direct and indirect costs of dengue and chikungunya diagnosis and treatment. The strength of the study is its prospective design, although the study was limited to the Ahmedabad and Kheda districts of Gujarat. This study can be done at a multicenter level countrywide to estimate the actual economic burden of the diseases and make a strong policy to strengthen the vector control program. Patients have to bear high costs from their pockets while suffering from dengue and chikungunya infections. The study provides improved knowledge about the impact of cost and economic burden associated with dengue and chikungunya, which will help policymakers allocate and appropriate the resources for the control of these diseases.

Ethics committee clearance

Institutional Ethical Committee approval was obtained vide letter no. ECR/NIMR/EC/2018/35 dated 26 Feb 2018.

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Conflicts of interest

There are no conflicts of interest.

References

1. Lee H, Halverson S, Ezinwa N. Mosquito-Borne diseases. *Prim Care-Clin Off Pract* 2018. doi: 10.1016/j.pop. 2018.05.001.
2. Carabali M, Hernandez LM, Arauz MJ, Villar LA, Ridde V. Why are people with dengue dying? A scoping review of determinants for dengue mortality. *BMC Infect Dis* 2015;15:301.
3. Guzman MG, Gubler DJ, Izquierdo A, Martinez E, Halstead SB. Dengue infection. *Nat Rev Dis Prim* 2016. doi: 10.1038/nrdp. 2016.55.
4. Sarkar JK, Pavri KM, Chatterjee SN, Chakravarty SK, Anderson CR. Virological and serological studies of cases of heemorrhagic fever in Calcutta. *Indian J Med Res* 1964;52:684-91.
5. Carey DE, Myers RM, DeRanitz CM, Jadhav M, Reuben R. The 1964 chikungunya epidemic at Vellore, South India, including observations on concurrent dengue. *Trans R Soc Trop Med Hyg* 1969;63:434-45.
6. Ganeshkumar P, Murhekar MV, Poornima V, Saravanakumar V, Sukumaran K, Anandaselvasankar A, *et al.* Dengue infection in India: A systematic review and meta-analysis. *PLoS Negl Trop Dis* 2018;12:e0006618.
7. Mutheneni SR, Morse AP, Caminade C, Upadhyayula SM. Dengue burden in India: Recent trends and importance of climatic parameters. *Emerg Microbes Infect* 2017;6:e70.
8. Arunachalam N, Murty Us, Kabilan L, Balasubramanian A, Thenmozhi V, Narahari D, *et al.* Studies on dengue in rural areas of Kurnool District, Andhra Pradesh, India. *J Am Mosq Control Assoc* 2004;20:87-90.
9. Govt of India Guidelines for integrated vector management for control of dengue/dengue haemorrhagic fever. Delhi Natl Vector Borne Dis Control Program (NVBDCP), Dir Gen Heal Serv Minist Heal Fam Welfare, Gov India. Published online 2016.
10. Mairuhu ATA, Wagenaar J, Brandjes DPM, van Gorp EC. Dengue: An arthropod-borne disease of global importance. *Eur J Clin Microbiol Infect Dis* 2004;23:425-33.
11. Raheel U, Faheem M, Riaz MN, Kanwal N, Javed F, Zaidi Nu, *et al.* Dengue fever in the Indian subcontinent: An overview. *J Infect Dev Ctries* 2011;5:239-47.
12. Rushby JAF, Hanson K. Calculating and presenting disability adjusted life years (DALYs) in cost-effectiveness analysis. *Health Policy Plan* 2001;16:326-31.
13. Halasa YA, Shepard DS, Zeng W. Economic cost of dengue in Puerto Rico. *Am J Trop Med Hyg* 2012;86:745-52.
14. Shepard DS, Coudeville L, Halasa YA, Zambrano B, Dayan GH. Economic impact of dengue illness in the Americas. *Am J Trop Med Hyg* 2011;84:200-7.
15. Suaya JA, Shepard DS, Siqueira JB, Martelli CT, Lum LC, Tan LH, *et al.* Cost of dengue cases in eight countries in the Americas and Asia: A prospective study. *Am J Trop Med Hyg* 2009;80:846-55.
16. Tarragona S, Monteverde M, Marchioni S, Caporale J, Pereiro AC, Palacios JM. Dengue in Argentina: An economic analysis of the impact of the 2009 epidemic. *Salud Colect* 2012;8:151-62.
17. Torres JR, Castro J. The health and economic impact of dengue in Latin America. *Cad Saude Publica* 2007;23:S23-31.
18. Undurraga EA, Betancourt-Cravioto M, Ramos-Castaneda J, Martínez-Vega R, Méndez-Galván J, Gubler DJ, *et al.* Economic and disease burden of dengue in Mexico. *PLoS*

- Negl Trop Dis 2015;9:e0003547.
19. Wettstein ZS, Fleming M, Chang AY, Copenhaver DJ, Wateska AR, Bartsch SM, *et al.* Total economic cost and burden of dengue in Nicaragua: 1996–2010. *Am J Trop Med Hyg* 2012;87:616-22.
 20. Kongsin S, Jiamton S, Suaya JA, Vasanawathana S, Sirisuvan P, Shepard DS. Cost of dengue in Thailand. *Dengue Bulletin* 2010;34:77-88.
 21. Shepard DS, Undurraga EA, Lees RS, Halasa Y, Lum LCS, Ng CW. Use of multiple data sources to estimate the economic cost of dengue illness in Malaysia. *Am J Trop Med Hyg* 2012;87:796-805.
 22. Shepard DS, Undurraga EA, Halasa YA. Economic and disease burden of dengue in Southeast Asia. *PLoS Negl Trop Dis* 2013;7:e2055. doi: 10.1371/journal.pntd.0002055.
 23. Garg P, Nagpal J, Khairnar P, Seneviratne SL. Economic burden of dengue infections in India. *Trans R Soc Trop Med Hyg* 2008;102:570-7.
 24. Carrasco LR, Lee LK, Lee VJ, Ooi EE, Shepard DS, Thein TL, *et al.* Economic impact of dengue illness and the cost-effectiveness of future vaccination programs in Singapore. *PLoS Negl Trop Dis* 2011;5:e1426.
 25. Beauté J, Vong S. Cost and disease burden of dengue in Cambodia. *BMC Public Health* 2010;10:521.
 26. Edillo FE, Halasa YA, Largo FM, Erasmo JNV, Amoin NB, Alera MTP, *et al.* Economic cost and burden of dengue in the Philippines. *Am J Trop Med Hyg* 2015;92:360-6.
 27. Kumar A, Rao CR, Pandit V, Shetty S, Bammigatti C, Samarasinghe CM. Clinical manifestations and trend of dengue cases admitted in a tertiary care hospital, Udipi district, Karnataka. *Indian J community Med Off Publ Indian Assoc Prev Soc Med* 2010;35:386-90.
 28. Sinha N, Gupta N, Jhamb R, Gulati S, Kulkarni Ajit V. The 2006 dengue outbreak in Delhi, India. *J Commun Dis* 2008;40:243-8.
 29. Bhavsar AT, Shepard DS, Suaya JA, Mafowosofo M, Hurley CL. A private hospital-based study assessing knowledge, attitudes, practices and costs associated with dengue illness in Surat, India. *Dengue Bulletin* 2010; 34.
 30. Singh J, Dinkar A, Atam V. Intracranial hemorrhage in dengue fever: A case series. *J Med Sci Clin Res* 2015;3:4447-52.
 31. Kumar N, Shyam AC, LNU V. Cost burden of dengue fever in a rural Ramanagara District of Karnataka State. *J Med Sci* 2016;2:59-61. doi: 10.5005/jp-journals-10045-0040.
 32. Kumar D, Garg S. Economic burden of dengue fever on households in Hisar district of Haryana state, India. *Int J Adv Med Heal Res* 2014;1:99.
 33. Bajwala VR, John D, Rajasekar TD, Murhekar MV. Severity and costs associated with hospitalization for dengue in public and private hospitals of Surat city, Gujarat, India, 2017–2018. *Trans R Soc Trop Med Hyg* 2019;113:661-9.
 34. Mistry M, Chudasama RK, Goswami Y, Dalwadi C, Mitra A, Mehta G. Epidemiological characteristics of dengue disease in Saurashtra region, India, during year 2015. *J Fam Med Prim Care* 2017;6:249-53.
 35. Dar L, Broor S, Sengupta S, Xess I, Seth P. The first major outbreak of dengue hemorrhagic fever in Delhi, India. *Emerg Infect Dis* 1999;5:589-90.
 36. Gupta E, Dar L, Narang P, Srivastava VK, Broor S. Serodiagnosis of dengue during an outbreak at a tertiary care hospital in Delhi. *Indian J Med Res* 2005;121:36-8.
 37. Debnath F, Ponnaiah M, Acharya P. Dengue fever in a municipality of West Bengal, India, 2015: An outbreak investigation. *Indian J Public Health* 2017;61:239.
 38. Galate LB, Agrawal SR, Shastri JS, Londhey V. Chikungunya fever among patients with acute febrile illness attending a tertiary care hospital in Mumbai. *J Lab Physicians* 2016;8:85-9.
 39. Suryawanshi SD, Dube AH, Khadse RK, Jalgaonkar SV, Sathe PS, Zawar SD, *et al.* Clinical profile of chikungunya fever in patients in a tertiary care centre in Maharashtra, India. *Indian J Med Res* 2009;129:438-41.
 40. Chandra P, Das B, Sowmya MK, Samanta S, Thimmaraju KV. Epidemiological study on chikungunya outbreak in Mangalore district, Karnataka. *Int J Pharma Bio Sci* 2011;2:343-7.
 41. Harving ML, Ronsholt FF. The economic impact of dengue hemorrhagic fever on family level in Southern Vietnam. *Dan Med Bull* 2007;54:170-2.
 42. Clark DV, Mammen MP Jr, Nisalak A, Puthimethee V, Endy TP. Economic impact of dengue fever/dengue hemorrhagic fever in Thailand at the family and population levels. *Am J Trop Med Hyg* 2005;72:786-91.
 43. Panmei K, Joseph AK, Rose W, Abraham OC, Mathuram AJ, Kumar S, *et al.* Direct cost of illness for dengue in hospitalized children and adults at a referral hospital in India. *Int J Infect Dis* 2019;84:S64-7.