

An Epidemiological Study of Dengue Knowledge Among Adults Exposed and Not Exposed to Health Education in an Urban Slum of a Metropolitan City

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Abstract

Background: Dengue remains a major public health concern in India, with gaps in knowledge of transmission, symptoms, breeding sites and biting behaviour. Comparisons of dengue-related knowledge between health-education-exposed and non-exposed adults in urban slums remain limited. This study assessed and compared knowledge between the groups and examined its association with socio-demographic characteristics. **Material and Methods:** This community-based analytical cross-sectional study included 100 adults from an urban slum in Mumbai, comprising 50 health-education-exposed and 50 non-exposed participants. Socio-demographic characteristics and dengue-related knowledge were compared using chi-square or exact tests. Composite knowledge scores were compared using the Mann–Whitney U test, and associations with socio-demographic characteristics were assessed using Mann–Whitney U and Kruskal–Wallis tests. Statistical significance was set at $P < 0.05$. **Results:** Among 100 participants (50 per group), socio-demographic characteristics did not differ significantly. Compared with non-exposed participants, exposed participants more often identified mosquito-bite transmission (90% vs 38%), dengue symptoms (94% vs 40%), indoor breeding sites (58% vs 20%), outdoor breeding sites (64% vs 34%), dengue preventability and preventive steps (88% vs 28%), and fatality (82% vs 32%) (all $p \leq 0.003$). Knowledge scores were higher among exposed participants (7.70 ± 1.31 vs 4.10 ± 2.52 ; $p < 0.001$). Poor knowledge was absent among exposed participants versus 68% of non-exposed participants. Occupation was associated with scores only among non-exposed participants ($p = 0.035$). **Conclusion:** Health-education-exposed participants demonstrated greater dengue-related knowledge than non-exposed participants. Targeted health education may address knowledge gaps regarding transmission, breeding sites and preventive practices in urban-slum communities.

Keywords: Dengue; Health Education; Mosquito Bite; Slums.

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INTRODUCTION

Dengue is an important mosquito-borne viral disease and a major public health problem in tropical and subtropical regions. It is transmitted predominantly by infected *Aedes* mosquitoes and ranges from self-limiting illness to severe disease and death.^[1,2] Recurrent outbreaks and their burden on health services make dengue prevention and control a continuing priority.^[2] In India also, dengue has been reported from several regions, with considerable variation in epidemiological burden.^[3] The WHO Global Strategy for Dengue Prevention and Control 2012–2020 emphasized integrated vector control, surveillance, communication for behavioural change and community participation.^[2]

At community level, dengue prevention involves preventing water stagnation and mosquito breeding, using personal protection and recognizing conditions favouring transmission.^[2,4] Knowledge of transmission, symptoms, *Aedes* breeding sites, biting behaviour and preventive measures forms an important component of dengue-related knowledge.^[1,2,4] However, knowledge may remain inadequate despite awareness of dengue and preventive

measures.^[4,5] Assessing specific knowledge domains can identify gaps that may be addressed through health education.

Studies from different community settings have demonstrated variation in dengue knowledge. Internationally, good knowledge was reported in 54% of parents attending child-health clinics in Westmoreland, Jamaica,^[6] and 45.9% of 609 residents in Aceh, Indonesia, with significant sociodemographic variation.^[7] In India, 96.3% of participants attending a tertiary-care hospital in New Delhi had heard of dengue and 86% recognized mosquito transmission, but only 73% identified a correct breeding site,^[4]

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while a 640-household survey in Chennai found gaps in knowledge of transmission, breeding sources and biting behaviour,^[8] and only 33.3% of participants in rural Tamil Nadu had adequate knowledge.^[5] In Maharashtra, among 410 adults from Wardha district, 76.6% identified the mosquito as the vector, 60.5% recognized fever as a symptom and 74.1% knew mosquito breeding places.^[9] In Pune, 68.4% of urban and 40.4% of rural participants recognized mosquito transmission, with differences also observed in symptom knowledge.^[10] A separate study from Ajmera, Pimpri, reported that 80.7% recognized mosquito-bite transmission, but 22% were unaware of mosquito biting time.^[11] Another study among urban-slum households found that 90.1% had heard of dengue, although 89% were unaware of peak daytime Aedes biting.^[12]

Health education has been investigated as an approach to improving dengue-related knowledge, with varying findings. Kusuma et al. reported significant improvements in knowledge of dengue causes and symptoms, mosquito breeding and biting behaviour following an intervention in urban-poor communities in Delhi.^[13] Kumar et al. reported high awareness of mosquito-borne transmission and a significant improvement in knowledge scores following a sensitisation workshop among school teachers ($\chi^2=23.6$, $P<0.001$).^[14] In contrast, Javed et al. found poor knowledge in 67.2% of 601 students exposed to awareness campaigns in Islamabad.^[15] Other Indian studies reported inadequate knowledge, including 17.5% recognition of Aedes transmission and 14% awareness of correct biting time among patients in Bihar, and knowledge gaps among factory workers in Punjab.^[16,17]

Taken together, these findings demonstrate variation in dengue-related knowledge across populations, with some studies reporting improvements following health education and others documenting persistent knowledge gaps. Studies from Maharashtra have identified deficiencies in knowledge of dengue transmission, symptoms, breeding sites and biting behaviour.^[9-12] However, evidence directly comparing these knowledge domains between health-education-exposed and non-exposed adults in urban-slum communities remains limited. Therefore, this study aimed to describe the sociodemographic characteristics of the participants, assess and compare dengue-related knowledge between health-education-exposed and non-exposed adults, and examine associations between dengue knowledge scores and sociodemographic characteristics of participants.

MATERIALS AND METHODS

Study Design: Community-based analytical cross-sectional study.

Study Setting: urban slum in Mumbai within the field practice area of the Urban Health Training Centre (UHTC), under the administration of the Department of Community Medicine of the parent medical college.

Study Period: 6 months (August 2019 – January 2020)

Study Population: Adults aged 18-60 years residing in the slum area.

Inclusion criteria: Adults aged 18-60 years who were

residing in the slum area for at least last 1 year.

Exclusion criteria: Individuals who were not willing to participate in the study and those with a documented cognitive or mental health condition affecting their ability to provide reliable responses were excluded.

Sample Size: The sample size was calculated using the formula $4PQ/L^2$,^[18] where P was taken as 45.9% based on previous study done by Harapan et al.^[7] $Q=100-P$, and (L) was the allowable absolute error of 10 percentage points. Substituting these values yielded a sample size of approximately 99.33, which was rounded up to 100 participants. Equal numbers of participants reporting previous exposure to dengue-related health education and those reporting no such exposure were recruited, with 50 participants in each group.

Sampling Technique: Plot-wise purposive sampling was used, with households approached consecutively within each plot. Participants were recruited to achieve equal allocation of health-education-exposed and non-exposed individuals.

Data Collection Tool: A pre-structured case record form was developed after a review of relevant literature and expert consultation. The form consisted of questions on sociodemographic characteristics, previous exposure to dengue-related health-promotion activities, and dengue-related knowledge. The knowledge section covered dengue transmission, symptoms, mosquito biting behaviour, indoor and outdoor breeding sites, preventability, preventive measures during outbreaks, participation in vector-control activities, appropriate action during fever, and the possibility of death due to dengue.

Ethical Considerations: Approval was obtained from the Head of the Institute and the Ethics Committee for Academic Research Projects (ECARP) of the parent medical college before starting data collection. Participation in the study was voluntary, and written informed consent was obtained from all participants. Anonymity and confidentiality of the collected information were maintained throughout the study.

Data Collection Procedure: The study area comprised 50 residential plots (1–42, 43, 43A and 44–49), with 180 houses per plot, giving approximately 9,000 houses and a population of 84,783.^[19] Each plot was divided into two parts, with 10 lines in each part; the lines were numbered A–K (excluding I) on one side and L–U on the other, with nine houses per line. In each plot, the first house was approached, followed by consecutive house-to-house visits until two eligible participants were recruited: one who reported previous exposure to dengue-related health education and one who reported no such exposure. When multiple eligible adults were present in a household, first eligible adult providing written informed consent was selected for participation. If a house was locked or no eligible participant was available, the next consecutive house was approached. Thus, two participants were recruited from each plot, yielding a total sample of 100 participants from 50 plots. Participants were interviewed using the case record form, after which health education regarding dengue transmission and prevention was provided.

Operational Definitions:

1. Health-education-exposed participants: Adults who self-reported previous exposure to dengue-related health education or health-promotion activities were classified as health-education-exposed.

2. Non-exposed participants: Adults who self-reported no previous exposure to dengue-related health education or health-promotion activities were classified as non-exposed.

Data Analysis: The data was compiled, entered into Microsoft Excel and analysed using IBM SPSS Statistics version 24.0. Sociodemographic characteristics and individual categorical knowledge responses were compared between the health-education-exposed and non-exposed groups using the chi-square test, Fisher's exact test or Fisher-Freeman-Halton exact test, as appropriate. Composite dengue knowledge scores were compared between the two groups using the Mann-Whitney U test. Associations between knowledge scores and sociodemographic characteristics were assessed separately within each group using the Mann-Whitney U test for variables with two categories and the Kruskal-Wallis test for variables with three or more categories.

Each of the 10 knowledge items contributing to the composite dengue knowledge score was scored as 1 for a correct response and 0 for an incorrect response. The scores were summed to obtain a composite knowledge score ranging from 0 to 10, with higher scores indicating greater dengue-related knowledge. Knowledge scores were categorised as poor (0–4), moderate (5–7) and good (8–10). The distribution of knowledge categories was compared between the two groups using the chi-square test. A P-value of less than 0.05 was considered statistically significant.

RESULTS

This study included 100 participants, comprising 50 participants each in the health-education-exposed and non-exposed groups. As presented in [Table 1], the sociodemographic characteristics of the two groups were comparable, with no statistically significant differences in age, sex, religion, educational status, occupation, or socioeconomic class (all $P > 0.05$).

Regarding perceptions of monsoon-related diseases, 60 participants (60.0%) believed that the monsoon brings diseases, including 34 (68.0%) in the health-education-exposed group and 26 (52.0%) in the non-exposed group. Among these 60 participants, 19 (31.7%) identified dengue, whereas 41 (68.3%) reported other diseases. Of the 19 participants who identified dengue, 11 belonged to the health-education-exposed group and 8 to the non-exposed group. All 50 participants in the exposed group reported receiving dengue-related health education and participating in dengue-related health-promotion activities. The reported channels of health education were public announcements (14/50; 28.0%), radio, television or newspapers (13/50; 26.0%), other sources (13/50; 26.0%), lectures (5/50; 10.0%), and printed media (5/50; 10.0%).

[Table 2] highlights variation in the specificity of preventive knowledge, particularly regarding household breeding sites and practical control measures. Although participants exposed to health education demonstrated broader awareness of dengue prevention, recognition of individual measures was uneven. Specifically, 19 participants (43.2%) identified changing water in refrigerator or flower-pot trays, while 18 (40.9%) identified covering water containers. Knowledge of vector-control activities undertaken by authorities appeared similar between the groups, with 23 participants (46.0%) in each group identifying larvicide application and fogging. Awareness that dengue could cause death was reported by 41 (82.0%) health-education-exposed participants compared with 16 (32.0%) non-exposed participants.

[Table 3] shows statistically significant between-group differences in the distribution of responses regarding dengue transmission, symptoms, time of mosquito bite, indoor and outdoor breeding sites, dengue preventability and preventive measures, and whether dengue can cause death ($p < 0.05$). Differences were not statistically significant for the response regarding appropriate action during fever (Fisher's exact $p = 0.117$) or authority-led preventive measures (Fisher-Freeman-Halton exact $p = 0.571$).

Table 1: Sociodemographic characteristics of participants according to exposure to health-education (N = 100)

Socio-demographic Characteristics	Category	Non-exposed (n = 50) n (%)	Exposed (n = 50) n (%)	P-value	Exact P-value
Age (years)	18–24	9 (18.0)	8 (16.0)	$\chi^2=1.040$, df = 2, $P = 0.5945$	
	25–39	19 (38.0)	24 (48.0)		
	40–60	22 (44.0)	18 (36.0)		
Sex	Male	12 (24.0)	15 (30.0)	$\chi^2=0.457$, df = 1, $P = 0.4992$	
	Female	38 (76.0)	35 (70.0)		
Religion	Hindu	14 (28.0)	13 (26.0)	$\chi^2=2.051$, df = 2, $P = 0.3568$	0.5826‡
	Muslim	36 (72.0)	35 (70.0)		
	Other	0 (0.0)	2 (4.0)		
Education	Illiterate	16 (32.0)	9 (18.0)	$\chi^2=6.551$, df = 5, $P = 0.2562$	0.286‡
	Primary	11 (22.0)	8 (16.0)		
	Secondary	16 (32.0)	18 (36.0)		
	Higher secondary	6 (12.0)	10 (20.0)		
	Graduate	1 (2.0)	3 (6.0)		
Occupation	Postgraduate	0 (0.0)	2 (4.0)	$\chi^2=2.216$, df = 1, $P = 0.1366$	
	Unemployed	37 (74.0)	30 (60.0)		
	Employed	13 (26.0)	20 (40.0)		
Socio-economic Class (Modified B.G. Prasad Classification, 2020)	Upper (I)	3 (6.0)	5 (10.0)	$\chi^2=6.129$, df = 4, $P = 0.1897$	0.198‡
	Upper-middle (II)	6 (12.0)	10 (20.0)		
	Middle (III)	13 (26.0)	19 (38.0)		
	Lower-middle (IV)	19 (38.0)	12 (24.0)		
	Lower (V)	9 (18.0)	4 (8.0)		

Footnotes:

χ^2 = Pearson's chi-square statistic; df = degrees of freedom;
† Fisher's exact test was additionally performed for 2×2 tables with expected cell frequencies below 5
‡ Fisher–Freeman–Halton exact test was additionally

performed for contingency tables with more than two rows and with expected cell frequencies below 5
P < 0.05 was considered statistically significant.
Source: Primary Data collected from Study Participants (N = 100)

Table 2: Distribution of dengue-related knowledge according to exposure to health-education (N = 100)

Knowledge component and response	Non-exposed (n = 50) n (%)	Exposed (n = 50) n (%)
Mode of dengue transmission		
Mosquito bite	19 (38.0)	45 (90.0)
Waterborne	2 (4.0)	3 (6.0)
Don't know	29 (58.0)	2 (4.0)
Knowledge regarding symptoms of dengue*		
Fever	20 (40.0)	47 (94.0)
Muscle and joint pain	5 (10.0)	19 (38.0)
Headache and eye pain	2 (4.0)	12 (24.0)
Nausea and vomiting	0 (0.0)	11 (22.0)
Giddiness/weakness	0 (0.0)	4 (8.0)
Don't know	30 (60.0)	3 (6.0)
Knowledge about time of dengue mosquito bite		
Morning	1 (2.0)	7 (14.0)
Night	6 (12.0)	8 (16.0)
Any time of day	3 (6.0)	9 (18.0)
Don't know	40 (80.0)	26 (52.0)
Knowledge regarding indoor breeding places*		
Under fridge/flower-pot trays	2 (4.0)	2 (4.0)
Water containers	10 (20.0)	29 (58.0)
Water tank inside the house	1 (2.0)	0 (0.0)
Don't know	40 (80.0)	21 (42.0)
Knowledge regarding outdoor breeding places*		
Roof gutters	3 (6.0)	4 (8.0)
Abandoned tyres/coconut shells	2 (4.0)	2 (4.0)
Water tanks above/outside the house	16 (32.0)	27 (54.0)
Don't know	33 (66.0)	18 (36.0)
Knowledge about whether dengue is preventable		
Yes	14 (28.0)	44 (88.0)
Don't know	36 (72.0)	6 (12.0)
Knowledge about preventive measures against dengue (Non-exposed n = 14, Exposed n= 44)* †		
Cover water containers	3 (21.4)	18 (40.9)
Place garbage in closed bins	4 (28.6)	4 (9.1)
Add larvicides to water	0 (0.0)	8 (18.2)
Change water in fridge/flower-pot trays	2 (14.3)	19 (43.2)
Burn unused tyres/containers	2 (14.3)	0 (0.0)
Use repellents and creams	4 (28.6)	4 (9.1)
Keep house/surroundings clean	5 (35.7)	17 (38.6)
Knowledge about preventive activities by authorities		
Inspection for mosquito larvae	2 (4.0)	0 (0.0)
Application of larvicides at potential breeding sites	23 (46.0)	23 (46.0)
Fogging inside and outside the house	23 (46.0)	23 (46.0)
Don't know	2 (4.0)	4 (8.0)
Action to take when experiencing fever during a dengue outbreak		
Use medication as prescribed after seeing a doctor	46 (92.0)	50 (100.0)
Don't know	4 (8.0)	0 (0.0)
Knowledge that dengue can lead to death		
Yes	16 (32.0)	41 (82.0)
No	3 (6.0)	4 (8.0)
Don't know	31 (62.0)	5 (10.0)

Foot Notes:

* Multiple Responses were allowed for this question. therefore, percentages may not total 100%.

†This question was asked only of respondents who answered

“Yes” to the preceding question. Percentages for this question were calculated using the eligible respondents as the denominator. Source: Primary Data collected from Study Participants (N = 100)

Table 3: Comparison of dengue-related knowledge components according to exposure to health-education (N = 100)

Knowledge-related Question and responses	Non-exposed (n = 50) n (%)	Exposed (n = 50) n (%)	P-value	Exact P-value
Knowledge about transmission of dengue				
Through Mosquito bite	19 (38.0)	45 (90.0)	$\chi^2=34.279$, df = 2, P <0.001***	<0.001*** ‡
Waterborne	2 (4.0)	3 (6.0)		
Did not know	29 (58.0)	2 (4.0)		
Knowledge about symptoms of dengue (Identified at least one symptom)				
Knew about symptoms	20 (40.0%)	47 (94.0%)	$\chi^2=32.972$, df = 1, P <0.001***	
Did not know about symptoms	30 (60.0%)	3 (6.0%)		
Knowledge about time of mosquito bite				
Morning	1 (2.0)	7 (14.0)	$\chi^2=10.755$, df = 3, P = 0.013*	0.011*‡
Night	6 (12.0)	8 (16.0)		
Anytime	3 (6.0)	9 (18.0)		
Did not know	40 (80.0)	26 (52.0)		
Knowledge about Breeding places inside the house (Identified at least one Breeding Place)				
Knew about breeding places	10 (20.0)	29 (58.0)	$\chi^2=15.174$, df = 1, P <0.001***	
Did not know about breeding places	40 (80.0)	21 (42.0)		
Knowledge about Breeding places outside the house (Identified at least one Breeding Place)				
Knew about breeding places	17 (34.0)	32 (64.0)	$\chi^2=9.004$, df = 1, P = 0.003**	
Did not know about breeding places	33 (66.0)	18 (36.0)		
Knowledge about whether dengue is preventable & Steps for Preventing Dengue (at-least one step)				
Considered Dengue Preventable and knew steps	14 (28.0)	44 (88.0)	$\chi^2=36.946$, df = 1, P <0.001***	
Did not know	36 (72.0)	6 (12.0)		
Knowledge about what is to be done if suffering from fever during dengue outbreak				
Take Prescribed Medicine after seeing doctor	46 (92.0%)	50 (100.0%)	$\chi^2=4.167$, df = 1, P = 0.041*	0.117†
Did not know	4 (8.0%)	0 (0.0%)		
Knowledge about preventive activities by authorities				
Inspection for mosquito larvae	2 (4.0)	0 (0.0)	$\chi^2=2.667$, df = 3, P = 0.446	0.571‡
Application of larvicides at potential breeding sites	23 (46.0)	23 (46.0)		
Fogging inside and outside the house	23 (46.0)	23 (46.0)		
Did not know	2 (4.0)	4 (8.0)		
Knowledge about whether dengue fever can cause death				
Yes	16 (32.0)	41 (82.0)	$\chi^2=29.886$, df = 2, P <0.001***	<0.001*** ‡
No	3 (6.0)	4 (8.0)		
Did not know	31 (62.0)	5 (10.0)		

Footnotes:

 χ^2 = Pearson's chi-square statistic; df = degrees of freedom;

*P < 0.05;

**P < 0.01;

***P < 0.001

† Fisher's exact test was additionally performed for 2×2 tables with expected cell frequencies below 5

‡ Fisher–Freeman–Halton exact test was additionally performed for contingency tables with more than two rows and with expected cell frequencies below 5

P < 0.05 was considered statistically significant.

Source: Primary Data collected from Study Participants (N = 100)

Table 4: Comparison of individual and composite dengue knowledge scores between participants exposed and non-exposed to health-education (N = 100)

Knowledge component	Non-exposed (n = 50), Mean ± SD	Exposed (n = 50), Mean ± SD	P-value	Exact P-value
1. Knowledge of dengue transmission	0.38 ± 0.49	0.90 ± 0.30	$\chi^2 = 29.340$, P<0.001***	
2. Knowledge of dengue symptoms	0.40 ± 0.49	0.94 ± 0.24	$\chi^2 = 32.972$, P<0.001***	
3. Knowledge of time of mosquito bite	0.02 ± 0.14	0.14 ± 0.35	$\chi^2 = 4.891$, P = 0.027*	0.059†
4. Knowledge of indoor breeding sites	0.20 ± 0.40	0.58 ± 0.49	$\chi^2 = 15.174$, P<0.001***	
5. Knowledge of outdoor breeding sites	0.34 ± 0.48	0.64 ± 0.48	$\chi^2 = 9.004$, P = 0.003**	
6. Knowledge that dengue is preventable	0.28 ± 0.45	0.88 ± 0.33	$\chi^2 = 36.946$, P<0.001***	
7. Knowledge of preventive practices	0.28 ± 0.45	0.88 ± 0.33	$\chi^2 = 36.946$, P<0.001***	
8. Knowledge of actions by authorities	0.96 ± 0.20	0.92 ± 0.27	$\chi^2 = 0.709$, P = 0.400	0.678†
9. Appropriate action for fever during an outbreak	0.92 ± 0.27	1.00 ± 0.00	$\chi^2 = 4.167$, P = 0.041*	0.117†
10. Knowledge that dengue can cause death	0.32 ± 0.47	0.82 ± 0.39	$\chi^2 = 25.500$, P<0.001***	

11. Composite dengue knowledge score (0–10) ‡	4.10 ± 2.52	7.70 ± 1.31	U = 358.5 P<0.001***	
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Foot Notes:

Individual question scores: 0 = incorrect and 1 = correct.
Mean and standard deviation are calculated from participant-level scores and represent the proportion of participants answering correctly. Hence, Pearson's chi-square test was used to compare groups for individual knowledge questions when expected cell counts were adequate.

χ^2 = Pearson's chi-square statistic;

df = degrees of freedom; df = 1 for rows 1–10

*P < 0.05;

**P < 0.01;

***P < 0.001

† Fisher's exact test (two-sided) was used for questions 3, 8 and 9 because of small expected cell counts.

‡ The composite dengue knowledge score (range: 0–10) was compared between groups using the Mann–Whitney U test as the data did not follow a normal distribution.

P < 0.05 was considered statistically significant.

Source: Primary Data collected from Study Participants (N = 100)

Table 5: Comparison of participants by dengue knowledge category according to exposure to health-education (N = 100)

Knowledge category	Non-exposed (n = 50) n (%)	Exposed (n = 50) n (%)	Total (N = 100), n (%)	P-value
Poor Knowledge	34 (68.0)	0 (0.0)	34 (34.0)	$\chi^2=51.881$, df = 2, P <0.001***
Moderate Knowledge	7 (14.0)	17 (34.0)	24 (24.0)	
Good Knowledge	9 (18.0)	33 (66.0)	42 (42.0)	

Foot Notes:

Knowledge was categorized as poor (score 0–4), moderate (score 5–7), and good (score 8–10). χ^2 = Pearson's chi-square statistic;

df = degrees of freedom;

***P < 0.001

P < 0.05 was considered statistically significant.

Source: Primary Data collected from Study Participants (N = 100)

Table 6: Association of sociodemographic characteristics with dengue knowledge scores among health-education-exposed and non-exposed participants (N = 100)

Sociodemographic characteristics	Non-Exposed (n = 50), n%	Non-exposed knowledge score, Median (IQR)	P-value	Exposed (n = 50), n%	Exposed knowledge score, Median (IQR)	P-value
Age (in years) †						
18–24	9 (18.0)	2.0 (2.0–3.0)	0.103	8 (16.0)	8.0 (6.75–9.0)	0.336
25–39	19 (38.0)	3.0 (2.0–4.5)		24 (48.0)	8.0 (7.0–8.0)	
40–60	22 (44.0)	4.0 (2.0–6.75)		18 (36.0)	8.0 (8.0–9.0)	
Sex‡						
Male	12 (24.0)	4.0 (2.0–8.25)	0.218	15 (30.0)	7.0 (6.0–8.5)	0.207
Female	38 (76.0)	3.0 (2.0–5.0)		35 (70.0)	8.0 (7.5–9.0)	
Religion†						
Hindu	14 (28.0)	2.0 (2.0–6.5)	0.566	13 (26.0)	8.0 (7.0–9.0)	0.807
Muslim	36 (72.0)	3.5 (2.0–5.0)		35 (70.0)	8.0 (7.0–9.0)	
Other	0 (0.0)	-		2 (4.0)	8.0 (8.0–8.0)	
Education†						
Illiterate	16 (32.0)	3.0 (2.0–4.0)	0.083	9 (18.0)	7.0 (7.0–9.0)	0.228
Primary	11 (22.0)	7.0 (4.0–8.0)		8 (16.0)	8.0 (7.75–9.0)	
Secondary	16 (32.0)	2.5 (2.0–4.25)		18 (36.0)	8.0 (7.25–8.0)	
Higher Secondary	6 (12.0)	2.5 (2.0–4.5)		10 (20.0)	8.0 (8.0–9.0)	
Graduate	1 (2.0)	2.0 (2.0–2.0)		3 (6.0)	6.0 (5.5–6.5)	
Postgraduate	0 (0.0)	-		2 (4.0)	8.5 (8.25–8.75)	
Occupation‡						
Unemployed	37 (74.0)	3.0 (2.0–5.0)	0.035*	30 (60.0)	8.0 (7.0–8.75)	0.902
Employed	13 (26.0)	4.0 (3.0–9.0)		20 (40.0)	8.0 (6.75–9.0)	
Socioeconomic class†						
Upper class (I)	3 (6.0)	3.0 (2.5–6.5)	0.993	5 (10.0)	8.0 (6.0–8.0)	0.452
Upper middle class (II)	6 (12.0)	3.0 (2.0–4.75)		10 (20.0)	8.0 (8.0–9.0)	
Middle class (III)	13 (26.0)	3.0 (2.0–6.0)		19 (38.0)	8.0 (6.5–8.0)	
Lower middle class (IV)	19 (38.0)	3.0 (2.0–5.0)		12 (24.0)	8.0 (7.0–9.0)	
Lower class (V)	9 (18.0)	4.0 (2.0–5.0)		4 (8.0)	8.5 (8.0–9.0)	

Foot notes:

The composite dengue knowledge score ranged from 0 to 10.

† Kruskal–Wallis test was used for comparisons involving more than two categories.

‡ Mann–Whitney U test was used for comparisons between two categories.

P-values represent comparisons within the non-exposed group and within the exposed group separately.

*P < 0.05

P < 0.05 was considered statistically significant.

Source: Primary Data collected from Study Participants (N = 100)

As detailed in [Table 4], health-education-exposed participants had significantly higher binary-scored knowledge results for dengue transmission, symptoms, indoor and outdoor breeding sites, dengue preventability, preventive practices, and whether dengue could cause death (all $p < 0.05$). The difference in the binary-scored item on mosquito-biting time was not statistically significant using Fisher's exact test ($p = 0.059$); neither were differences in knowledge of authority-led preventive activities ($p = 0.678$) or appropriate action during fever ($p = 0.117$). The composite knowledge score was higher among exposed than non-exposed participants (7.70 ± 1.31 vs. 4.10 ± 2.52 ; Mann-Whitney U = 358.5, $p < 0.001$).

[Table 5] presents the distribution of participants across knowledge categories according to health-education exposure. Among non-exposed participants, 34 (68.0%) had poor knowledge, 7 (14.0%) had moderate knowledge, and 9 (18.0%) had good knowledge. In contrast, none of the health-education-exposed participants had poor knowledge, while 17 (34.0%) had moderate knowledge and 33 (66.0%) had good knowledge. The difference in knowledge-category distribution between the groups was statistically significant ($\chi^2 = 51.881$, $df = 2$, $P < 0.001$).

[Table 6] depicts the associations between sociodemographic characteristics and dengue knowledge scores within the health-education-exposed and non-exposed groups. Among non-exposed participants, knowledge scores differed significantly by occupation, with employed participants having a higher median score than unemployed participants (4.0 vs. 3.0; $P = 0.035$). No statistically significant associations were observed with age, sex, religion, educational status, or socioeconomic class in either group ($P > 0.05$).

DISCUSSION

The present study found higher overall knowledge scores among participants reporting health-education exposure. Previous community-based studies have documented varying levels of dengue awareness and persistent gaps in preventive practices. In North India, Chinnakali et al. reported that 96.3% had heard of dengue, 86.3% recognised mosquito transmission and 73% identified at least one correct breeding site, despite inadequate preventive practices.^[4] In rural Tamil Nadu, Krishnamoorthy et al. found adequate overall knowledge in only 33.3% of participants, while 52.3% correctly identified mosquito bites as the mode of transmission.^[5] Harapan et al. reported good knowledge in 45% of participants in Indonesia, whereas Taksande and Lakhkar found that 76.58% identified mosquitoes as the vector and 60.48% recognised fever as a symptom in Central India.^[7,9] Conversely, Kusuma et al. and Kumar et al. reported improved knowledge following educational activities.^[13,14] Unlike these studies, which assessed

community awareness or educational interventions, the present study directly compared exposed and non-exposed participants within the same community. These findings suggest a potential role for health education in strengthening dengue-related knowledge.

Public announcements and mass media were the predominant reported information sources in this study. Gupta et al. similarly identified television and other audiovisual media as important sources in Delhi following the 1996 dengue epidemic.^[20] However, Krishnamoorthy et al., Singru et al. and Tikoo et al. documented varying levels of knowledge across rural Tamil Nadu, Pune's urban and rural communities, and factory workers in Amritsar, respectively.^[5,10,17] These observations highlight that information access does not guarantee comprehensive understanding, underscoring the need to combine mass-media communication with repeated, locally relevant messages and practical preventive guidance.

Consistent with the higher composite scores, recognition of mosquito transmission and common symptoms was greater among exposed participants. Similar variations in dengue knowledge were reported by Chinnakali et al., Taksande and Lakhkar, Harapan et al. and Kumar et al.^[4,7-9] Jeelani et al. found that 59% of respondents in Puducherry recognised fever as a symptom, while Mathur et al. documented continuing awareness gaps in Jodhpur.^[21,22]

Taken together, these results highlight the importance of addressing transmission, clinical features and vector behaviour together in dengue education.

Knowledge of breeding sites and preventive measures is essential for household-level dengue control. In the present study, exposed participants more frequently identified indoor and outdoor breeding sites and recognised dengue as preventable, although knowledge of specific source-reduction measures remained inconsistent. Chinnakali et al., Krishnamoorthy et al. and Mohapatra and Aslami reported gaps in knowledge and preventive practices in North India, rural Tamil Nadu and Bihar, respectively.^[4,5,16] Jeelani et al. found limited recognition of clean water as a potential breeding habitat.^[21] In contrast, Singh et al. reported high awareness of weekly water replacement and covering water containers among respondents who had heard of dengue in urban-slum and rural populations; nevertheless, Aedes breeding persisted, particularly in peridomestic containers.^[12] Kusuma et al. found that Delhi slum residents recognised clean stagnant water (60.1%), domestic water containers (18.7%) and coolers (15.0%) as potential breeding sources; nevertheless, every surveyed household had at least one potential breeding site.^[23] Similarly, Daudé et al. reported that although 77% of respondents were concerned about mosquitoes, only 43% monitored their surroundings for breeding sites.^[24] Collectively, these findings highlight that awareness of breeding sites does not necessarily translate into consistent source-reduction practices, emphasising the need for practical household guidance alongside dengue education.

Despite better knowledge across several domains among exposed participants, awareness of official vector-control measures did not differ significantly between groups. However, greater recognition of dengue as potentially fatal and higher composite scores supported the overall pattern of better disease awareness. Kusuma et al. and Nivedita reported improvements in dengue-

related knowledge following educational interventions, while Al-Muhandis and Hunter highlighted the value of integrating educational messages into community-based dengue-control programmes.^[13,25,26] This underscores the importance of combining individual education with broader community-based vector-control initiatives.

Occupation was the only sociodemographic variable significantly associated with knowledge among non-exposed participants; employed participants had a higher median score than unemployed participants (4 vs. 3; $P = 0.035$). Other sociodemographic associations were not significant. Krishnamoorthy et al. reported associations between adequate knowledge, education, socioeconomic status and health-information exposure.^[5] Harapan et al. found associations with education, occupation, marital status, income, socioeconomic status and urban residence in univariate analyses, although socioeconomic status alone remained an independent predictor in multivariable analysis.^[7] Chinnakali et al. documented high awareness alongside inadequate preventive practices, while Taksande and Lakhkar examined knowledge, attitudes and practices in rural Central India.^[4,9] Singru et al. reported better awareness of transmission, fever and breeding sites among urban than rural participants in Pune, although preventive practices did not differ significantly.^[10] Overall, sociodemographic associations with dengue knowledge vary across settings, highlighting the need to tailor community education to local population characteristics.

CONCLUSION

Dengue prevention requires a comprehensive approach that combines community awareness, individual responsibility and collective action. Health education should be an integral component of dengue control, with communication strategies designed to be accessible, locally relevant and sustainable. Strengthening collaboration between communities and public health authorities can help foster a culture of preventive action and support long-term efforts to reduce the burden of dengue.

Strengths of the study:

1. Direct comparison of dengue-related knowledge between health-education-exposed and non-exposed adults.
2. Assessed multiple dimensions of dengue knowledge, including transmission, symptoms, mosquito-biting time, breeding sites and preventive measures.
3. Examined both individual knowledge components and the overall knowledge score, providing a broader assessment of dengue-related knowledge.
4. Explored the relationship between sociodemographic characteristics and knowledge scores separately in the two exposure groups.

Limitations:

1. The findings reflect dengue-related knowledge at the time of the survey and do not capture changes in knowledge over time.
2. The study assessed prior exposure to health education but did not evaluate the content, frequency or timing of exposure.

3. The study was conducted in a single urban-slum setting; findings may vary across communities with different sociodemographic and health-education profiles.
4. The assessment focused on reported knowledge and did not directly measure the adoption of dengue-preventive practices.

Recommendations:

1. Strengthen community-based dengue health education, particularly among adults without prior exposure to health-education activities.
2. Emphasise mosquito-bite transmission, breeding sites, preventive practices and early medical consultation for fever.
3. Use locally appropriate communication channels, including community announcements and mass media.
4. Reinforce messages through periodic awareness campaigns and encourage regular household-level mosquito-breeding prevention.

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Conflicts of interest

There are no conflicts of interest.

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