ORIGINAL ARTICLE

A cross-sectional study: Knowledge, attitude and practice (KAP) and risk factors on dengue fever among children in Eastern India

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ABSTRACT

Introduction: Dengue fever, a viral illness transmitted by mosquitoes, is linked to four serotypes of the dengue virus. Among those susceptible to infection, children face heightened vulnerability, and the risk of severe dengue disease is particularly pronounced in infants and children, especially those who have encountered a different dengue serotype in the past. To effectively prevent and control dengue, possessing sufficient knowledge, maintaining positive attitudes, and adopting proper practices (KAP) are imperative. This research seeks to gauge the prevalence of dengue among participants and explore the correlation between households' knowledge, attitudes, and practices related to dengue (KAP) and the likelihood of children testing positive for dengue antibodies. The study aims to account for socioeconomic and demographic variations, providing insights into the multifaceted factors influencing dengue among children in India. **Methodology:** This analysis drew upon data obtained from a cross-sectional study conducted inWest Bengal, India, spanning from November 2022 to October 2023. The study encompassed 392 households and 483 participating children. **Results**: The study revealed a crude dengue of 25.1% among the participating children (n=483). Analysis of household KAP scores indicated that 5% of households achieved scores exceeding 75%, while the majority fell within the range of 50% to 75% (n=271, 69%), and 101 households scored below 50% (26%). Notably, each KAP domain exhibited a significant and positive association with the others. **Conclusions:** The findings from our study offer valuable insights into the prevalence of dengue among children in West Bengal, India. Shedding light on specific demographic and socioeconomic factors associated with the risk of dengue in this population. Interestingly, our results indicate that relying solely on knowledge, attitudes, and practices (KAP) may not effectively pinpoint individuals at a higher risk of dengue infection.

KEYWORDS

Serogroup; Optimism; Culicidae; Prevalence; Health Knowledge, Attitudes, Practice; Socioeconomic Factors; Virus Diseases; Family Characteristics

INTRODUCTION

Dengue fever, a viral disease transmitted by mosquitoes and associated[1] with four serotypes of the dengue virus, poses a growing global health threat, particularly affecting children in various Asian and Latin American nations. The risk of severe dengue disease is notably elevated in children with secondary heterologous dengue infections. In Brazil, the largest country in South America, the incidence of dengue has surged, reaching over 1.5 million reported cases in 2019[2]. Various demographic and socio-economic factors contribute to the spread and transmission of dengue, encompassing suboptimal living conditions, immunologically naive populations, global trade and mobility, climate change, and the adaptive characteristics of the principal mosquito vectors Aedes aegypti and Aedes albopictus.[(3-4)]

Since dengue vaccines are not universally

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suitable or available, and antiviral medications remain unavailable, the primary strategies for dengue prevention revolve around controlling mosquito vectors and minimizing human-vector contact. Opportunistic mosquitoes like Aedes aegypti and Aedes albopictus thrive in urban environments, often utilizing open water storage, a consequence of precipitation, for breeding[5]. In Indian cities, where clean water is stored in open containers[6], residents inadvertently create ideal breeding sites for these mosquitoes. Poor housing quality, inadequate sanitation practices, and high population density further contribute to the sustained propagation of dengue.[7-9]

Understanding the knowledge, attitudes, and practices (KAP) of communities is crucial for identifying gaps, assessing awareness levels[10], and evaluating behavioral patterns that could inform public health interventions[11]. High levels of KAP empower individuals to actively engage in disease control and prevention initiatives. Despite numerous studies exploring the relationship between KAP and dengue risk in various populations, limited knowledge exists about the link between households' KAP, demographic and socio-economic characteristics, and children's dengue seropositivity. Therefore, the main objectives [14]of this analysis were to estimate dengue seroprevalence in a pediatric study population and investigate the associations between households' dengue-related KAP and children's dengue seropositivity.[12]

MATERIAL & METHODS

Study Design

This analysis is grounded in the cross-sectional data obtained during the baseline data collected in West Bengal, India, with the primary objective of evaluating the effectiveness of a community mobilization intervention for dengue control. Originally designed to collect data from 68 clusters and recruit 5,848 children aged 2 to 12 years, the study encountered challenges related to the pandemic and regional instability. Consequently, the baseline data collection had to conclude prematurely, resulting in complete data being gathered from four clusters and partial data from seven clusters. This data collection occurred between November 2022 and October 2023.Participation eligibility in selected clusters hinged on the presence of children aged 2 to 12 years within households, provided that both the parent or legal guardian and the child consented to the data collection. Exclusions from this analysis comprised households and children with tainted blood samples and/or indeterminate serology results.[13] Trained interviewers conducted household surveys in Portuguese during door-to-door visits, targeting the principal adult respondent in each household. The surveys covered a spectrum of topics, including living conditions, socioeconomic status, social capital, and the basic health history of the involved children. Additionally, respondents were queried on aspects of dengue knowledge, attitudes, and practices (KAP).[14]

The Knowledge, Attitudes, and Practices (KAP) module comprised a combination of partially categorized questions, multiple-choice queries, dichotomous inquiries, and Likert scale responses. In the knowledge domain, five questions were designed to assess awareness of dengue symptoms, modes of transmission, and strategies for dengue prevention. The attitude domain, consisting of five questions, aimed to evaluate perceptions about dengue and the acceptability of dengue prevention practices. The practice domain encompassed six items pertaining to the adoption of preventive practices and behaviors related to seeking dengue treatment.[16] To create a comprehensive KAP index, a scoring system was implemented, assigning maximum scores of 10, 8, and 10.5 points for knowledge, attitude, and practice, respectively. The total KAP score for households, reaching a maximum of 28.5 points, was then categorized into groups: low (<15 points or <50% of maximum points), moderate (>15 or <22 points or between 50% to 75% of the maximum score), or high (>22 points or >75% of the maximum score).[15]

Statistical Analysis

Statistical analyses were performed to examine the primary outcome of dengue seropositivity (negative or positive) in this study. Seroprevalence, along with 95% confidence intervals, was estimated using a one-proportion z-test. Chi-squared tests were employed to investigate the relationship between each domain of Knowledge, Attitudes, and Practices (KAP) (categorized as low, moderate, or high) and dengue seropositivity. Kendall rank correlation tests were utilized to assess associations between pairs of KAP domains (i.e., Knowledge and Attitudes, Knowledge and Practices, and Attitudes and Practices). Univariate regression analyses were conducted

to explore associations between sociodemographic covariates and seropositivity.[17]

Subsequently, a multivariable regression model was constructed to evaluate associations between the risk of seropositivity and potential predictors, including KAP, age, race, average monthly household income, household water storage method, recent dengue episode, dengue death history within the household, and education level and occupation status of the household's principal adult respondent. The selection of variables was informed by hypothesized causal associations and confounders identified through a comprehensive literature review and direct acyclic graphs.

For both univariate analyses and multivariable regression models, relative risks (RR) and 95% confidence intervals were estimated using Zou's modified Poisson regression approach—a method that offers estimates of relative risk, as opposed to odds ratios, particularly when the outcome is common.

Children's ages were categorized into two groups: 2-5 years old and 6 to 12 years old. Race was classified into five categories based on the Instituto Brasileiro de Geografia e Estatística's classification used for the Indian census. Distinctions were made between households with no potable water storage or sealed individual water tanks and those with open water storage methods (e.g., buckets, pots). Households were considered to have a dengue history if they reported a recent dengue episode or the death of a family member due to dengue. The household education level of the adult respondent was categorized based on the completion of elementary school, considering its importance for literacy. Occupation status was divided into respondents with paid employment at the time of the questionnaire versus those who were unemployed, retired, or in other categories. Monthly household incomes were categorized as low (<500 Indian real), moderate (>500 or <2500 Indian real), or high (>2500 Indian real), considering Fortaleza's cost of living and the average household income of the resident population in the Ceara state.[18]

All statistical analyses were conducted using R version 4.2.0.

RESULTS

Characteristics of Participating Households and Children

There were 392 households and 483 children who provided a blood sample of sufficient quality for this analysis. The mean age of participating children was 6.5 years with an almost equal proportion of boys and girls participating in the study (Table 1). The mean age (SD) of household principal adult respondents was 29 years with the majority being female (n=345, 88%). Children were most often reported as being multiracial (n=285, 73%). Parental respondents had a high completion rate of elementary school (n=276, 70%) and most householdshad a moderate household income (n=354, 65%).

TABLE 1. SOCIODEMOGRAPHIC CHARACTERISTICS OF CHILDREN AND HOUSEHOLDS

Children	**Total (N=483)**
Child Age, year	
Mean (SD) Median [Min, Max]	6.14 (2.74) 6.10 [2.00, 12.0]
2-5	180 (50%)
6-12	180 (50%)
Child Race	
Multiracial	309 (63.8%)
White	124 (26.1%)
Black	30 (6.4%)
Yellow	11 (2.5%)
Other	7 (1.2%)
Child Gender	
Female	222 (46.0%)
Male	260 (54.0%)
School Attendance	
Yes	430 (89.2%)
No	51 (10.4%)

Refused	2 (0.4%)
Households	Total (N=392)
Respondent Education	
Lower than Elementary School	119 (29.6%)
Elementary School or Higher	277 (70.4%)
Respondent Gender	
Female	345 (88.0%)
Male	47 (11.2%)
Does not know	1 (0.8%)
Respondent Race	
Black	25 (9.7%)
Multiracial	295 (72.7%)
White	50 (14.0%)
Asian	11 (2.6%)
Other	3 (1.0%)
Occupation	
Retired/Unemployed/Other	203 (51.5%)
Employed	191 (48.5%)
Household KAP	
Low	102 (25.8%)
Moderate	270 (69.1%)
High	20 (5.1%)

Only five percent (n=20) of households achieved over 75% for overall KAP, while most households achieved scores between 50% and 75% (n=271, 69%), and 101 households scored lower than 50% of the total score (26%). The results of the Kendall rank correlation tests and Chi-squared tests demonstrate that the three domains have a statistically significant positive association with each other. However, in univariate tests there was no evidence of an associationbetween children's seropositivity and the household's level of each individual domain (knowledge, practice, or attitude) or with the overall KAP measure.

Demographic and Socioeconomic Determinants of DengueSeropositivity in Children

In the multivariable regression model, the parental education level, households' KAP level, age of the child, and household water storage method were shown to be significantly associated withthe risk of dengue seropositivity in children (Table 3).

TABLE 2. MULTIVARIABLE REGRESSION MODEL OF SOCIODEMOGRAPHIC PREDICTORS OF CHILDREN'S SEROLOGY RESULTS

Characteristic	Levels	RR1	95%CI1	p-value
Household KAP	Low	REF	REF	REF
	Moderate	1.17	[0.82, 1.69]	0.312
	High	2.09	[1.09, 3.97]	0.017*
Respondent's Education	Less than Elementary School	REF	REF	REF
	Elementary School or Higher	0.64	[0.49, 0.87]	0.004**
Child Age	Younger Group (2-5 years old)	REF	REF	REF
	Older Group (6-12 years old)	6.14	[3.51, 10.76]	< 0.001***
Child Race	Other	REF	REF	REF
	Multiracial/White	1.01	[0.65, 1.60]	0.910
Water Storage Method	Other Water Storage Method	REF	REF	REF
	Sealed Water Tank/No Water Storage	0.71	[0.55, 0.99]	0.031*
Respondent's	Retired/Unemployed/Other	REF	REF	REF

1 RR=Relative Risk, CI= Confidence Interval;*Other is individuals who refused to answer

Among all included predictors, children's age was most strongly associated with the risk of dengue seropositivity, which was significantly higher among children aged 6-12 years comparedto children aged 2-5 years old (RR: 6.2, 95% CI: 3.4-10.7, p<0.001). Children of parents with higher education levels, who at least completed elementary school, were less

likely to be seropositive (RR: 0.7, 95% CI: 0.5-0.9, p=0.004). There were no statistically significant associations detected between dengue seropositivity and monthly household income, principal adult's occupation, children's race, or household's dengue history. Children living in households without potable water storage or using sealed water tanks were found to be significantly associated with a lower risk of dengue seropositivity (RR: 0.7, 95% CI: 0.6-1.0, p=0.041).

Notably, our result showed that higher values of KAP were associated with an increased risk of dengue seropositivity (RR: 2.1, 95% CI: 1.1-4.0, p=0.027).

DISCUSSION

The findings from our study revealed that a quarter of the participating children were seropositive for dengue, and certain socioeconomic and demographic factors were identified as associated with the risk of dengue seropositivity.[19] Interestingly, our results suggest that Knowledge, Attitudes, and Practices (KAP) were not protective predictors of dengue seropositivity risk in our cross-sectional study; instead, they were positively associated with seropositivity.[20-22]

The overall dengue seroprevalence observed in our study was in line with other investigations conducted in dengue-endemic settings among children. We observed significant variations in seroprevalence across different sociodemographic factors such as race, sex, and age.[23] Black and white children exhibited the highest seroprevalence compared to multiracial and other groups, though caution is warranted in interpreting these differences due to the low number of seropositive children in certain racial groups.[24] Previous studies have noted associations between racial and ethnic minority status and dengue seropositivity, often linked to social conditions such as housing, municipal services, and education.[25-26]

While not statistically significant, our study indicated that girls had a higher estimated dengue seroprevalence than boys. This aligns with mixed findings on gender differences in dengue incidence, with some studies reporting higher male incidence likely due to gender-related differences in exposure. Additionally, we found a positive association between children's age and seropositivity, consistent with similar studies. The longer time at risk of infection for older children (6-12 years old) is attributed to the prolonged detectability of IgG in blood.[27]

A noteworthy discovery was that children were 35% less likely to be seropositive if the parent/guardian respondent had completed at least elementary school, indicating a positive association between parental education and dengue prevention measures. Water storage methods emerged as a crucial factor, with open containers and unsealed reservoirs acting as significant breeding sites for Aedes mosquitoes.[28]

An intriguing aspect of our study was the inverse association between high KAP levels in households and a higher relative risk of dengue seropositivity in children. This finding may be attributed to a lack of temporality in our cross-sectional data, as we measured dengue seropositivity using IgG, which can persist for several years. The inverse association may be a result of a temporal mismatch between our outcome and the exposure of interest. Previous case-control and cohort studies have shown that lower KAP scores are associated with a higher risk of dengue infection, particularly among children without previous dengue experience. This suggests that a child's past dengue infection may improve the overall KAP in the household.[29]

CONCLUSION

In conclusion, our study highlighted certain demographic and socio-economic factors, particularly children's age, parent's education, and water storage methods, as influential in determining the risk of seropositivity in children. An important insight gained was the limitation associated with using Knowledge, Attitudes, and Practices (KAP) measures as potential predictors of dengue seropositivity in cross-sectional studies. KAP measures could be influenced by previous infection experiences, a factor likely applicable to other infectious diseases as well.Despite this limitation, KAP remains a valuable tool for identifying gaps in knowledge, attitudes, and practices, which can be utilized to guide public health measures such as educational campaigns. It is essential to acknowledge the dynamic nature of KAP and its potential to change based on individuals' previous infection experiences. Additionally, future studies could consider incorporating measures of social acceptability of interventions, providing insights into the likelihood of intervention adoption. This additional dimension

would enhance the understanding of various dengue interventions and their potential impact.

AUTHORS CONTRIBUTION

All author have contributed equally.

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