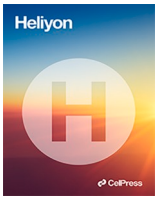
Heliyon 10 (2024) e28799

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon



Research article

Determinants of malaria prevention and control at household level in Assam: An analysis of data using composite index

Himanshu K. Chaturvedi [1,*], Preeti Tiwari [1]

ICMR-National Institute of Medical Statistics, New Delhi, India

ARTICLE INFO

Keywords:
Prevention practice
Awareness
Predictors
Socio-demographic factors
Multinomial logistic regression

ABSTRACT

Background: Malaria prevention and control is a major public health problem of tropical countries including India. Usage of insecticide-treated bed nets, and early treatment especially in high-risk areas are the crucial factors for the malaria prevention at household levels. This study aimed to determine the crucial factors associated with malaria prevention at households' level such as household's characteristics, education, knowledge and awareness, insecticide treated bed nets usage, early treatment etc.

Methods: Data of 1989 households was used from the cross-sectional survey of malaria-endemic areas of Assam. Principal component analysis and multinomial logistic regression model were used to compute the composite scores of malaria awareness and prevention practices, and to estimate the associated factors with malaria prevention practices, respectively.

Results: The average age of household respondents were 41.1 ± 12.0 years and among them 71% were males. Almost 47% respondents were illiterate, and 38.6% of the respondents were farmers and 35% were employed. Multinomial logistic regression analysis indicates that malaria prevention practices are associated with age, education, religion, type of house and occupation of household heads and their level of malaria awareness among them. The prevention practices were significantly five times associated [Adjusted Rates Ratio (ARR): 5.0, 95% CI: 2.7–9.4] with the high level of malaria awareness compared with the low level of awareness. Overall, the level of prevention awareness, education, occupation, and house type related to the standard of living was significantly associated with the malaria prevention practices.

Conclusion: Malaria awareness and education are the key factors of malaria prevention practices that need to be accelerated for effective control of malaria. Malaria education and increasing awareness of people have a high impact on malaria prevention practices and their control.

1. Background

According to the WHO report 2020, nearly half of the world's population was at risk of malaria and 229 million cases of malaria were estimated worldwide [1]. About 86% of all malaria deaths in the South-East Asia region were recorded in India. About 22% population of India lives in high transmission (>1 case per 1000 population) areas, 67% (838.9 m) live in low transmission (0–1 case

* Corresponding author. National Institute of Medical Statistics, Indian Council of Medical Research, Ansari Nagar, New Delhi, 110029, India.
E-mail addresses: chaturvedi_icmr@yahoo.com (H.K. Chaturvedi), preet.tiwari888@gmail.com (P. Tiwari).
[1] Postal Address of Affiliation: ICMR-National Institute of Medical Statistics, Indian Council of Medical Research, Ansari Nagar, New Delhi, 110029, India

https://doi.org/10.1016/j.heliyon.2024.e28799
Received 22 June 2023; Received in revised form 19 March 2024; Accepted 25 March 2024
Available online 29 March 2024

per 1000 population) areas, and 11% (137.7 m) live in malaria-free (0 cases) areas [2,3]. The major burden of malaria in India is contributed by the most backward, poor, and remote parts of the country, with 90–95% cases reported from rural areas and 5–10% from urban areas. States of Rajasthan, Gujarat, Karnataka, Goa, Southern Madhya Pradesh, Chhattisgarh, Jharkhand, and Orissa and North-Eastern states were accounted for more than 5 Annual Parasite Incidences (API) [4].

The seven North-Eastern states of India share 4% of the country's population, but it contributes more than 15% of the total malaria cases of India [5,6]. Despite the high malaria transmission, malaria intervention was a challenging issue due to inaccessibility, difficult terrains, large forested areas, administrative issues in the inter-state and international border areas, frequent flooding, poor roads, and inadequate network connectivity [7]. Out of seven states of North-East India, Assam alone constitutes 70% of the total population of northeast India and is a major industrial state endowed with a huge rain forest reserve and natural resources. The majority population of Assam lives in rural (>80%) areas and an estimated 34% of the population lives below the poverty line [8]. Due to high rainfed area, Malaria is a major health issue in Assam.

Good prevention practices and health awareness are important components of reducing the risk of malaria [9]. The prevention practices of malaria are influenced by education and awareness of people about malaria and also on other factors such as social, cultural, economic, and political factors related to the high risk of malaria. Though it is not intentional, human behaviour affects health-promoting and disease-preventing activities, in some instances to increase risk and in others reducing it [9,10]. Many studies showed community awareness and their behavioural practices related to causation, prevention, and transmission of Malaria are the key factors to prevent and control Malaria [10,11].

Although investment in health sectors has been gradually increasing especially for intervention and control of malaria such as spraying DDT in high-risk areas, use of impregnated-bed nets, and mass collection of blood slides from the community, have been executed by the government, there is no appreciable change in malaria incidence [6,7]. A clear understanding of the health-seeking behaviour of households and community knowledge is crucial for an effective control program of malaria.

Although the high burden of malaria infection, and increasing deaths, reported the associated poor health awareness and prevention practices of malaria [12,13]. There is an urgent need to examine the factors associated with malaria prevention practices. This study aimed to determine the major factors such as socio-demographic, and households' information, level of education, and health awareness, associated with malaria prevention practices. This study would be helpful to increase the malaria prevention and control in the endemic areas.

2. Methods

2.1. Study area

The total population of Assam was 31.17 million with a geographic area of 78,438 km^2, and it shares more than two-third

Fig. 1. Map of Assam showing the two selected districts as the study area. Source: http://censusindia.gov.in/maps/State_Maps/StateMaps_links/assam.jpg

population of North-East India. The population density of the state was also high with 398 per km^2, and 85.9% of the population shared by the rural area of Assam (Census 2011). The study was carried out in the high endemic areas of Assam.

2.2. Study design

A study on health-seeking behaviour for febrile illness was conducted in two districts of high malaria-endemic areas of Assam (Fig. 1). The required sample size was worked to capture the variability in health-seeking behaviour [14] and practices related to malaria prevention. Overall, 1989 households' sample were selected randomly using the method of two-stage sampling during the survey. According to the survey design, 100 PSUs (census villages/wards) were selected randomly at the first stage using the method of probability proportional to size (PPS) sampling, and 20 households from each PSU were selected in a second stage by systematic sampling. The household listing of selected PSUs was prepared during the survey by visiting house-to-house and enquiring whether anybody had malaria or fever in the last three months. A sample of 20 households, who had reported a fever case and received treatment, was selected for interview.

The head of the selected households, or the senior-most persons, was interviewed by the trained field workers to collect the information related to the general background of household individuals, knowledge, awareness, and malaria prevention practices including health-seeking behaviour. A detailed description of study design and ethical issues are provided elsewhere [14].

2.3. Data analysis

A sample of 1989 households' data collected from the community-based survey was used for statistical analysis. The socio-demographic information such as age, education, occupation, type of house, etc. was categorized. The response to questions related to awareness and prevention practices of malaria were also included. A set of questions were asked related to malaria awareness such as common symptom of malaria, malaria may cause fatality, malaria diagnosed by blood test, and malaria spread due to mosquito bite. The prevention practices questions were related to use of bed net, repellent/insecticide, and smoke to prevent mosquito bites, use of extra bed net, precaution for outside visit etc. during the interview. This information was grouped separately as malaria awareness and prevention practices.

Composite Score (index): The principal component analysis was used to estimate the composite scores of awareness based on the first principal component. Composite score of household or individual j is a linear combination of all the awareness variables as stated below.

$$Awj = \alpha 1\left(\frac{xj1 - \bar{x}1}{s1}\right) + \alpha 2\left(\frac{xj2 - \bar{x}2}{s2}\right) + \alpha 3\left(\frac{xj3 - \bar{x}3}{s3}\right) + \ldots + \alpha k\left(\frac{xjk - \bar{x}k}{sk}\right)$$

where $\bar{x}_k$ and s_k are the mean and standard deviation of awareness x_k, and α_k represents the weight (factor load) of x_k for the first principal component. The first principal component variable across the households has a mean zero and variance of λ, which corresponds to highest eigenvalue of the correlation matrix x. A larger weight α is assigned to the awareness variable x that vary most across households/individual. Accordingly, high awareness across all the households related to any awareness variable x got smaller weight (close to zero). This is a commonly used method for computation of wealth or asset index based on the individual or household response of set of categorical or dichotomous variables related to household's assets [15,16].

2.4. Standardized score (SAj)

The composite score Awj is converted to standardized score using the following formula. It is mainly to convert the range of composite score to the same scale between 0 and 1.

$$SAj = \frac{(Awj - LOWESTAwj)}{Range\ Awj}$$

The composite score was developed separately for set of variables related to awareness and prevention practices of malaria for all the respondents. Further, it is converted to standardized scores separately for both awareness and prevention practices. The range (0–1) is divided in three equal intervals (1/3 each) of standardized scores such as 0–0.333 low, 0.334–0.666 medium, and 0.667–1.0 high. Based on the standardized score of household individuals, they were categorized as the low, medium, and high level of awareness and prevention practices.

Multinomial logistic regression analysis was used to estimate the adjusted rates ratio (ARR) of all the categories of variables with respect to reference level (e.g. Low prevention practices) for comparison and identification of associated factors [17]. The model includes the prevention practices levels as an outcome variable and other variables such as age, sex, education, occupation, the religion of household respondents and house type including awareness level (based on the score) as an independent variable. The statistical software IBM SPSS version 20.0 and STATA 13.0 were used for statistical analysis.

2.5. Ethics approval

Ethical clearance for this study was not required as we have used the existing data collected in a previous project on health-seeking

behavior and reporting patterns to health centers especially with fever symptoms funded by the Indian Council of Medical Research, New Delhi (Project Id No.2003/01090). The project was also approved by the scientific advisory committee (SAC) constituted by the Indian Council of Medical Research, New Delhi. All research methods were carried out in accordance with relevant guidelines and regulation of Indian Council of Medical Research, New Delhi.

Consent to participate: The written informed consent of selected household individuals was taken before interviewing them during the survey.

3. Results

Socio-demographic information of household respondents such as age, gender, education, occupation, religion, type of house are presented in Table 1. Majority of respondents (62%) were aged (31–50 years), and males (71%). Among the 1989 households' respondents, the proportion of illiterate was higher (47%) whereas only 10% was educated up to secondary and above. Occupation of the respondents were mainly farmers (39%), followed by employed (35%) and housewives (21%). Most of the households were Hindu (93%) and lived in *Kutcha* houses (76%).

The response to questions related to awareness and prevention practices of malaria with factor loadings are presented in Table 2. The awareness of malaria was recorded high such as knowledge about the common symptom (75%), malaria may cause fatality (92%), awareness about the diagnosis (23%) and reason of spreading (40%). Prevention practices of malaria were also recorded based on the response of households such as usage of bed net (85%), repellent/insecticide (4%) and smokes (44%). The extra bed net used for guests was high (51%), but only 32% of households had taken precautions during the outside visit for prevention of malaria.

Association of prevention practices of malaria with age, sex, education, occupation, religion, type of house and level of awareness are presented in Table 3. Association of prevention practices of malaria was significant with all the variables such as age, sex, education, occupation of households' respondents including their religion, house type, and level of awareness. Prevention practices were significantly higher in various sub-groups such as it was higher among the respondents <30 years of age (34.4%), housewives (44.1%) and female respondents (34.4%), and among the middle (43.3%) and secondary & above (36.8%) educated peoples. It was also higher among those who lived in *Pucca* house (53.6%) and had medium and high (26%) levels of malaria awareness.

The two-way cross-sectional presentation between awareness and prevention practices are shown in Fig. 2. The presentation indicates the contribution of increasing the level of awareness on increasing prevention practices of malaria without considering any other household-level information. The contribution of higher and medium level of malaria awareness (35% of high and 57% of medium level) were showing more impact on malaria prevention practices.

The Multinomial Logistic Regression (MLR) model showed the association of the three levels of prevention practices of malaria with the background characteristics of the respondents and awareness levels (Table 4). The analysis showed significant association and high Adjusted Rates Ratio (ARR) for high and medium levels of prevention practices (low as reference) with age, sex, education, religion, occupation, type of house and level of malaria awareness. High prevention practices were significantly low among the adult age respondents (31–50 years) [ARR: 0.76, 95% CI:0.55–1.04]; whereas it was significantly higher among the secondary & above educated respondents [ARR:8.5; 95% CI:5.0–14.2] and among the middle educated [ARR:4.5; 95% CI:3.3–5.9], as compare to illiterate samples. It was also significantly higher for Others (includes housewife & homework) [ARR:7.9, 95% CI: 5.3–11.9] and farmers [ARR:3.5; 95% CI: 2.5–4.9]; and for *Pucca* house [ARR:3.9; 95% CI:2.1–7.4]. Significantly, high prevention practices were also found among the respondents with high [ARR:5.1; 95% CI:2.7–9.4] and medium [ARR:3.7; 95% CI:2.1–6.7] levels of awareness.

Table 1
Distribution of household respondents by age, education, occupation, religion, and type of house in the study sample of the high endemic area.

Variable	Category	Number of respondents (N = 1989)	
		N	%
Age (in Years)	≤30	462	23
	31–50	1,229	62
	51+	298	15
Sex	Female	572	29
	Male	1417	71
Education	Illiterate	935	47
	Primary	376	19
	Middle	480	24
	Secondary+	198	10
Occupation	Housewife	422	21
	Employed	687	35
	Farmer	774	39
	Others	106	5
Religion	Hindu	1,841	93
	Muslim	105	5
	Others	43	2
House Type	*Kutcha*	1,517	76
	Semi pucca	375	19
	Pucca	97	5

Table 2
The principal component analysis of people responses related to knowledge and awareness, and prevention practices of malaria.

Knowledge & Awareness	Response (%)	Factor loading
Fever is a common symptom of malaria	75	0.63
Malaria may cause fatality	92	0.65
Diagnosis of malaria by a blood test	23	0.72
Malaria spread due to mosquito bite	40	0.63
Eigenvalue		1.73
% of variance		43.3
Range of composite scores of awareness		−2.37, 1.53
Prevention Practices	**Response (%)**	**Factor loading**
Using bed net to prevent Malaria	85	0.49
Use of repellent/insecticide for prevention	4	0.29
Using smoke to avoid Mosquito bites	44	0.67
Keeping extra bed net for Guest	51	0.79
Taken precaution during the outside visit	32	0.86
Eigenvalue		2.13
% of variance		42.6
Range of composite scores of preventions		−1.50, 2.15

Note: Response (%) is denoted for the samples who has given response "Yes" to the mentioned questions.

Table 3
Association of age, sex, education, occupation, religion, house type and level of awareness with prevention practices of malaria.

Variables	Prevention Practices of Malaria							
	Low		Medium		High		$\chi 2$	p-value
	N	%	N	%	N	%		
Age (Years)								
≤ 30	147	31.8	156	33.8	159	34.4	39.6	**<0.001**
31 - 50	521	42.4	453	36.9	256	20.7		
> 50	100	33.6	118	39.6	80	26.8		
Sex								
Female	186	32.5	189	33.0	197	34.4	40.3	**<0.001**
Male	712	50.2	342	24.1	363	25.6		
Education level								
Illiterate	490	52.4	309	33.0	136	14.6	242.5	**<0.001**
Primary	148	39.4	151	40.2	77	20.4		
Middle	96	20.0	176	36.7	208	43.3		
Secondary+	34	17.2	91	46.0	73	36.8		
Occupation								
Employed	355	51.7	242	35.2	90	13.1	172.5	**<0.001**
Farmer	288	37.2	300	38.8	186	24.0		
Housewife/House work	85	20.1	151	35.8	186	44.1		
Others	40	37.7	34	32.1	32	30.2		
Religion								
Hindu	724	39.3	648	35.2	469	25.5	28.2*	**<0.001**
Muslim	31	29.5	50	47.6	24	22.9		
Others	13	30.2	29	67.4	1	2.3		
House Type								
Kutcha	641	42.3	508	33.5	368	24.3	90.3	**<0.001**
Semi pucca	107	28.5	194	51.8	74	19.7		
Pucca	20	20.6	25	25.8	52	53.6		
Awareness Level								
Low	106	66.7	37	23.3	16	10.0	104.2	**<0.001**
Medium	471	41.6	367	32.4	295	26.0		
High	191	27.4	323	46.3	183	26.3		

$P < 0.001$ shows highly significant.; * Fisher's exact test statistic.

4. Discussion

This study has showed the association of malaria prevention practices with age, education, occupation and type of house, and awareness towards the disease. The findings showed that awareness is the most important factor which can be improved further by community participation in the malaria control program [18]. However, awareness and prevention practices are highly associated, but only 30% of high awareness contributed to high prevention practices. Such disparities have also been reported in other studies [18,19].

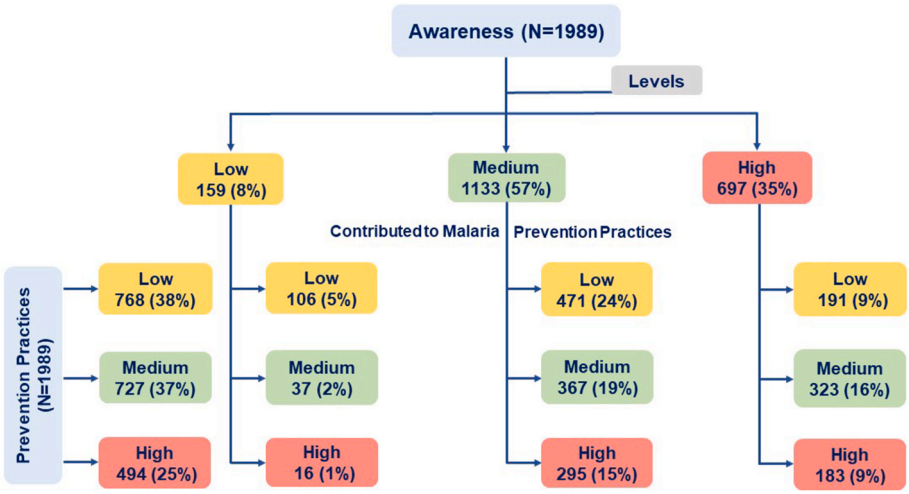


Fig. 2. Flowchart showing the interaction of levels between awareness and malaria prevention practices.

Table 4
Multinomial logistic regression analysis and adjusted rates ratio (ARR) of prevention practices of malaria with predictive variables included in the model.

Predictor Variables	Prevention Practices (Ref. Low level: 0.0–0.33)			
	Medium level		High level	
	ARR	95% CI	ARR	95% CI
Age				
<30 years	Ref		Ref	
31–50 years	0.94	0.71–1.26	0.76	0.55–1.04
50+ years	1.23	0.84–1.80	1.17	0.76–1.79
Sex				
Male	Ref		Ref	
Female	1.06	0.79–1.43	**1.42**	**1.01–2.00**
Education				
Illiterate	Ref		Ref	
Primary				
& Middle	**1.88**	**1.48–2.39**	**4.47**	**3.34–5.96**
High school+	**3.35**	**2.12–5.29**	**8.47**	**5.06–14.16**
Occupation				
Employed	Ref		Ref	
Farmer	**2.03**	**1.56–2.65**	**3.52**	**2.51–4.95**
Others$	2.93	2.08–4.14	**7.95**	**5.29–11.96**
Religion				
Hindu	0.68	0.46–1.02	**1.91**	**1.11–3.31**
Others*	Ref		Ref	
House type				
Kutcha	Ref		Ref	
Semi pucca	**2.22**	**1.65–2.99**	1.23	0.85–1.78
Pucca	1.50	0.79–2.86	**3.95**	**2.12–7.36**
Awareness level				
Low	Ref		Ref	
Medium	**1.93**	**1.27–2.93**	**3.71**	**2.06–6.71**
High	**3.64**	**2.34–5.65**	**5.06**	**2.73–9.39**

Note: $ includes housewife & working in home; * includes Muslim & Christian; CI: Confidence Interval: ARR- Adjusted Rates Ratio, Ref-reference category.

In slum communities of Delhi, more than 50% of people know the mosquito bite can transmit malaria, but few of them only know about the symptoms of malaria disease and follow the methods of prevention from malaria [20]. Similarly, in another study, the rural tribal community of Bastar district of Madhya Pradesh had more awareness about the malaria, but most of them had not taken any precautions for malaria prevention [21].

Education is also one of the key factors influencing prevention practices as reflected in the analysis. A high association of education with an increased risk of malaria has been reported in many studies [19–23]. The malaria incidence was also associated with the low income of the family, poor housing, and lack of hygiene [24–27]. In this study, the people living in *Pucca* house were expected to be

economically better and represent a larger contribution in the high level of prevention practices of malaria. The reason for low prevention practices was also related to poverty and poor economic conditions [26,27]. A study in the Jaisalmer district of Rajasthan described the transmission and magnitude of malaria were high in low socio-economic classes as compared to high socioeconomic classes [19].

A low awareness level contributed more to poor (low) prevention practices of malaria compared with the high and medium levels of awareness among the household's which may be the important factor of increased risk of malaria incidence in Assam as reported [7]. A high level of prevention practices (25%) of malaria was recorded among high (9%) and medium (15%) levels of awareness of households. Overall, prevention practices can be improved by increasing awareness as well as other personal and household living conditions.

Behavioural practices related to the prevention of malaria are major factors associated with the transmission and high risk of malaria especially in the endemic areas. It was possibly due to the lack of awareness and proper implementation of malaria-specific public health programmes [18]. The negligence of malaria prevention practices may increase the risk of malaria [7], Though it may not be intentional, but it affects the promotion of healthy life and disease-prevention activities, and the management of malaria control. There is a need for improvement in the awareness related to prevention practices of malaria that can be achieved through proper health education and motivation to people [28,29]. Thus, proper health education should be provided to increase the community-level health knowledge and awareness among the people for the prevention of practices of malaria in the local language at the community level especially to the economically poor and uneducated people [30]. It might be useful to enhance their knowledge to control malaria transmission. In this study, we have used the secondary data collected in other study on health seeking behaviour from the malaria endemic area of Assam, which was a major limitation of the study [14]. Though there may not be much change in the major outcome of this study, but there are differences in some of the factors used as determinants such as level of education, and health awareness.

Strength of the study: This study has demonstrated a new approach of using a composite score for malaria prevention practices and identified its determinants. It may be useful for prevention and control of malaria especially in high endemic areas of Assam, India.

Limitation of the study: This study is based on the previous survey data and there could be possibility of recall bias in the self-reporting of the disease. This area also comes under high rainfall areas, which also make it more endemic area for the malaria disease.

Funding

There is no funding for this study.

Data availability statement

Data used in this study are available from the corresponding author only for research purpose which can be shared with the consent of the Indian Council of Medical Research, New Delhi.

CRediT authorship contribution statement

Himanshu K. Chaturvedi: Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Preeti Tiwari:** Writing – original draft, Validation, Methodology, Investigation, Formal analysis, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

Authors would like to acknowledge the Indian Council of Medical Research, New Delhi for their financial support provided to conduct the survey. Furthermore, we would like to thank the scientific advisory committee. We are also thankful to the local health authorities and household participants for accomplish this study.

Abbreviations

ARR	Adjusted Rates Ratio
CI	Confidence Interval
DDT	Dichlorodiphenyltrichloroethane
MLR	Multinomial Logistic Regression Analysis
PPS	Probability Proportional to Size
PSU	Primary Sampling Units
SPSS	Statistical Package for the Social Sciences
WHO	World Health Organization

References

[1] WHO, World Malaria Report 2020, World Health Organization, Geneva, 2020. https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2020.
[2] WHO, World Malaria Report 2014, Geneva World Health Organization, 2014. Available at: http://apps.who.int/iris/bitstream/10665/144852/2/9789241564830_eng.pdf.
[3] A. Kumar, H.K. Chaturvedi, A.K. Mohanty, et al., Surveillance based estimation of burden of malaria in India, 2015–2016, Malar. J. 19 (2020) 156, https://doi.org/10.1186/s12936-020-03223-7.
[4] A. Kumar, N. Valecha, T. Jain, A.P. Dash, Burden of malaria in India: retrospective and prospective view, Am. J. Trop. Med. Hyg. 77 (Suppl 6) (2007) 69–78.
[5] D.K. Sarma, P.K. Mohapatra, D.R. Bhattacharyya, et al., Malaria in North-East India: importance and implications in the era of elimination, Microorganisms 7 (12) (2019) 673, https://doi.org/10.3390/microorganisms7120673.
[6] Annual report 2014-15, National vector borne disease control programme. available from http://nvbdcp.gov.in/Doc/Annual-report-NVBDCP-2014-15.pdf.
[7] V. Dev, P.C. Bhattacharyya, R. Talukdar, Transmission of malaria and its control in the northeastern region of India, J. Assoc. Phys. India 51 (2003) 1073–1076 ([PubMed] [Google Scholar]).
[8] Statistical Handbook of Assam, Directorate of Economics and Statistics, Government of Assam, Guwahati, 2013.
[9] H.K. Heggenhougen, V. Hackethal, P. Vivek, The Behavioral and Social Aspect Malaria and its Control, TDR/STR/SEB/Vol/03.1, WHO, 2003. https://www.who.int/tdr/about/seb_malaria.pdf.
[10] A.S. Laar, A.K. Laar, P.A. Dalinjong, Community perception of malaria and its influence on health-seeking behavior in rural Ghana: a descriptive study, Malaria World Journal 4 (1) (2013) 1–6.
[11] E. Chirebvu, C.M. John, N.B. Ntombi, Knowledge and practices on malaria in Tubu village, in a malaria-endemic area in northern Botswana implications for interventions, Malaria World Journal 4 (15) (2013) 1–9.
[12] I.E. Saeed, E.S. Ahmed, Determinants of malaria mortality among displaced people in Khartoum state, Sudan. Eastern Mediterranean, Health Journal 9 (4) (2003) 593–599.
[13] G. Madubuko, O. Onwujekwe, E. Obikeze, B. Uzochukwu, I. Okoronkwo, O. Ochonma, Burden of endemic disease and health seeking behaviour in Ebonyi state, Nigeria:Socio-Economic status and geographic differences, Afr. J. Nurs. Midwifery 11 (2) (2009) 98–112.
[14] H.K. Chaturvedi, J. Mahanta, A. Pandey, Treatment-seeking for febrile illness in north-east India: an epidemiological study in the malaria endemic zone, Malar. J. 8 (2009) 301. http://www.org.doi:1186/1475-2875-8-301.
[15] David J. McKenzie, Measuring inequality with asset indicators, J. Popul. Econ. 18 (2) (2005) 229–260.
[16] S. Abeyasekera, Multivariate methods for index construction ,Household Surveys in Developing and Transition Countries: Design, Implementation and Analysis, 18:367-387.(Chapter 18). Available at: http://unstats.un.org/unsd/hhsurveys/FinalPublication/ch18fin3.pdf.
[17] D.W. Hosmer, S. Lemeshow, Applied Logistic Regression, John Wiley & Sons, New York, 2000.
[18] F.L. Dunn, Behavioural aspects of the control of parasitic diseases, Bull. World Health Organ. 57 (1979) 499–512.
[19] S.P. Yadav, R.C. Sharma, V. Joshi, Study of social determinants of malaria in desert part of Rajasthan, India, J. Vector Borne Dis. |42 (2005) 141–146.
[20] R.S. Sharma, P.K. Srivastava, S.M. Kaul, S. Lal, Urban Malaria Control in India Including Control of Malaria and Dengue in the NCT, Delhi. Family Medicine India, Directorate of National Anti Malaria Control Programme, Delhi, 2000, pp. 42–45.
[21] R. Panda, L.J. Kanhekar, D.C. Jain, Knowledge, attitude and practice towards malaria in rural tribal communities of south Bastar district of Madhya Pradesh, J. Comm. Dis. 32 (2000) 222–227.
[22] R.K. Singh, S. Haq, R.C. Dhiman, Studies on knowledge, attitude and practices in malaria endemic tribal areas of Bihar and Jharkhand, India, J. Trop. Dis. 1 (3) (2013) 110. http://www.org.doi:10.4172/2329-891X.100110.
[23] S.K. Rasania, A. Bhanot, T.R. Sachdev, Awareness and practices regarding malaria of catchment population of a primary health centre in Delhi, J. Comm. Dis. 34 (2002) 78–84.
[24] F. Kaona, M.T. Siajunza, C. Manyando, S. Khondowe, G.K. Ngoma, Utilisation of malarial drugs at a household level: results from a KAP study in Choma, southern province and Mporokoso, northern province of Zambia, Cent. Afr. J. Med. 46 (2000) 268–270.
[25] A.K. Sharma, S. Bhasin, S. Chaturvedi, Predictors of knowledge about malaria in India, J. Vector Borne Dis. 44 (2007) 189–197.
[26] H. Banguero, Socio-economic factors associated with malaria in Colombia, Soc. Sci. Med. 19 (10) (1984) 1099–1104.
[27] L. Mata, Socio-cultural factors in the control and prevention of parasitic diseases, Rev. Infect. Dis. 4 (4) (1982) 871–879.
[28] H.K. Chaturvedi, R.C. Bajpai, A. Pandey, Risk of malaria among febrile patients: retrospective analysis of a hospital based study in an endemic area of northeast India, Int. Health (2014), https://doi.org/10.1093/inthealth/ihu020. http://www.org.
[29] A.K. Sharma, O.P. Aggarwal, S. Chaturvedi, S.K. Bhasin, Is education a determinant of knowledge about malaria among Indian tribal population? J. Comm. Dis. 35 (2003) 109–117.
[30] O.M. Onyinyechi, A.I. Nazan, S. Ismail, Effectiveness of health education interventions to improve malaria knowledge and insecticide-treated nets usage among populations of sub-Saharan Africa: systematic review and meta-analysis, Front. Public Health 11 (2023).