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Assessment of public perspectives and barriers towards dengue preventive practices using the Health Belief Model in Puducherry, India: A cross-sectional study

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ABSTRACT

Objective: To assess the perspectives and barriers towards dengue preventive practices among the residents of Puducherry, India.

Methods: A cross-sectional survey was conducted in 300 households in Puducherry, using a population-proportionate (7:3) distribution from urban and rural areas by grid sampling. One adult interview per household was conducted and the participants were selected using a KISH grid. A semi-structured questionnaire based on the Health Belief Model (HBM) with additional questions on knowledge assessment was used. Knowledge was assessed based on the correctness of answers and the HBM scores were calculated on a 5-point Likert scale. Participants were categorized based on the median score under each domain. Logistic regression was used for adjusted analysis and models were built to predict the performances in each domain.

Results: Four percent of the participants lacked basic knowledge regarding dengue transmission. While 208 (69.3%) participants did not consider themselves at risk of contracting dengue within the next year, majority perceived dengue as a disease with low severity. Around 49.3% (148) were skeptical about the benefit of time and money spent on dengue prevention. Inadequate government efforts were stated as the major barrier (47.0%) and frequent reminders (142, 47.3%) as the major cue to action. Age above 50 years (a*OR* 1.78, 95% *CI* 1.04-3.06, *P*=0.037)) and rural locality (a*OR* 2.68, 95% *CI* 1.52-4.71, *P*=0.001) were found to be significantly associated with poor knowledge scores. Urban participants had a significantly higher chance to perceive low susceptibility as compared to the rural counterparts (a*OR* 1.74, 95% *CI* 1.05-2.9, *P*=0.03). Participants with less than a high school education had low perceived benefits (a*OR* 2.46, 95% *CI* 1.52-3.96, *P*<0.001) and low self-efficacy scores (a*OR* 2.66, 95% *CI* 1.61-4.39, *P*<0.001).

Conclusions: This study identifies key gaps in dengue prevention, including low perceived susceptibility, mild disease perception, limited knowledge of breeding sites, and overreliance on government efforts. Tailoring interventions to community needs, stratified to factors influencing the community perspectives can significantly improve dengue prevention efforts.

KEYWORDS: Dengue; Public perspectives; Prevention; Barriers; Health belief model

Significance

This study addresses the critical issue of dengue control by examining the obstacles and identifying motivators for individuals to adopt preventive measures. Key findings include the poor perceived susceptibility and severity of the disease, perceptions on inadequate government efforts and the effectiveness of frequent reminders in prompting action. Additionally, a significant number of people were unaware of various *Aedes* mosquito breeding sites beyond stagnant water, such as plastic containers and flower pots. These insights can inform targeted Communication for Behavioral Impact (COMBI) strategies, enhancing public awareness and participation in dengue control, ultimately improving the effectiveness of prevention efforts.

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1. Introduction

Dengue is the most common arboviral disease with an estimated global economic burden of US$ 89 billion annually (95% UI 37 billion-197 billion)[1]. Puducherry, a Union Territory of India is hyperendemic to dengue and had experienced major outbreaks in 2003 and 2017. Given the absence of a specific treatment for dengue and the scepticism surrounding dengue vaccines, implementing effective vector control measures are a crucial tool in curbing the transmission of dengue[2]. Disseminating entomological and epidemiological facts within a community can enhance awareness of the disease, and health education has been an integral component of the National Vector Borne Control Programme in India since its inception. Nevertheless, various studies consistently reveal suboptimal dengue preventive practices across communities in different regions of the country, despite variations in awareness levels[3–5]. This may be attributed to a lack of community mobilization for the sustenance of behavioural change. Consequently, the program has devised a comprehensive strategy and action plan to foster active community participation in the prevention and control of dengue[6]. The development of an effective Communication for Behavioural Impact (COMBI) strategy towards dengue control mandates an understanding of the community segments, their perspectives regarding the disease, and the barriers towards the adoption of the change[7].

World Health Organization advocates the use of behavioural sciences for better health initiatives and recognises Health Belief Model (HBM) as an established theoretical framework to design behavioural change interventions for dengue control[8,9] (Figure 1). According to HBM, a person's likelihood of engaging in a particular behaviour may be predicted using a person's belief in the personal threat of disease along with the effectiveness of the recommended health behaviour[10]. This study aims to assess the perspectives and barriers of residents of Puducherry, India towards dengue preventive practices and determine their association with sociodemographic factors. The findings can facilitate tailoring a COMBI strategy for the community mobilisation by identification of lacunae and audience segmentation.

2. Subjects and methods

2.1. Study design, setting and participants

This cross-sectional study was done among adult (aged 18 years and above) residents of the Puducherry district belonging to the Puducherry Union Territory. Puducherry, known as "The French Riviera of the East" is the capital of the Territory spreading over an area of 294 km^2 (11.941 6 °N, 79.808 3 °E), situated on the Coromandel Coast of the Bay of Bengal and sharing boundaries

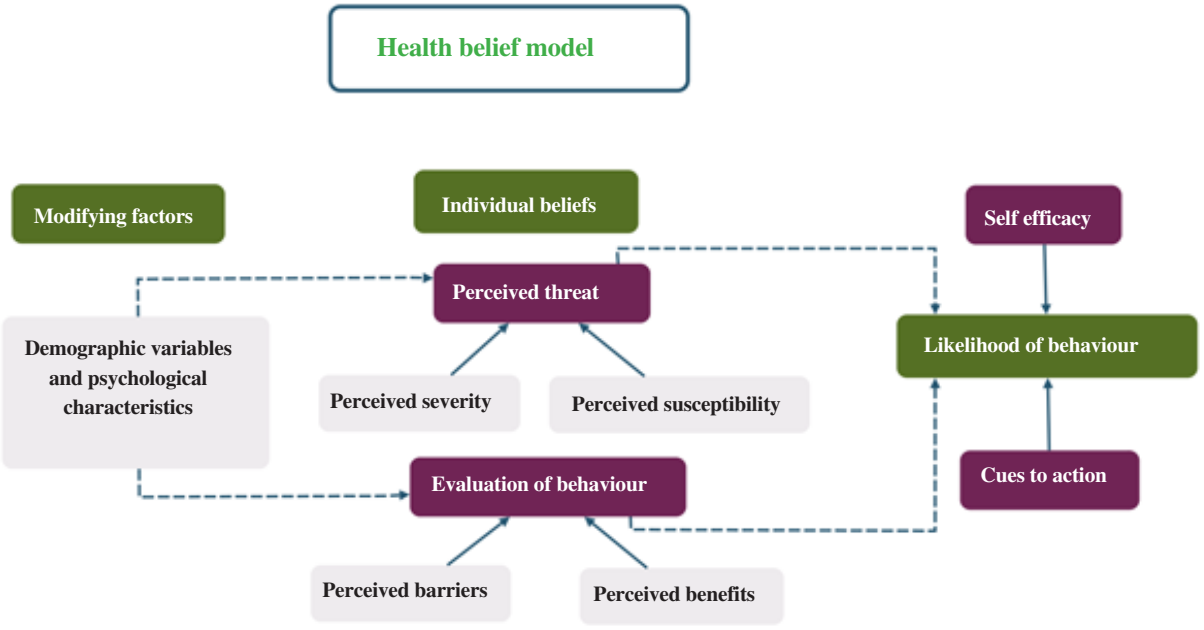

Figure 1. Health belief model. Concept adopted from Rosenstock *et al.*[10].

with Tamil Nadu on the other sides. The region is distinct for its French cultural ancestry, high population density, and a mix of rural, urban and semi-urban populations from different socio-economic classes. The study was conducted during the premonsoon and monsoon months of June to November 2022. The sample size was calculated based on a study done in the region in 2015[5], which reported only a quarter of the participants knew that clean water was a breeding habitat for the mosquito that transmits dengue. To estimate a proportion of 25%, with an absolute precision of 5%, 288 participants were to be recruited which was rounded to 300 participants.

Over 0.95 million people reside in Puducherry, around 70% of them living in urban and semi-urban areas and the remaining in rural areas[11]. The study sites were selected by the grid sampling method. Grids of size 1 km × 1 km were overlaid in the geographical map of Puducherry and a total of 10 grids were randomly selected, considering a population proportionate distribution of urban and rural settings. Hence, seven grids were chosen from urban and peri-urban areas and 3 grids from rural areas using the ArcGIS software as shown in Supplementary Figure 1. The names of the streets/ neighbourhoods in the selected grids were enumerated and two streets in each grid was chosen by simple random method.

2.2. Data collection

The survey in each grid began by disembarking at a junction of the choosen street and proceeding in a single direction, encompassing every other house until a total of 15 houses were covered. In the event that a house was found locked, the subsequent house was visited instead. Each household was limited to one interview. The selection of interview participants was determined using the KISH grid methodology[12]. The procedure was repeated in every choosen street covering 15 households in each street.

A pre-validated questionnaire based on the Health Belief Model (HBM) was adapted for the specific context[13]. The semi-structured questionnaire encompassed several components, including a proforma for collecting basic sociodemographic information, a section to evaluate participants' knowledge regarding dengue prevention, and the six constructs of the HBM including perceived severity, perceived susceptibility, perceived benefits, perceived barriers, perceived self-efficacy, and cues to action. Knowledge assessment was scored based on the accuracy of responses provided. The HBM constructs were measured using a 5-point Likert scale, ranging from strongly disagree to strongly agree. The questionnaire was translated into the local language (Tamil) and underwent quality assurance through back-translation and piloting. To ensure content validity, the modified questionnaire underwent expert review utilizing the modified Delphi technique[14]. The construct validity was ensured by retaining items with a minimum factor loading of 0.5. The overall internal consistency was acceptable with Cronbach-alpha value of 0.734 (ranged from 0.626 to 0.871 across dimensions).

2.3. Data analysis

The data were entered into Microsoft Excel, and subsequent analysis was conducted using SPSS Statistics for Windows, version 25.0 (IBM, Armonk, NY, USA). The score of knowledge regarding dengue and the health belief model was checked for normality using the Kolmogorov-Smirnov test. Further analysis was done by using parametric tests as all variables were found to be normally distributed. Participants were categorized based on the median score within each domain of the HBM scores. Associations between these categories and sociodemographic variables were examined using the *Chi*-square test. Logistic regression was employed for adjusted analysis, and adjusted predictive models were constructed to determine the factors influencing performance in each HBM domain. Statistical significance was defined as a *P*-value of less than 0.05.

2.4. Ethical considerations

Ethics clearance was obtained from the Institutional Human Ethics Committee (IHEC/IRB No: IHEC-1022/N/J) before initiating the study. Informed written consent was obtained from all participants. Privacy and confidentiality of the responses received were ensured and were used for this study only.

3. Results

3.1. Participant demographics and knowledge on dengue fever

A total of 314 participants were enrolled in the study. Among them, 14 participants were found to be unaware of the cause and transmission of dengue fever. Due to their lack of basic knowledge on dengue, these 14 participants were excluded from further interviews regarding the Health Belief Model. Among the excluded participants, 9 (64.0%) belonged to urban settings, while 5 (36.0%) resided in rural settings.

The participants in the study had a mean age of (45±14) years. Among the participants, 114 (36.3%) had received an education of high school or above. A past history of diagnosed dengue was reported by only one participant, whereas, 10 (3.2%) participants reported a history of dengue among their family members. Television was the most common source of information about dengue, reported by 63.1% of participants, followed by health workers/primary health centers (26.4%), and newspapers (10.2%).

Knowledge of participants was graded on a score of 0-10 and the

mean knowledge observed was 4±1. Around 30% of the participants believed that dengue can be spread through coughing and sneezing. Stagnant water was perceived as the primary breeding source for *Aedes* mosquitoes by 44.3% of participants, followed by coconut shells (43.7%), tires (27.3%), and other open containers (26%). Only 207 participants (69%) correctly identified fever as a symptom of dengue and 26.3% of participants were unable to mention any symptoms associated with dengue. Around half of the participants mentioned proper solid waste management and prevention of water stagnation as important dengue preventive measures. The responses regarding knowledge on dengue is summarised in Table 1.

3.2. The Health Belief Model

The summarized findings for perceived susceptibility, perceived severity, perceived benefits, and perceived self-efficacy are presented in Table 2. Approximately two-thirds of the participants (208, 69.3%) did not consider themselves at risk of contracting dengue within the next year and the majority of participants perceived dengue as a disease with low severity.

The participants' responses were influenced by the ongoing COVID-19 pandemic. Many individuals associated COVID-19 vaccination with protection against dengue and other illnesses. One participant stated, "I believe I won't get dengue as I have already received two doses of the COVID-19 vaccine." Another participant mentioned, "We have successfully dealt with the worst situations related to COVID-19, so diseases like dengue no longer concern us." Interestingly, while 274 participants (91.3%) acknowledged that dengue could be prevented by eliminating breeding sources in their homes, nearly half of the participants remained skeptical about the effectiveness and worthiness of investing time and money in dengue prevention. Among the participants, 153 (51.0%) expressed confidence in their knowledge of dengue preventive practices. However, only 88 (29.3%) participants reported knowing the specific information they should share with their families for dengue prevention. Interestingly, 116 (38.7%) participants were uncertain about their role in dengue prevention.

3.3. Perceived barriers and cues to action

Inadequate government efforts were identified as the major barrier by 142 (47.3%) participants. Additionally, 108 (36.0%) participants acknowledged facing challenges in identifying breeding sites within their homes.

The elderly population specifically highlighted difficulty in source identification and reduction as a major barrier. One elderly participant stated, "My wife and I reside here, but we are unable to carry out cleaning activities around our house. We have to hire a laborer on a daily wage basis, and even that we cannot afford to do frequently due to economic constraints."

Most cues to action were linked to government activities. Approximately half of the participants (142, 47.3%) sought frequent reminders and 137 (45.7%) participants desired continuous government support in reducing breeding sites. Additionally, 132 (44.0%) participants wanted instructions from authorities to aid their engagement in dengue preventive measures (Table 3).

Table 1. Knowledge regarding dengue fever (n=300).

Variable	Number	Percentage
Cause of dengue fever*		
Mosquito bite	300	95.5
Unknown	14	4.5
The mosquito that causes dengue fever breeds in clean water		
Yes	80	26.7
No	208	69.3
Unknown	12	4.0
Usual breeding site of mosquitoes that cause dengue fever		
Stagnant water	133	44.3
Coconut shell	131	43.7
Tyres	82	27.3
Open containers	78	26.0
Ditches	45	15.0
Grinding stone	29	9.7
Roof gutters	9	3.0
Cement tanks	8	2.7
Indoor plant vase	5	1.7
Unknown	12	4.0
Dengue can spread through direct contact, coughing/sneezing		
Yes	89	29.7
No	144	48.0
Unknown	67	22.3
The biting time of mosquitoes that cause dengue fever		
Dawn	43	14.3
Day time	72	24.0
Dusk	61	20.3
Night	67	22.3
Unknown	65	21.7
Symptoms of dengue fever that you know		
Fever	207	69.0
Headache	40	13.3
Body pain	58	19.3
Nausea/vomiting	31	10.3
Rhinitis	59	19.7
Pain behind the eyes	2	0.7
Unknown	79	26.3
Practices that can prevent or control the spread of dengue fever		
Proper solid waste management	142	47.3
Prevent water stagnation	142	47.3
Close the water storage containers	27	9.0
Use mosquito nets	9	3.0
Use mosquito repellents	14	4.7
Fogging	2	0.7
Use mosquito aerosol spray	11	3.7
Unknown	43	14.3

*The question regarding the cause of dengue alone has a total respondent number of 314.

Table 2. Perception of participants regarding susceptibility and severity of dengue and benefits of dengue control activities [*n* (%)].

Statement	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
Perceived susceptibility (median score:14; IQR: 5)					
I have a chance to get dengue fever in the next 1 year	39 (13.0)	101 (33.7)	68 (22.7)	57 (19.0)	35 (11.7)
I'm a healthy person, therefore I would not get dengue	64 (21.3)	141 (47.0)	7 (2.3)	61 (20.0)	27 (9.0)
As dengue is a seasonal disease, after the season I will be free from the risk of acquiring dengue	51 (17%)	160 (53.3)	13 (4.3)	57 (19.0)	19 (6.3)
Even though I'm exposed to mosquito bites every day, I'm not getting dengue. So, I assume that I'm not at risk of dengue	47 (15.7)	177 (59.0)	14 (4.7)	48 (16.0)	14 (4.7)
Perceived severity (median score:11; IQR:2)					
If I get dengue, it can be treated easily	12 (4.0)	69 (23.0)	59 (19.7)	128 (42.7)	32 (10.7)
Dengue can cause death if left untreated	11 (3.7)	84 (28.0)	70 (23.3)	104 (34.7)	31 (10.3)
Dengue can occur with the presence of rash and bleeding	3 (1.0)	75 (25.0)	175 (58.3)	35 (11.7)	12 (4.0)
Despite the availability of medical facilities, I have the fear of getting dengue	63 (21.0)	96 (32.0)	14 (4.7)	73 (24.3)	54 (18.0)
Perceived benefits (median score:21; IQR:4)					
Ensuring that the house area is free from containers holding water, drainage, used tires and coconut shells will avoid dengue	3 (1.0)	18 (6.0)	5 (1.7)	180 (60.0)	94 (31.3)
I feel that participating in health campaigns can prevent my family from getting dengue	6 (2.0)	22 (7.3)	24 (8.0)	203 (67.7)	45 (15.0)
I feel that time and money spent on dengue prevention are valuable	13 (4.3)	122 (40.7)	13 (4.3)	111 (37.0)	41 (13.7)
Dengue can be controlled by fogging	42 (14.0)	112 (37.3)	34 (11.3)	93 (31.0)	19 (6.3)
I can save others from getting dengue if I spread information about dengue preventive activities	2 (0.7)	82 (27.3)	22 (7.3)	177 (59.0)	17 (5.7)
Consulting a doctor for fever did not give benefit to me	32 (10.7)	229 (76.3)	5 (1.7)	30 (10.0)	4 (1.3)
Perceived self-efficacy (median score:19; IQR:3)					
I have enough knowledge about dengue prevention	9 (3.0)	113 (37.7)	25 (8.3)	126 (42.0)	27 (9.0)
I will ensure there are no breeding sites for mosquitoes in my house	-	95 (31.7)	6 (2.0)	186 (62.0)	13 (4.3)
I can't play an important role in dengue prevention	6 (2.0)	178 (59.3)	29 (9.7)	81 (27.0)	6 (2.0)
Prevention of dengue fever should be done by the government authorities	10 (3.3)	148 (49.3)	11 (3.7)	90 (30.0)	41 (13.7)
I know what information should be communicated with my family for dengue prevention	2 (0.7)	197 (65.7)	13 (4.3)	86 (28.7)	2 (0.7)
It is an individual responsibility to look for and eliminate mosquito breeding sites	2 (0.7)	107 (35.7)	8 (2.7)	83 (27.7)	100 (33.3)

Table 3. Perceived barriers and cues to action for dengue preventive measures [*n* (%)].

Statement	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
Perceived barriers (median score: 24; IQR: 5)					
It is hard for me to see a doctor if I get a fever	62 (20.7)	199 (66.3)	2 (0.7)	29 (9.7)	8 (2.7)
Why is it hard to see a doctor? (*n*=37)			Acceptability: 15 (40.5) Accessibility: 9 (24.3) Affordability: 10 (27.0) Lack of time: 3 (8.1)		
It is hard for me to check the mosquito larvae in and around my house	19 (6.3)	168 (56.0)	5 (1.7)	100 (33.3)	8 (2.7)
It is hard for me to use mosquito nets	9 (3.0)	64 (21.3)	96 (32.0)	127 (42.3)	4 (1.3)
It is hard for me to use repellent or insecticide spray to kill mosquitoes	10 (3.3)	123 (41.0)	38 (12.7)	86 (28.7)	43 (14.3)
Thermal fogging can cause health problems	25 (8.3)	153 (51.0)	38 (12.7)	66 (22.0)	18 (6.0)
Larvicides can cause toxicity in water	6 (2.0)	163 (54.3)	83 (27.7)	45 (15.0)	3 (1.0)
I am not able to practice dengue preventive measures as I have other important works to do	23 (7.7)	238 (79.3)	10 (3.3)	20 (6.7)	9 (3.0)
I need a lot of money to carry out preventive measures at home	16 (5.3)	233 (77.7)	19 (6.3)	24 (8.0)	8 (2.7)
The efforts taken by the government are not enough to meet up the epidemic situation	15 (5.0)	127 (42.3)	17 (5.7)	49 (16.3)	92 (30.7)
Perceived cues to action (median score:20; IQR:7)					
I will take preventive measures only if my area becomes a hotspot for dengue fever	40 (13.3)	118 (39.3)	11 (3.7)	125 (41.7)	6 (2.0)
I will go to the clinic only if my fever worsens	41 (13.7)	167 (55.7)	6 (2.0)	66 (22.0)	20 (6.7)
I will only cooperate in dengue prevention activities if I were rewarded	27 (9.0)	189 (63.0)	22 (7.3)	33 (11.0)	29 (9.7)
I will cooperate only if the authorities give out instructions for preventive measures	19 (6.3)	142 (47.3)	7 (2.3)	81 (27.0)	51 (17.0)
I need continuous support from the government to reduce mosquito breeding sites in and around my house	16 (5.3)	143 (47.7)	4 (1.3)	73 (24.3)	64 (21.3)
I need to be reminded often to take steps for dengue prevention	14 (4.7)	139 (46.3)	5 (1.7)	66 (22.0)	76 (25.3)
The people around me are not inclined to dengue prevention activities	30 (10.0)	128 (42.7)	28 (9.3)	54 (18.0)	60 (20.0)

Table 4. Association of knowledge score with sociodemographic variables [*n* (%)].

Variable		Unadjusted				Adjusted	
		Knowledge scores≤4	Knowledge scores>4	*OR* (95% *CI*)	*P*-value	*OR* (95% *CI*)	*P*-value
Age group	>50 years (*n*=102)	65 (63.7)	37 (36.3)	1.76 (1.08-2.87)	0.024	1.78 (1.04-3.06)	0.037
	≤50 years (*n*=198)	99 (50.0)	99 (50.0)				
Sex	Male (*n*=72)	37 (51.4)	35 (48.6)	0.84 (0.49-1.43)	0.52	-	-
	Female (*n*=228)	127 (55.7)	101 (44.3)				
Locality	Rural (*n*=90)	65 (72.2)	25 (27.8)	2.91 (1.71-4.97)	<0.001	2.68 (1.52-4.71)	0.001
	Urban (*n*=210)	99 (47.1)	111 (52.9)				
Economic status	BPL (*n*=182)	111 (61.0)	71 (39.0)	1.92 (1.19-3.07)	0.006	1.51 (0.90-2.52)	0.115
	APL (*n*=118)	53 (44.9)	65 (55.1)				
Education	<High school (*n*=187)	114 (61.0)	73 (39.0)	1.97 (1.23-3.16)	0.005	1.52 (0.90-2.56)	0.116
	≥High school (*n*=113)	50 (44.2)	63 (55.8)				

Table 5. Association of dengue HBM scores with sociodemographic variables.

Variable		Unadjusted				Adjusted	
		Scores low	Scores high	*OR* (95% *CI*)	*P*-value	*OR* (95% *CI*)	*P*-value
Perceived susceptibility							
Age group	>50 years (*n*=102)	68 (66.7)	34 (33.3)	1.63 (1.0-2.69)	0.049	1.39 (0.82-2.35)	0.22
	≤50years (*n*=198)	109 (55.1)	89 (44.9)				
Sex	Male (*n*=72)	44 (61.1)	28 (38.9)	1.12 (0.6-1.9)	0.67	-	-
	Female (*n*=228)	133 (58.3)	95 (41.7)				
Locality	Urban (*n*=210)	132 (62.9)	78 (37.1)	1.69 (1.03-2.78)	0.04	1.74 (1.05-2.9)	0.03
	Rural (*n*= 90)	45 (50.0)	45 (50.0)				
Economic status	APL (*n*=118)	70 (59.3)	48 (40.7)	1.02 (0.63-1.63)	0.92	-	-
	BPL (*n*=182)	107 (58.8)	75 (41.2)				
Education	<High school (*n*=187)	119 (63.6)	68 (36.4)	1.65 (1.03-2.66)	0.036	1.59 (0.96-2.63)	0.07
	≥High school (*n*=113)	58 (51.3)	55 (48.7)				
Perceived severity							
Age	>50 years (*n*=102)	47 (46.1)	55 (53.9)	0.77 (0.48-1.25)	0.290	-	-
	≤50 years (*n*=198)	104 (52.5)	94 (47.5)				
Sex	Male (*n*=72)	42 (58.3)	30 (41.7)	1.52 (0.89-2.6)	0.12	-	-
	Female (*n*=228)	109 (47.8)	119 (52.2)				
Locality	Urban (*n*=210)	108 (51.4)	102 (48.6)	1.16 (0.7-1.89)	0.56	-	-
	Rural (*n*= 90)	43 (47.8)	47 (52.2)				
Economic status	APL (*n*=118)	65 (55.1)	53 (44.9)	1.37 (0.86-2.18)	0.19	-	-
	BPL (*n*=182)	86 (47.3)	96 (52.7)				
Education	<High school (n=187)	87 (46.5)	100 (53.5)	0.66 (0.41-1.06)	0.09	-	-
	≥High school (n=113)	64 (56.6)	49 (43.4)				
Perceived benefits							
Age group	≤50 years (*n*=198)	112 (56.6)	86 (43.4)	1.16 (0.71-1.87)	0.550	-	-
	>50 years (*n*=102)	54 (52.9)	48 (47.1)				
Sex	Male (*n*=72)	38 (52.8)	34 (47.2)	0.87 (0.5-1.48)	0.61	-	-
	Female (*n*=228)	128 (56.1)	100 (43.9)				
Locality	Urban (*n*=210)	113 (53.8)	97 (46.2)	0.81 (0.49-1.34)	0.41	- -	- -
	Rural (*n*= 90)	53 (58.9)	37 (41.1)				
Economic status	APL (*n*=118)	65 (55.1)	53 (44.9)	0.98 (0.6-1.56)	0.94	-	-
	BPL (*n*=182)	101 (55.5)	81 (44.5)				
Education	<High school (*n*=187)	119 (63.6)	68 (36.4)	2.46 (1.52-3.96)	<0.001	2.46 (1.52-3.96)	<0.001
	≥High school (*n*=113)	47 (41.6)	66 (58.4)				
Perceived self-efficacy							
Age group	>50 years (*n*=102)	67 (65.7)	35 (34.3)	1.84 (1.12-3.01)	0.01	1.39 (0.80-2.34)	0.22
	≤50 years (*n*=198)	101 (51.0)	97 (49.0)				
Sex	Male (*n*=72)	39 (54.2)	33 (45.8)	0.90 (0.53-1.54)	0.72	-	-
	Female (*n*=228)	129 (56.6)	99 (43.4)				
Locality	Urban (*n*=210)	115 (54.8)	95 (45.2)	0.84 (0.51-1.39)	0.50	-	-
	Rural (*n*=90)	53 (58.9)	37 (41.1)				
Economic status	APL (*n*=118)	65 (55.1)	53 (44.9)	0.94 (0.59-1.5)	0.79	-	-
	BPL (*n*=182)	103 (56.6)	79 (43.4)				
Education	<high school (*n*=187)	123 (65.8)	64 (34.2)	2.90 (1.79-4.70)	<0.001	2.66 (1.61-4.39)	<0.001
	≥High school (*n*=113)	45 (39.8)	68 (60.2)				

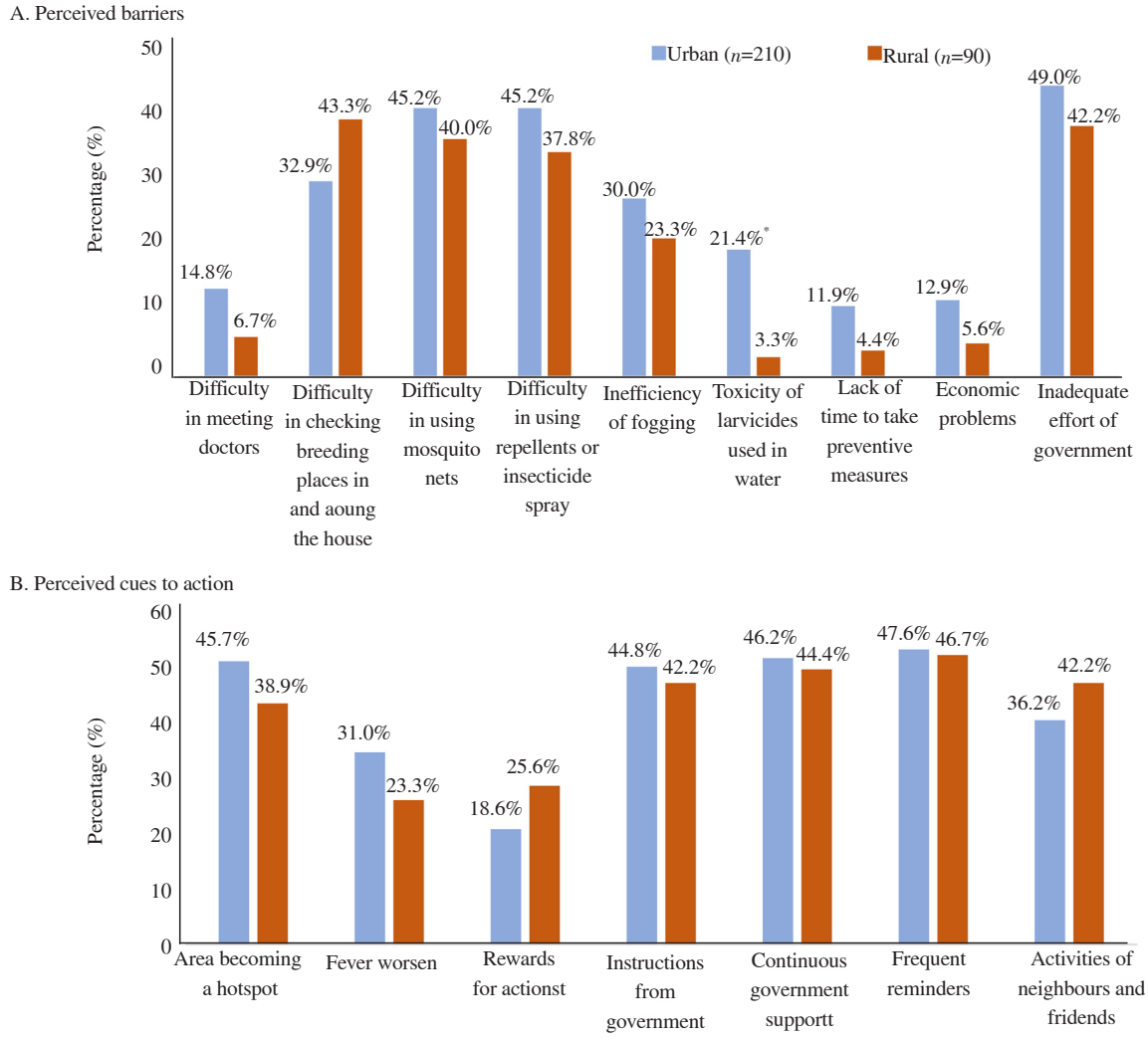

Figure 2. Urban-rural differences in perceived barriers and cues to action. *Indicates a statistically significant difference (P<0.01) using *Chi*-square test.

3.4. Association of sociodemographics with perceptions regarding dengue prevention

A low knowledge score was found to be associated with several factors, including age above 50 years (*OR* 1.76, 95% *CI* 1.08-2.87, P=0.024), rural residence (*OR* 2.91, 95% *CI* 1.71-4.97, P<0.001), Below Poverty Line economic status (*OR* 1.92; 95% *CI* 1.19-3.07, P=0.006), and education below high school (*OR* 1.97, 95% *CI* 1.23-3.16, P=0.005). However, after adjusting for confounding variables, age above 50 years (a*OR* 1.78, 95% *CI* 1.04-3.06, P=0.037) and rural locality (a*OR* 2.68, 95% *CI* 1.52-4.71, P=0.001) were identified as the significant risk factors associated with low knowledge scores regarding dengue (Table 4).

Despite better knowledge scores, the urban participants had a significantly higher chance of being in low perceived susceptibility category as compared to the rural population with an adjusted odds ratio of (a*OR* 1.74, 95% *CI* 1.05-2.9, P=0.03). Percieved benefits and self-efficacy to carry out dengue preventive activities was found to be significantly lower in the participants with below high school education, respectively (a*OR* 2.46, 95% *CI* 1.52-3.96, P<0.001) and a*OR* 2.66, 95% *CI* 1.61-4.39, P<0.001) (Table 5).

Analysis of barriers to dengue preventive activities showed a significantly higher difficulty in meeting the doctor (P<0.001) and checking for breeding sources (P=0.001), among participants above 50 years. An age and geographically segmented representation of the barriers and cues to action to dengue preventive practices is depicted in Figures 2 and 3.

4. Discussion

This study assessed the knowledge and perspectives regarding dengue among residents of Puducherry and its sociodemographic associations. Surprisingly, despite numerous dengue campaigns over the years, 14 participants had no basic knowledge about dengue transmission. In contrast, a recent study in Delhi's slums showed that all participants were aware that mosquitoes transmit dengue[15]. Many participants in our study were unaware of *Aedes* mosquitoes'

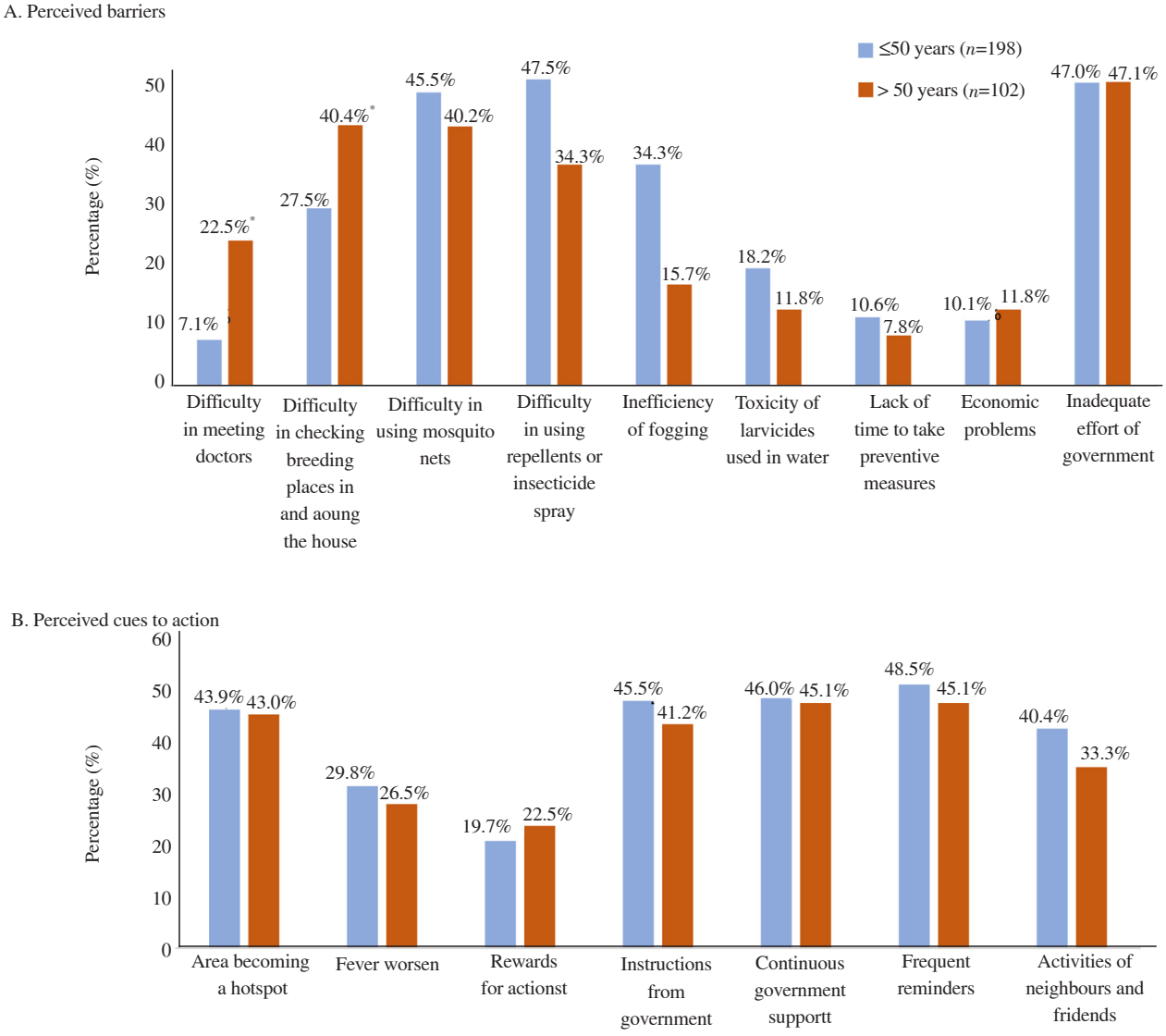

Figure 3. Age category differences in perceived barriers and cues to action. *Indicates a statistically significant difference (P<0.001) using *Chi*-square test.

clean water breeding habits, and some believed dengue could spread through contact. Similar confusion about the biting time of dengue-spreading mosquitoes was observed in other studies in central India[5,16]. Despite a 2017 dengue outbreak, the community's knowledge about dengue did not show significant improvement compared to a study conducted two decades ago in the same setting[5]. This lack of progress may indicate the limited sustainability of knowledge gained or the influence of other emerging diseases or outbreaks. Insufficient knowledge about transmission, breeding sites, and biting times can impede effective dengue control measures. Inadequate knowledge about the disease's signs and symptoms can lead to delays in seeking medical care, increasing mortality and morbidity associated with dengue[17]. Additionally, a significant number of cases may remain unidentified, resulting in delayed detection of outbreaks. Education level was a significant determinant of knowledge about dengue and its transmission, as well as attitudes towards control activities. This finding is consistent with studies from various regions, highlighting the crucial role of education in a community's health[18–20]. Access to health information through television and social media, improved availability of digital media and educational resources, and better opportunities for interactions with knowledgeable individuals can contribute to increased knowledge among urban and high socioeconomic classes[21]. Efforts should be made to ensure equitable access to information and resources for all, regardless of their socioeconomic status or location.

Perceptions of disease susceptibility within a community are influenced by various internal and external influences, and can evolve over time. In contrast to a 2017 study in Cuddalore (a nearby area), a majority of participants (60%) in our study felt less susceptible to dengue[22]. This shift may be attributed to changes in the healthcare system, community dynamics, and heightened media focus on the COVID-19 pandemic. During pandemics or epidemics, attention and

reporting on endemic diseases often decline, potentially causing the public to overlook the underreported diseases[23]. Media projections have an overriding role in influencing community perceptions[24]. The impact of COVID-19 was evident in the community's response, with some individuals associating COVID-19 vaccines with protection against dengue and downplaying the dengue severity post-pandemic. In addition, it is essential to clarify that perceptions about rural areas having more dengue breeding sources may not be accurate, emphasizing the need to educate the public about mosquito breeding site distribution, including identifying 'key containers' in specific localities, to enhance dengue prevention understanding. Furthermore, the majority of the participants considered dengue a low-severity disease contrary to studies from other countries[25-28]; potentially influenced by the successful management of the widespread COVID-19 pandemic. However, trivializing dengue may result in delayed healthcare seeking and increase the risk of complications, including mortality. Alarmingly, over three-fourths of participants were unaware of severe dengue forms. Immediate efforts are required to educate the community about the full clinical spectrum of dengue.

The perception of the benefits of preventive health activities is crucial for motivating action and sustaining engagement. In our study, participants widely acknowledged the benefits of eliminating breeding sources, participating in health campaigns, and sharing dengue prevention information. Studies from Malaysia have shown that participants believe their efforts are futile if their neighbors or community members do not adopt preventive activities, even when they recognize the benefits[29]. To reduce reliance on government-led mosquito control and address this perception gap, effective communication strategies are crucial. Enhancing individuals' self-efficacy in communicating dengue prevention information to their families is also important, as even those with adequate knowledge may feel uncertain. Targeting school and college students in interventions can facilitate knowledge transfer to families and encourage the adoption of preventive measures. Health education initiatives should underscore individuals' roles in dengue prevention and highlight the positive impacts of investing time in such activities. It's especially important to focus on individuals with limited formal education, as education significantly shapes perceptions of benefits and self-efficacy.

While social structures and leadership undoubtedly influence dengue control[30], our study revealed a prevailing tendency within the community to disproportionately attribute government shortcomings as the primary barrier to dengue prevention. This perception overlooks the fact that *Aedes* mosquitoes breed in clean water, placing sole responsibility on the government for cleaning ditches. Effective dengue control demands evidence-based interventions that are efficient, health-friendly, and cost-effective, with a well-planned implementation strategy tailored to sociodemographic factors[31]. Field health workers, alongside community volunteers, can play a crucial role by conducting household surveys and empowering the community to identify and eliminate breeding sites[32]. Some participants expressed concerns about larvicides' potential water toxicity, echoing global study findings[33]. Addressing these barriers requires effective communication strategies that provide accurate information and dispel misconceptions. The success of a dengue control program hinges on active participation from both the health system and the community. As expressed by the majority of participants, frequent reminders for dengue prevention can be effectively disseminated through popular information sources like television and newspapers. Community health workers also play a crucial role by conducting monthly house visits. While participants stressed the need for ongoing government support, empowering the community to recognize their role in dengue prevention is equally crucial[34]. Regular community capacity assessments and community empowerment programs are essential for effective dengue control. Long-term success requires active involvement from multiple stakeholders to ensure sustainability.

Our study has limitations worth noting. It relied on interviews, which may introduce a social desirability bias as participants could provide answers they deemed socially acceptable rather than reflecting their true perceptions. However, we minimized this bias by avoiding suggestive probes for desirable responses. Being a cross-sectional study, it may not capture the dynamics of the evaluated variables over time. Since the survey was carried out during working hours, the responses were majorly contributed by women. Another limitation is its quantitative dominance, lacking in-depth exploration of underlying reasons for health perceptions, dengue knowledge levels, and willingness to engage in control measures. As a result, the study may not fully capture the complexities and nuances of these factors. Nevertheless, we present results from a community-based study with representative sampling. We used households as the study unit to avoid intra-class correlations among individual responses.

In conclusion, this study uncovered key gaps in dengue prevention, including low perceived susceptibility, the misconception of dengue as a mild illness, limited knowledge of breeding sites, and the belief that the government bears primary responsibility for prevention. To address these issues, it is vital to strengthen epidemiological surveillance, improve media reporting, and launch effective health campaigns in the study area. Community perspectives and barriers to dengue prevention were influenced by factors like age, location, socioeconomic status, and education. Thus, interventions must consider participants' education levels and acceptability. Despite having adequate knowledge, urban residents tend to underestimate their susceptibility to dengue. To rectify this, robust risk communication through suitable media channels is crucial for both urban and rural populations. Tailored behavioral change communication should target diverse age groups, educational backgrounds, and geographical settings, with a special focus on students who can disseminate information to their communities. Customized interventions addressing community-specific needs can significantly improve dengue prevention efforts.

Conflict of interest statement

The authors declare no potential conflicts of interest.

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Authors' contributions

The study was conceptualized by AR, and AR, DG, GV, and BV all contributed to the study's design. AR and DG were responsible for preparing the data collection tools, and GV handled the Tamil translations. DG and GV played a significant role in data acquisition and management. Data analysis was conducted by AR and BV, with all authors contributing to the interpretation of the findings. The manuscript's initial draft was crafted by DG, while AR, GV and BV provided valuable inputs during the review and editing process. AR takes on the role of a 'guarantor' for the integrity of the work, overseeing it from inception to manuscript preparation. All authors have reviewed and endorsed the manuscript, affirming their confidence in the integrity of the research.

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