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Assessing the Financial Burden of Dengue Across Socioeconomic Groups in Hyderabad and Karachi

Sana Rafiq[1], Aqsa Saleem*[2], Shahzad Rauf[3], Falak Naz Qazi[4], Naranjan Kumar[5], Rabia Rauf[6]

[1] Occupational Therapist, The Circle (Caring for Children), Karachi, Pakistan.
[2] Occupational Therapist, Institute of Holistic and Rehabilitation Inclusion, Karachi, Pakistan.
[3] Medical Officer, Civil Hospital, Badin, Pakistan.
[4] Master Trainer, Caring for Cannot, Lahore, Pakistan.
[5] Occupational Therapist, Liaquat National Hospital, Karachi, Pakistan.
[6] Assistant Manager, Al Asar Welfare Organization, Karachi, Pakistan.

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Correspondence:
Dr. Aqsa Saleem
Occupational Therapist, Institute of Holistic and Rehabilitation Inclusion, Karachi, Pakistan.
Email: aqsa.12saleem@gmail.com

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Abstract

Background:

Dengue is a communicable disease rapidly growing in low- and middle-income countries and creating huge epidemiological and economic burden by affecting millions of people globally. The present study is aimed to determine the economic burden of dengue among the population living in two major cities of Pakistan that are Karachi and Hyderabad and to identify the burden of disease in relation to demography and socio-economic status of the population.

Methods:

This cross-sectional cost of illness study was conducted at two major cities of Sindh i.e. Karachi and Hyderabad on a total of 634 participants. Participants with age ≥18 years and a laboratory confirmed dengue infection. Based on the framework of COI, the costs were categorized into three categories: direct medical, direct non-medical, and indirect costs.

Results

The generalized linear model showed cost burden was higher (1.12 times) on participants residing in Karachi in comparison to total dengue-related costs compared with those treated in Hyderabad. The cost burden also increases among different SES groups in relative to the lower socioeconomic group reporting 1.52 times higher among middle, 1.84 times higher among upper-middle, and 2.12 times higher among upper socioeconomic groups.

Conclusion

Deducing the findings of this study and evidences available on data search, it is considerate that cases of dengue has been rising; passing every year. While higher income group can afford the cost, the population belongs from LES suffers from increase out of pocket expenditure that greatly effects their budget by increasing a burden on house hold expense.

Keywords

Cost of Illness, Dengue, Economic Burden, Healthcare Costs, Socioeconomic Status, Socioeconomic Disparities

1. INTRODUCTION

Dengue is a vector-borne disease that is rapidly growing in low- and middle-income countries and creating huge epidemiological and economic burden by affecting millions of people globally ((Du et al., 2021; Zeng et al., 2021). During the period of last three decades the incidence of dengue has shown a rapid growth mainly due to multiple factors like urbanization, population growth, climate change and increasing socioeconomic inn equalities (Zeng et al., 2021). Epidemiological data has provided evidences that the cases of dengue fever has increased from about 23-30 million from 1990 to 100 million in 2017 and a trend shows even further increase in the upcoming years (Du et al., 2021; Zeng et al., 2021; Zhang et al., 2025). It is also estimated that mortality rate has increased nearly to

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doubled due to dengue infection with an increased in disability-adjusted life years (DALYs) to over 2 million during the same period, underlying the increasing health and economic impact of the disease on the population (Yang et al., 2021; Zhang et al., 2025).

Evidences suggested that in South Asian region the dengue fever has shown a proportionate high share of burden with a relatively high age-standardized incidence rate and an increased DALYS (Tian et al., 2022). The global burden disease estimation has reported that in South Asian region the dengue has shown a highest rate of morbidity and mortality that is mainly due to failure in vector control. (Du et al., 2021; Yang et al., 2021).

Beyond its epidemiological impact, dengue imposes a substantial and growing economic burden on households, health systems, and national economies. Shepard et al. (2016) estimated that in 2013 alone, dengue caused approximately 58.4–58.7 million symptomatic infections and 13,586 deaths globally, with an annual economic cost of US$8.9 billion (95% uncertainty interval: US$3.7–19.7 billion). Importantly, only 18% of cases required hospitalization, while nearly half were treated on an ambulatory basis and over one-third incurred non-medical costs, indicating that a large proportion of the financial burden falls directly on households rather than health systems.

A study conducted by Shepard et al has estimated that dengue causes a 2.9 million cases out of which 6000 deaths occur annually that creates an economic burden of US$950 million/year. Country specific studies have revealed that in America the dengue cost a US$2.1 billion per year where as in Mexico it cost approximately US$170 million/year (Undurraga et al., 2015). Bangladesh reported an average societal cost of US$479 per hospitalized dengue episode, with out-of-pocket expenditures accounting for 66% of total costs. It is important to note that, dengue cost the poorest income quintile to experience a higher relative financial burden compared to wealthier households, often surpassing monthly household income resulting in serious health expenditure (Sarker et al., 2023).

Although number of studies have revealed a high economic burden of disease among the population world wide yet in the perspective of Pakistan very few studies have been conducted in which the economic burden of the dengue has been determined. Every year national media in Pakistan reports a large number of dengue cases but not a single study is available on the data search in which the economic burden of the disease has been determined in the major cities of Pakistan. It is therefore the present study is aimed to determine the economic burden of dengue among the population living in two major cities of Pakistan that are Karachi and Hyderabad and to identify the burden of disease in relation to demography and socio-economic status of the population.

2. LITERATURE REVIEW

Dengue fever impact low socio-economic population, among whom the disease causes out of pocket health expenditure over health care financing. The financial impact of dengue is recognized as progressive and proportional impacting people more living in urbanized setup with poor demography and vector control (Oliveira et al., 2019; Lee et al., 2017; Sarker et al., 2023).

2.1. Economic Burden due to Dengue in Pakistan

Number of literatures have provided evidences that dengue causes a huge economic burden in Pakistan. A study conducted by Rafique et al in 2015 highlighted that dengue causes a substantial medical cost and a productivity

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loss. Similarly in another study conducted by Nasir et al (2023) reported that economic losses due to dengue directly impacts the socioeconomic stability and increases vulnerability of progressive poverty. In another study Mahmood et al has also underlined the similar findings where it has been observed that low-income families of Faisalabad suffered income constraint, work absenteeism and greater financial stress following dengue that limits their ability to invest in preventive measures.

2.2. Comparative analyses from different South East Asian Countries

Evidence from other south Asian countries also provided the similar findings where it has been highlighted by number of studies that Dengue negatively impacts the socio-economic stability of the population. A study conducted in Bangladesh has revealed that dengue treatment costs surpassed monthly household revenue among the poorest quintile, demonstrating disastrous health expenditure (Sarker et al., 2023). In another study Uddin (2020) similarly demonstrated significant productivity losses and household expenditure shocks associated with dengue in Dhaka, with socioeconomic status acting as a key determinant of financial vulnerability.

In India study has estimated that dengue imposes billions of dollars in annual economic losses, with most medical expenses incurred in the private sector and paid directly by households (Shepard et al. 2014). Similarly in another study from Gujarat and other Indian states it has been identified that poorer families frequently resort to borrowing, selling assets, or depleting savings to cope with dengue-related expenses (Kaur et al., 2022hus, increases vulnerability towards socio-economic inequalities.

2.3. Global Evidences

A study covering multicounty analyses has highlighted that low income house hold incurred more on dengue treatment in comparison to wealthier group (Lee et al 2017). Similarly, a study conducted in China and Brazil underline that household income, employment status and insurance coverage are the potential predictors of dengue related financial burden which means that families with high house hold income, positive number of employment status and insurance coverage suffers less from dengue caused economic burden in comparisons to families lacking the facilities (Xu et al., 2022 and Yu et al., 2023).

In a review study it has been highlighted that in developing countries the dengue treatment cost is larger and inequitable costing more to lower income families than upper (Oliveira et al., 2019; Rodríguez-Morales et al., 2024).

2.4. Research Gap and Relevance to Hyderabad and Karachi

Despite a number of studies available on data search emphasizing a substantial economic burden of dengue on low socio-economic population limited studies are available that determine the impact of dengue in term of economic loss and its association with various socio-economic classes. Additionally, none of the study is available on data search in which the impact of dengue has been determined among the two major cities of Pakistan that are Karachi and Hyderabad, It is therefore the present study is aimed to determine the financial burden of dengue across socioeconomic groups in Hyderabad and Karachi.

3. METHODOLOGY

3.1. Research Design and Study Setting

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A cross-sectional cost-of-illness (COI) study design was conducted to measure and compare the financial burden of dengue fever across socioeconomic groups in Karachi and Hyderabad, Sindh, Pakistan. The study settings included Civil Hospital, Hyderabad and Abbasi Shaheed Hospital, Karachi. Patients with confirmed laboratory diagnosis of dengue were recruited for the study.

3.2. Population, Sampling Technique and Sample Size

3.2.1. Population

The patients were identified through hospital records. Afterwards in person interviews were conducted when patient came for the follow up visit at hospital. The inclusion criteria for study included participants with age ≥18 years and a laboratory confirmed dengue infection. Cases which showed complete cost and socioeconomic information were included in the final analysis.

3.2.2. Sampling technique

Stratified method of probability sampling was used. In the initial stage, strata were made based on the city. Later, hospitals with large number of dengue cases were identified. Finally, in the final stage, patients were identified from hospital registries and selected using systematic random sampling. Afterwards, participants were categorized into socioeconomic groups based on a composite socioeconomic index.

3.2.3. Sample size

The sample size for this study was calculated to ensure sufficient statistical power to detect differences in the financial burden of dengue across socioeconomic groups in Karachi and Hyderabad. The calculation was based on the formula for estimating a proportion with a specified precision:

$$n = \frac{Z^2 \cdot p \cdot (1-p)}{d^2}$$

Where:

n= required sample size

Z= standard normal deviate at 95% confidence level (1.96)

p= estimated proportion of dengue patients incurring significant financial burden

d= margin of error (precision), set at 5% (0.05)

Since there was limited local data on the exact proportion of dengue patients facing financial burden, a conservative estimate of p=0.5was used to maximize sample size.

$$n = \frac{(1.96)^2 \cdot 0.5 \cdot (1-0.5)}{(0.05)^2} = 384$$

Considering the multistage stratified sampling design, a design effect of 1.5 was applied to account for clustering within healthcare facilities:

$$n_{\text{adjusted}} = 384 \times 1.5 = 576$$

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To account for potential non-response or incomplete data, a 10% increase was added:

$$n_{\text{final}} = 576 + (0.10 \times 576) = 634$$

3.3. Cost Measurement and Valuation

Based on the already formed framework of COI, the costs were categorized into three categories: direct medical, direct non-medical, and indirect costs (Jo, 2014). The direct medical costs involve doctor fee, investigation expenses, medicines, and in-patient expense. The data was obtained through hospital bill record. Direct non-medical cost consisted of commute, and food. The indirect costs involved the human capital approach, valuing productivity losses based on self-reported income and days of work lost due to illness (Hodgson & Meiners, 1982). The study followed guidelines of WHO to identify economic burden as well as STROBE for observational studies. The costs were in PKR standardized to the study year using consumer price indices where applicable.

3.4. Socioeconomic Status (SES) Classification

Socioeconomic status in Pakistan is commonly categorized into lower, lower-middle, middle, upper-middle, and upper classes based on income and consumption data derived from the Pakistan Bureau of Statistics Household Integrated Economic Survey (HIES). (Pakistan Bureau of Statistics, HIES)

3.5. Statistical Analysis

Descriptive statistics were used to summarize demographic characteristics and cost components. Due to the typically skewed nature of cost data, median costs and interquartile ranges (IQRs) were reported alongside means.

Comparisons of financial burden across SES groups and between cities were performed using:

Kruskal–Wallis tests for multi-group comparisons

Mann–Whitney U tests for pairwise city-level comparisons

To identify predictors of higher financial burden, a multivariate generalized linear model (GLM) with a gamma distribution and log link was employed, as recommended for healthcare cost data (Manning & Mullahy, 2001). Independent variables included city, SES group, disease severity, hospitalization status, and duration of illness.

Statistical significance was set at $p < 0.05$. Analyses were conducted using SPSS / STATA.

3.6. Ethical Considerations

Ethical approval was obtained from Institutional Ethics Committee of Civil Hospital, Hyderabad, and Abbasi Shaheed Hospital, Karachi. Participants provided their written prior to data collection. They were ensuring the data will be kept confidential.

4. RESULTS

4.1. Demographics

The analysis was performed on a data of 634 participants. The participants from Karachi were 313 (49.4%) from and from Hyderabad 321 (50.6%). The median age was slightly lower in Hyderabad with 43 years and interquartile range (IQR) from 27-55 as compared to Karachi which showed a median age of 43 years and IQR: 27–55). The ratio

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of male and female participants was almost equal with 44% of participants were married. Most participants (59%) had at least secondary level education.

City	N	Median Age (years)	Male	Female	Married	Education ≥Secondary
Karachi	313 (49.4%	43	160 (51.11%)	153 (48.88%)	134	187
Hyderabad	321 (50.6%)	41	173 (53.89%)	148 46.10%)	145	190

Table 1a. Demographic Characteristics by City

Socioeconomic Status Distribution and Costs

Participants were categorized into SES groups: Lower (20%), Lower-middle (28%), Middle (25%), Upper-middle (18%), and Upper (7%). Median total dengue costs varied across SES groups, reflecting differences in healthcare utilization and indirect costs. Kruskal Wallis test: $\chi^2 = 76.3$, df = 4, $p < 0.001$, indicating significant differences in total costs across SES groups.

SES Group	N (%)	Median Total Cost (PKR)
Lower	124	16,134
Lower-middle	178	16,643
Middle	166	17,032
Upper-middle	120	16,416
Upper	46	17,088

Table 1b. SES Distribution and Median Total Cost (PKR)

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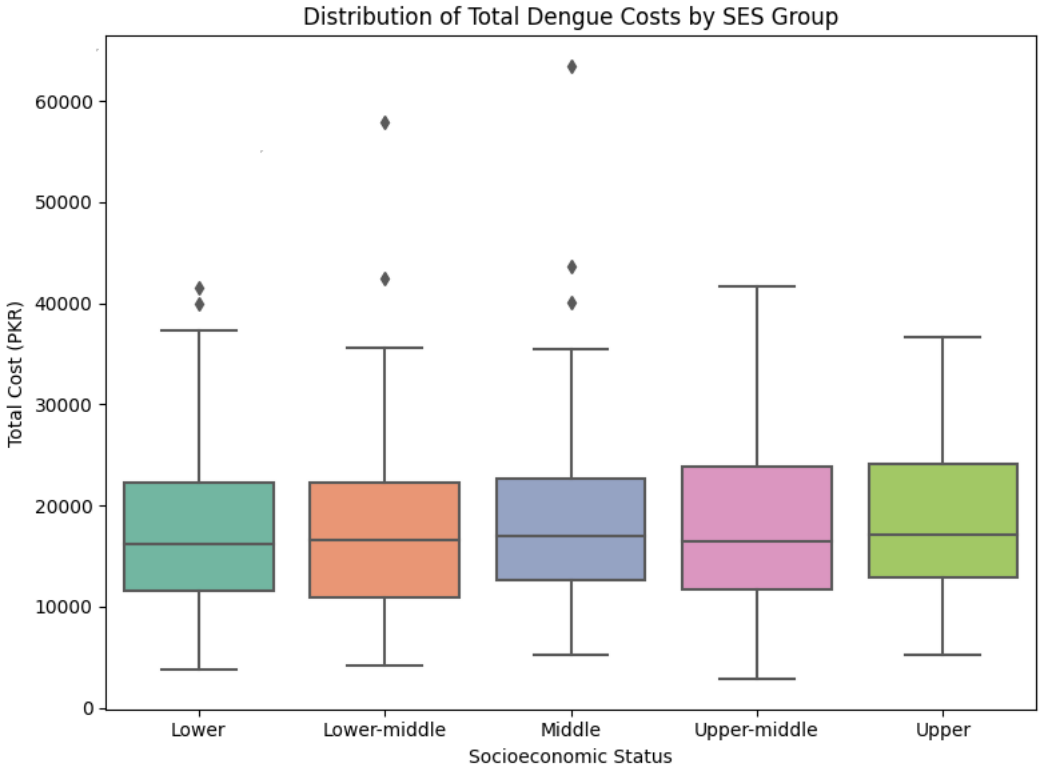

4.2. Cost Comparison by City

Median total costs were higher in Karachi (PKR 19,200; IQR: 11,500–28,500) than Hyderabad (PKR 16,900; IQR: 10,800–25,000). Mann–Whitney U test: U = 44,580, p = 0.02, indicating significantly higher costs in Karachi.

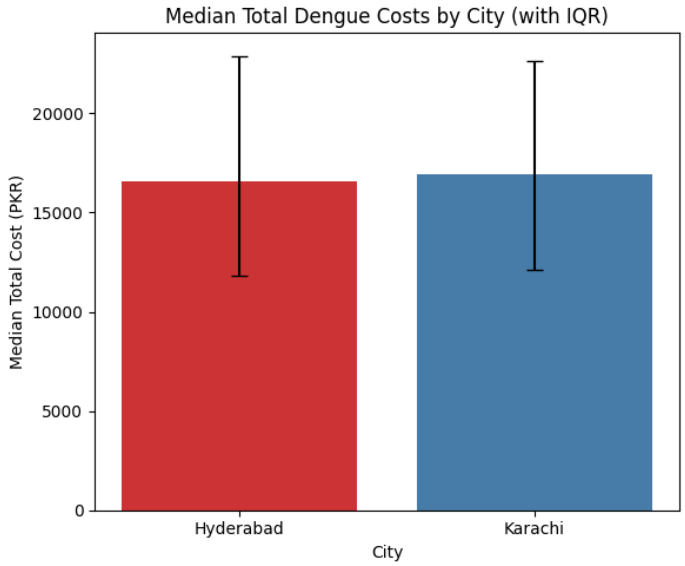

Figure 2. Median Total Dengue Costs by City

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4.3. Predictors of Higher Financial Burden

Predictor cost between cities and SES group was determined using a generalized linear model (GLM) with gamma distribution and log link identifying predictors of total dengue costs. The cost burden was higher (1.12 times) on participants residing in Karachi in comparison to total dengue-related costs compared with those treated in Hyderabad. The cost burden also increases among different SES groups in relative to the lower socioeconomic group reporting 1.52 times higher among middle, 1.84 times higher among upper-middle, and 2.12 times higher among upper socioeconomic groups. Hospitalized patients incurred 2.07 times higher costs, while severe dengue cases were associated with 1.79 times higher total costs.

Predictor	β (log-scale)	SE	p-value	Interpretation
City (Karachi vs Hyderabad)	0.11	0.05	0.03	1.12× higher costs in Karachi
SES (ref: Lower)				
Lower-middle	0.17	0.06	0.003	1.19× higher cost
Middle	0.42	0.07	<0.001	1.52× higher cost
Upper-middle	0.61	0.08	<0.001	1.84× higher cost
Upper	0.75	0.09	<0.001	2.12× higher cost
Hospitalized (Yes vs No)	0.73	0.06	<0.001	2.07× higher cost
Severe disease (Yes vs No)	0.58	0.07	<0.001	1.79× higher cost

Table 2. GLM Predictors of Total Dengue Costs

Pakistan Bureau of Statistics. Household Integrated Economic Survey (HIES). Government of Pakistan. Retrieved from https://www.pbs.gov.pk/hies

5. Discussion

The study provides evidence of the impact of dengue on financial burden across various socio-economic classes residing at two major cities that are Karachi and Hyderabad. The findings underline a significant difference in the cost incurred in the dengue treatment in the two major cities based on hospitalization stay cost, socio economic status and severity of disease. The findings revealed that dengue treatment cost in Karachi was 12% more than Hyderabad, the findings closely align with the study that suggested that urbanization is a key factor of increasing the risk of dengue (Zeng et al., 2021) hence therefore cost incurred in its management also increases with rapid urbanization that we can found in Karachi in comparison to Hyderabad. Additionally, the study revealed that socio economic status of the families and the cost incurred in dengue treatment differs substantially where expenses increase substantially in higher SES (Castro et al., 2017).

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The increase in treatment cost in Karachi significantly highlights the availability of treatment options ranging from public hospitals to private tertiary care facilities. However, due to rapid urbanization and population growth the various other cost that increases the economic burden must be taken into account that includes travelling/commute expense, waiting time in the hospital and diagnostics/lab charges. Similar findings were also highlighted by Lee et al in 2017 where it was identified that treatment seeking behavior and lack of challenge in service availability due to urban cost gradient increases the cost in dengue treatment (Lee et al., 2017; Sarker et al., 2023). This been further confirmed in the findings that clearly indicated that families with higher SES incurred more in treatment than those with low SES.

Further the current study has also highlighted that patients in the upper socioeconomic group incurred more than double the total cost in comparison to those in the subsequent lowest SES category. This pattern reflects differential healthcare utilization, where higher-income households are more likely to seek inpatient care, private facilities, advanced diagnostics, and prolonged treatment, thereby increasing absolute costs. The findings were in line with the study of Lee et al 2017, in which it was highlighted that wealthier population incurred more than lower SES class

Hospitalization and severity of disease have also emerged as the strongest predictors of higher costs, where hospitalized patients incurring double the total costs in comparison to non-hospitalized cases. The findings were found in consistent with global cost-of-illness frameworks that underline inpatient care and productivity losses as the dominant cost drivers for dengue (Castro et al., 2017; Shepard et al., 2016). Additionally, severity of disease further augmented the costs by approximately 79%, reflecting longer hospital stays, investigations/lab charges, and extended work absenteeism. The study findings inline from the evidences provided in another study conducted in Malaysia and Singapore that highlights substantial indirect costs due to lost workdays, which disproportionately affect low-wage and informally employed workers who lack income protection (Abubakar et al., 2022; Ting et al., 2024).

The findings highlight the need of policy reform for targeted financial protection mechanisms in dengue-endemic urban centers. Lack of healthcare insurance coverage and reliance on out-of-pocket financing in Pakistan heighten household vulnerability, particularly among lower socioeconomic groups. The same been observed in other Asian countries as reported by Yu et al in 2023. Facilities of early diagnosis, improving public sector infrastructure and mass awareness of prevention can reduce the magnitude of household expenditures.

6. Conclusion

Deducing the findings of this study and evidences available on data search, it is considerate that cases of dengue has been rising; passing every year. While higher income group can afford the cost, the population belongs from LES suffers from increase out of pocket expenditure that greatly effects their budget by increasing a burden on house hold expense. In addition to that severity of disease and hospitalization cost further increases the vulnerability of low SES population to suffer from the impact of disease at financial level.

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AUTHOR'S CONTRIBUTION AND DECLARATIONS

Conception or Design: Sana Rafiq & Aqsa Saleem

Data Collection and processing, Analysis or Interpretation of Data: Shahzad Rauf, Naranjan Uddasi, Falak Naz Qazi, Rabia Rauf.

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Furthermore, this research did not involve the use of animals, plants, or any biological specimens requiring ethical approval. Therefore, ethical clearance from an institutional review board, prior informed consent (PIC) from respondents, or animal/plant welfare approvals are not applicable to this study.

The author(s) affirm full compliance with international ethical standards for research and publication.

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