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Predictors of knowledge about malaria in India

Arun Kumar Sharma, Sanjeev Bhasin & S. Chaturvedi

Department of Community Medicine, University College of Medical Sciences, Delhi

Abstract

Background & objectives: Reduction of malarial morbidity and mortality is important to meet the overall objectives of reducing poverty and has been included in the Millennium Development Goals. To achieve these targets it is imperative to have active community participation to control malaria. Community participation in turn depends on people's knowledge and attitude towards the disease.This study was conducted to examine the factors that predict the knowledge of Indian population regarding malaria. A questionnaire based cross-sectional survey was conducted for data collection.

Results: Data were collected from 15,750 adult respondents using a pre-tested questionnaire representing urban, rural, tribal and slum population from 21 states. Knowledge about various aspects of malaria was tested using a structured questionnaire. Logistic regression analysis was applied to determine predictors of knowledge about etiology, clinical features, mode of transmission, prevention and control.

Interpretation & conclusion: Common predictors of correct knowledge about etiology and clinical features of malaria were male sex and college education. Female sex, illiteracy and tribal population were more likely to have been associated with wrong beliefs about fatality of malaria. Being tribal respondent was the single most important predictor of inadequate knowledge. Similarly, use of smoke for killing of adult mosquito was predicted by rural or slum residence and illiteracy. All findings were based on logistic regression analysis. Geographical variations also influenced knowledge about malaria. It may be inferred that improvement in knowledge, attitude and practices related to malaria may be attained only after looking at its predictors at micro level. However, a strategic framework at national level is certainly needed to provide directions at local level.

Key words Knowledge – malaria – predictors – prevention – treatment

Introduction

It is more than 125 years since CLA Laveran, a French scientist discovered the malarial parasite, yet even today malaria continues to be the world's most important tropical disease and kills more people than any other disease except tuberculosis. It is a public health problem in more than 100 countries, inhabited by a total of some 2400 million people, about 40% of the world's population[1]. In India although the malaria incidence has now been reduced to 1.82 million cases from about 75 million cases in 1950s, it continues to be the cause for concern[2]. Over the past few decades the proportion of *Plasmodium falciparum* cases has increased to 47.5% and it has become resistant to conventional antimalarial drugs. Moreover, there is vector resistance to conventionally used insecticides. The National Health Policy (2002) has set the goals of reduction in mortality on account of malaria by 50% by 2010 and efficient control of morbidity[3]. Reduction of malarial morbidity and mortality is also important to meet the overall objectives of reducing

poverty and has been included in the Millennium Development Goals. To achieve these targets it is imperative to have active community participation to control malaria. Community participation in turn depends on people's knowledge and attitude towards the disease. There is a need to know the existing knowledge and attitudes of population regarding malaria as a disease, its treatment and control. Most organised vector control strategies require public support of one kind or another and the extent of people's cooperation can determine the success or failure of the entire campaign[4]. In fact human behaviour as a contributing factor has been largely neglected in research on vector borne diseases in part because of the long-standing separation of the behavioural disorder from the physical and biomedical disciplines[5]. In India, inspite of several mass communication and educational approaches, people's participation is far below expectations. In light of this, we thought it relevant to examine the factors that predict the knowledge of Indian population regarding malaria. With this aim, we conducted this study throughout the country.

Material & Methods

The present study was a multicentric, cross-sectional study. One medical college was selected from each state of the country. Few states not having any medical college were not included in the study. Thus, a total of 22 medical colleges were selected to take part in the study. The Department of Community Medicine at the University College of Medical Sciences (UCMS), Delhi was the coordinating centre for the whole country. In all the other 21 states the Departments of Community Medicine were selected as the Nodal Department for conducting the study in their respective states. The tool of the study was a structured close ended proforma which was prepared in consultation with the National Vector Borne Disease Control Programme (NVBDCP), Delhi and it was pre-tested in the field practice area of the Department of Community Medicine, UCMS, Delhi. From each medical college 750 proformae were filled. The respondents were adult male or female members of more than 20 yr of age. Half of the proformae (375) were filled from the urban population and the remaining 375 from the rural and tribal populations. To have a fair representation from different strata of the rural or tribal areas, the population was divided into three groups—125 proformae were filled from the families from within the rural field practice areas of the respective Departments of Community Medicine, 125 proformae were filled from the nearest PHC villages which were not a part of field practice area and 125 proformae from a tribal population if available within 75 km from the medical college or otherwise from a sub-centre at least five km from the PHC area. Tribal population was present in 17 of the 21 states. Likewise, 125 proformae were filled from the families within the urban field practice centres of the medical colleges, 125 proformae from one of the slum areas of city and 125 from periurban areas. Prior to conducting the study, two faculty members from the Department of Community Medicine of each participating medical college were imparted two days' training at UCMS, Delhi in collaboration with NVBDCP, Delhi. They were explained the methodology of data collection, preparation of master chart, and transfer of data in computer. They were instructed to send the master chart on a computer floppy to the coordinating centre for an all India analysis. Data collection was carried out between March and September 2000. The data were subsequently entered into computer software programme (SPSS) and analysed.

In this paper, we are presenting a logistic regression analysis to determine the predictors of various aspects of knowledge about malaria.

Results

Since each medical college was requested to fill up data from 750 families from six different types of population, a total of 15,750 respondents were administered the questionnaire. The Goa state did not

take part in the study. For the purpose of analysis data from rural field practice centres and that of nearest PHC were merged and labelled as rural. Likewise, the data from urban field practice centres and periurban areas were merged and labelled as urban. Thus, data are being presented in the study from four strata namely, urban, slum, rural and tribal.

Age and sex distribution of the respondents is shown in Table 1. There were 5,250 (33.3%) respondents from urban areas and 2,500 (15.9%) from slums. The proportion of rural respondents was 37.3% and that of tribal respondents was 13.5%. Among the respondents 49.2% were males and 50.8% were females. Overall 31% respondents were illiterate. Of the rest one-third had studied up to class VIII. In general literacy level in female was poor compared to their male counter parts across all population groups.

Table 1. Distribution of sampled population according to the predictor variables

Predictors	Male	Female	Total
Age Group			
< 29	2287 (29.5)	2836 (36.4)	5123 (32.5)
30–39	2076 (26.8)	2481 (31)	4557 (28.9)
40–49	1607 (20.7)	1442 (18.1)	3049 (19.5)
> 49	1783 (23)	1238 (15.5)	3021 (19.1)
Education			
Illiterate	186 (24)	3142 (39.3)	5003 (31.8)
School	2788 (36)	2651 (33.1)	5439 (34.5)
College	3102 (40)	2206 (27.6)	5308 (33.7)
Type of residence			
Urban	2548 (32.9)	2702 (33.8)	5250 (33.3)
Rural	2786 (35.9)	3089 (38.6)	5875 (37.3)
Slum	1199 (15.5)	1301 (16.3)	2500 (15.9)
Tribal	1218 (15.7)	907 (11.3)	2125 (13.5)
Geographical region			
Northeast	762 (9.8)	738 (9.2)	1500 (9.5)
North	2003 (25.8)	2497 (31.2)	4500 (28.5)
East	1662 (21.4)	1338 (16.7)	3000 (19.1)
South	1443 (18.7)	2307 (28.8)	3750 (23.8)
Central	474 (6.1)	276 (3.5)	750 (4.8)
West	1407 (18.2)	843 (10.6)	2250 (14.3)

Figures in parentheses indicate percentage.

The probable predictors included in the model were age, sex, education, place of residence and geographical area of the respondents. Educational qualification was categorised as illiterate, school (up to XII standard) and college level education. According to the place of residence, the respondents were classified as living in urban townships, slums, rural and tribal areas. Since the data collection was meant to be representative of the whole country, considering geographical and socio cultural heterogeneity, the population was categorised into north (Rajasthan, Haryana, Chandigarh, Himachal Pradesh, Uttar Pradesh and Punjab), south (Andhra Pradesh, Karnataka, Tamil Nadu and Kerala), west (Maharashtra and Gujarat), central (Madhya Pradesh and Chhattisgarh), east (West Bengal, Orissa and Bihar) and northeast (Assam and Meghalaya) regions. All predictor variables were entered into the logistic regression model. Outcome was interpreted in terms of following aspects of the disease.

Etiology: The respondents were asked whether mosquito causes malaria. Male gender and higher educational status were more likely to be associated with correct knowledge about mosquito causing malaria. Knowledge about this was better among respondents from north, east and central parts of the country compared to south, west and northeast regions. Tribal respondents were 52% less likely to know about malaria being caused by mosquito compared to urban residents (OR: 0.48, 95% CI: 0.42–0.55; p <0.000) (Table 2).

Clinical features: We included three clinical features of malaria, namely fever, chills and rigor, in this analysis to identify its predictors. A uniform pattern was observed that people in the 30–49 yr age group, male gender, higher education and residents of north, west or east India, were associated with better knowledge about clinical features of the disease (Table 2). Male respondents had significantly better knowledge

Table 2. Predictors of knowledge of malaria regarding its spread and clinical features

Predictors	Mosquito is the cause of malaria		Symptoms of malaria					
			Fever		Chills		Rigor	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Age group								
< 29			(Reference group)					
30–39	1.18 (1.05–1.32)	0.005	1.37 (1.20–1.56)	0.000	1.31 (1.20–1.43)	0.000	1.19 (1.08–1.31)	0.000
40–49	1.34 (1.17–1.53)	0.000	1.76 (1.56–1.97)	0.000	1.62 (1.46–1.80)	0.000	1.36 (1.22–1.50)	0.000
> 49	0.99 (0.87–1.13)	0.821	1.26 (1.09–1.45)	0.002	1.38 (1.24–1.53)	0.000	1.39 (1.24–1.54)	0.000
Gender								
Female			(Reference group)					
Male	1.19 (1.08–1.30)	0.000	1.21 (1.08–1.34)	0.001	1.12 (1.04–1.20)	0.002	1.12 (103–1.20)	0.004
Education								
Illiterate			(Reference group)					
School	2.17 (1.95–2.40)	0.000	1.76 (1.56–1.97)	0.000	1.00 (0.92–1.09)	0.843	1.27 (1.15–1.39)	0.000
College	4.76 (4.16–5.42)	0.000	3.67 (3.16–4.26)	0.000	1.52 (1.39–1.68)	0.000	1.69 (1.53–1.86)	0.000
Type of residence								
Urban			(Reference group)					
Rural	0.96 (0.86–1.07)	0.459	1.13 (0.99–1.28)	0.050	0.90 (0.83–0.98)	0.015	0.79 (0.73–0.86)	0.000
Slum	1.01 (0.88–1.16)	0.887	1.07 (0.91–1.25)	0.425	1.17 (1.04–1.30)	0.005	0.64 (0.57–0.72)	0.000
Tribal	0.48 (0.42–0.55)	0.000	0.72 (0.62–0.83)	0.000	0.83 (0.74–0.93)	0.002	0.71 (0.63–0.80)	0.000
Geographical region								
Northeast			(Reference group)					
North	2.00 (1.67–2.40)	0.000	1.51 (1.24–1.84)	0.000	2.62 (2.32–2.97)	0.000	0.22 (0.19–0.25)	0.000
East	1.56 (1.30–1.87)	0.000	2.04 (1.64–2.54)	0.000	1.31 (1.16–1.49)	0.000	0.63 (0.55–0.71)	0.000
South	0.39 (0.34–0.47)	0.000	0.42 (0.35–0.50)	0.000	0.46 (0.40–0.52)	0.000	0.11 (0.09–0.13)	0.000
Central	1.33 (1.02–1.73)	0.034	2.93 (2.00–4.31)	0.000	0.83 (0.70–0.99)	0.047	0.11 (0.09–0.14)	0.000
West	1.01 (0.84–1.22)	0.917	2.03 (1.60–2.58)	0.000	4.35 (3.73–5.07)	0.000	0.37 (0.33–0.43)	0.000

OR—Odds ratio; CI—Confidence interval.

compared to the female respondents about fever (p <0.001), chills (p <0.002) and rigor (p <0.004).

Spread: That malaria spreads by mosquito was also less likely to be known to tribal people and residents of south India. Knowledge about place of laying eggs was relatively poor among tribal respondents and residents of north, south or central India. Similarly, knowledge about resting place was better in residents of eastern (OR: 2.21, 95% CI: 1.95–2.51; p <0.000) and western parts of the country (OR: 3.48, 95% CI: 3.02–3.99; p <0.000), and respondents above 40 yr of age.

Prevention measures: Use of smoke as a prevention measure was more common among rural and tribal respondents compared to slum and urban respondents. Illiteracy and residence in western India were also associated with use of smoke as prevention measure. College-educated respondents were 2 to 3.6 times more knowledgeable about several prevention measures, similarly, urban residents had better level

of knowledge compared to their rural, tribal and slum counterparts. Respondents from eastern states had seven times better knowledge compared to residents of northeastern states (OR: 7.04, 95% CI: 5.77–8.60, p <0.000) (Table 3).

In Table 4, regression shows predictors of adult mosquito killing methods. Insecticide was better known among college educated, urban residents and male sex. But smoke use was more commonly known method among older adults, males, tribal residents and people living in central and western India.

Diagnosis: Knowledge regarding use of blood slides was overall less common. But predictors of more likely knowledge of blood examination were respondents with age above 49 yr, male gender, college education and residence in northern, southern or western India (Table 5).

Outcome: There was significant variation in knowledge about fatality of malaria. Predictably, educational status showed a linear positive relationship with knowledge about fatality of malaria. Urban residents were significantly more knowledgeable

Table 3. Predictors of knowledge about prevention measures against mosquito breeding

Predictors	Correct knowledge about prevention measures							
	Oils in drains		Drainage of water		Source reduction		Use of fish	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Age group								
< 29	(Reference group)							
30–39	1.19 (1.08–1.32)	0.001	1.12 (1.03–1.22)	0.008	1.12 (1.02–1.23)	0.014	1.46 (0.09–1.96)	0.010
40–49	1.18 (1.05–1.32)	0.004	1.10 (1.00–1.21)	0.040	1.40 (1.26–1.55)	0.000	1.43 (1.04–1.96)	0.027
>49	1.26 (1.12–1.42)	0.000	1.15 (1.04–1.27)	0.005	1.29 (1.16–1.44)	0.000	1.37 (0.99–1.91)	0.058
Gender								
Female	(Reference group)							
Male	1.39 (1.29–1.52)	0.000	1.11 (1.03–1.18)	0.004	0.98 (0.91–1.05)	0.574	1.47 (1.15–1.87)	0.002
Education								
Illiterate	(Reference group)							
School	1.65 (1.49–1.84)	0.000	1.45 (1.34–1.58)	0.000	1.68 (1.53–1.85)	0.000	2.06 (1.46–2.90)	0.000
College	2.35 (2.11–2.62)	0.000	2.04 (1.87–2.23)	0.000	3.06 (2.78–3.38)	0.000	3.62 (2.57–5.11)	0.000
Type of residence								
Urban	(Reference group)							
Rural	0.80 (0.73–0.88)	0.000	0.68 (0.63–0.74)	0.000	0.85 (0.78–0.92)	0.000	0.46 (0.36–0.60)	0.000
Slum	0.54 (0.47–0.61)	0.000	0.97 (0.88–1.07)	0.588	0.82 (0.73–0.91)	0.000	0.52 (0.37–0.74)	0.000
Tribal	0.49 (0.42–0.56)	0.000	0.50 (0.45–0.56)	0.000	0.74 (0.66–0.84)	0.000	0.55 (0.38–0.79)	0.000
Geographical region								
Northeast	(Reference group)							
North	3.51 (2.89–4.28)	0.000	0.82 (0.73–0.92)	0.001	0.78 (0.68–0.89)	0.000	1.97 (0.75–5.14)	0.167
East	7.04 (5.77–8.60)	0.000	0.62 (0.54–0.70)	0.000	1.44 (1.25–1.66)	0.000	5.91 (2.35–14.87)	0.000
South	1.77 (1.44–2.18)	0.000	0.56 (0.49–0.63)	0.000	1.49 (1.29–1.70)	0.000	2.35 (0.89–6.22)	0.085
Central	1.45 (1.09–1.94)	0.011	1.51 (1.26–1.81)	0.000	0.76 (0.62–0.95)	0.014	0.40 (0.05–3.46)	0.408
West	6.43 (5.24–7.89)	0.000	0.98 (0.86–1.12)	0.797	2.64 (2.28–3.05)	0.000	44.48 (18.2–108.4)	0.000

OR—Odds ratio; CI—Confidence interval.

Table 4. Predictors of knowledge about methods of killing adult mosquitoes

Predictors	Adult mosquito killing measures									
	Insecticide spray		Space spray		Mosquito coil		Vaporisers		Smoke*	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Age group										
< 29	(Reference group)									
30–39	1.08 (0.99–1.18)	0.080	1.46 (1.23–1.73)	0.000	0.96 (0.88–1.04)	0.327	1.07 (0.94–1.23)	0.292	1.19 (1.08–1.30)	0.000
40–49	1.22 (1.11–1.35)	0.000	1.57 (1.30–1.89)	0.000	0.91 (0.82–1.00)	0.054	0.99 (0.85–1.15)	0.896	1.34 (1.22–1.48)	0.000
>49	1.20 (1.08–1.33)	0.000	1.49 (1.22–1.81)	0.000	0.85 (0.77–0.94)	0.002	0.95 (0.81–1.12)	0.552	1.27 (1.15–1.40)	0.000
Gender										
Female	(Reference group)									
Male	1.22 (1.13–1.31)	0.000	1.44 (1.26–1.66)	0.000	0.85 (0.79–0.91)	0.000	1.01 (0.91–1.13)	0.843	1.31 (1.22–1.40)	0.000
Education										
Illiterate	(Reference group)									
School	1.30 (1.19–1.42)	0.000	2.06 (1.68–2.53)	0.000	1.66 (1.52–1.81)	0.000	1.43 (1.23–1.66)	0.000	0.85 (0.78–0.92)	0.000
College	2.42 (2.21–2.65)	0.000	3.57 (2.93–4.35)	0.000	2.40 (2.19–2.63)	0.000	2.12 (1.83–2.45)	0.000	0.55 (0.50–0.60)	0.000
Type of residence										
Urban	(Reference group)									
Rural	1.08 (1.00–1.18)	0.044	0.49 (0.42–0.57)	0.000	0.99 (0.92–1.07)	0.848	0.38 (0.34–0.43)	0.000	1.04 (0.96–1.13)	0.352
Slum	0.55 (0.49–0.61)	0.000	0.75 (0.62–0.90)	0.003	1.52 (1.37–1.68)	0.000	0.60 (0.52–0.70)	0.000	0.99 (0.90–1.11)	0.984
Tribal	0.72 (0.65–0.81)	0.000	0.31 (0.23–0.42)	0.000	2.40 (2.19–2.63)	0.000	0.17 (0.13–0.22)	0.000	1.37 (1.19–1.56)	0.000
Geographical region										
Northeast	(Reference group)									
North	0.86 (0.76–0.97)	0.013	5.97 (3.99–8.96)	0.000	0.37 (0.33–0.42)	0.000	1.62 (1.32–1.99)	0.000	1.11 (0.97–1.26)	0.129
East	1.18 (1.04–1.35)	0.009	6.32 (4.19–9.54)	0.000	0.73 (0.64–0.83)	0.000	0.75 (0.59–0.95)	0.018	1.37 (1.19–1.56)	0.000
South	0.35 (0.31–0.40)	0.000	1.57 (1.00–2.46)	0.049	1.40 (1.24–1.59)	0.000	0.92 (0.73–1.16)	0.481	0.81 (0.71–0.93)	0.002
Central	1.00 (0.84–1.20)	0.939	3.17 (1.91–5.26)	0.000	0.48 (0.39–0.58)	0.000	3.20 (2.47–4.16)	0.000	2.57 (2.14–3.09)	0.000
West	3.03 (2.63–3.51)	0.000	7.08 (4.68–10.73)	0.000	0.91 (0.80–1.04)	0.191	2.22 (1.78–2.77)	0.000	2.66 (2.31–3.06)	0.000

*Incorrect response; OR—Odds ratio; CI—Confidence interval.

Table 5. Predictors of knowledge about diagnosis of malaria and severity of disease

Predictors	Diagnosis				Outcome			
	Symptoms		Blood slide		Malaria could be fatal*		Malaria is not self limiting#	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Age group								
<29	(Reference group)							
30–39	1.01 (0.94–1.12)	0.497	1.09 (1.00–1.19)	0.047	0.93 (0.85–1.01)	0.096	1.18 (1.05–1.32)	0.004
40–49	1.12 (1.01–1.23)	0.027	1.15 (1.04–1.27)	0.005	0.81 (0.73–0.89)	0.000	1.31 (1.15–1.49)	0.000
>49	1.05 (0.95–1.17)	0.283	1.16 (1.05–1.29)	0.003	0.85 (0.76—0.94)	0.002	1.12 (0.99–.27)	0.073
Gender								
Female	(Reference group)							
Male	0.93 (0.86–0.99)	0.037	1.15 (1.07–1.23)	0.000	1.19 (1.11–1.28)	0.000	1.05 (0.97–1.16)	0.231
Education								
Illiterate	(Reference group)							
School	1.39 (1.28–1.52)	0.000	1.76 (1.62–1.92)	0.000	1.54 (1.41–1.68)	0.000	1.80 (1.63–1.99)	0.000
College	1.61 (1.47–1.76)	0.000	3.53 (3.23–3.87)	0.000	2.13 (1.94–2.34)	0.000	3.80 (3.35–4.30)	0.000
Type of residence								
Urban	(Reference group)							
Rural	0.94 (0.87–1.02)	0.162	0.99 (0.92–1.07)	0.813	0.93 (0.85–1.01)	0.081	1.03 (0.93–1.15)	0.560
Slum	0.94 (0.85–1.04)	0.239	0.89 (0.80–0.98)	0.022	0.82 (0.73–0.91)	0.000	0.93 (0.82–1.06)	0.275
Tribal	0.85 (0.76–0.95)	0.004	0.54 (0.48–0.61)	0.000	0.65 (0.58–0.73)	0.000	1.11 (0.97–1.28)	0.142
Geographical region								
Northeast	(Reference group)							
North	0.79 (0.70–0.90)	0.000	1.48 (1.30–1.68)	0.000	0.08 (0.06–0.11)	0.000	0.39 (0.32–0.49)	0.000
East	1.23 (1.08–1.41)	0.002	0.83 (0.72–0.95)	0.007	0.12 (0.09–0.15)	0.000	0.47 (0.37–0.59)	0.000
South	0.25 (0.22–0.28)	0.000	1.35 (1.19–1.54)	0.000	0.06 (0.05–0.08)	0.000	0.36 (0.29–0.45)	0.000
Central	0.54 (0.45–0.65)	0.000	0.51 (0.41–0.63)	0.000	0.13 (0.09–0.17)	0.000	0.19 (0.15–0.25)	0.000
West	2.09 (1.80–2.44)	0.000	2.15 (1.87–2.47)	0.000	0.05 (0.39–0.07)	0.000	0.31 (0.25–0.39)	0.000

*Can't say included; #Can't say excluded; OR—Odds ratio; CI—Confidence interval.

than slum (p <0.000) and tribal residents (p <0.000) (Table 5).

Treatment: Knowledge about availability of medicine in general and chloroquine in particular was specifically lacking among younger, female and illiterate population, living in tribal areas and southern and western India. Knowledge regarding availability of medicine was better among college-educated respondents and those living in central India.

Discussion

Literature search for previous similar studies did not reveal any such study conducted at national level. Majority of the studies conducted from India focused on level of knowledge regarding malaria in specified community restricted to a particular type of population or at best to a state. These studies have reported diverse findings. In a study from rural and tribal communities of south Bastar dis-

trict only 34.6% of respondents suspected any fever to be malaria and a meagre (8.2%) knew the drug for treatment of malaria[6]. From Jaisalmer district of Rajasthan, Yadav *et al*[7] reported that because of different behaviours of cast group, transmission magnitude of malaria was three times higher in backward communities than in forward communities. In Manipur, Singh *et al*[8] found that rural tribal residents had relatively inferior level of knowledge compared to their urban counterparts. These findings are similar to our study where tribal population had inferior knowledge regarding various aspects of malaria compared to other strata.

It was also observed that the knowledge about clinical features, mechanism of spread and prevention measures was less among residents of south India compared to that of other parts of the country, after adjusting for age, sex and educational status. This may be attributed to low prevalence of the disease in southern India. We also observed in our study that tribal population had poor knowledge status compared to other respondents in almost all aspects of the disease not withstanding their geographical location and educational status. Our finding is in difference of what reported by Singh *et al*[8] from Manipur, where rural tribal residents had inferior knowledge than urban tribal residents[2]. One of the possible reasons may be that the extension of IEC activities to tribal people is inadequate. The female respondents being relatively less knowledgeable about various aspects of malaria may also be attributed to their lack of exposure to communication and educational attainment. The educational status showed a distinct direct relationship with knowledge levels after adjusting for other variables. Rasania *et al*[9] found in their study conducted in Delhi that literacy status was the sole predictor of knowledge about malaria. But Kaona *et al*[10] reported from Zambia that there was no association between educational level and knowledge of causes of malaria.

We also observed that participants from south Indian states and northeastern region were relatively less knowledgeable. In south India the prevalence of malaria is less compared to other parts of the country, hence the knowledge status is poor. However, in northeastern region, not withstanding the high endemicity, the knowledge is inadequate. This may be attributable to poor IEC activities in this area. It may be concluded that the reach of IEC activities have to improve particularly among tribal population, female members of the society and residents of south Indian states. This combined with overall improvement in educational status may help improved community participation in malaria control programme.

In our study, age was not found to be significant predictor of knowledge but in a study in Zimbabwe, Van Geldermalsen and Munochiveyi *et al*[11] found that people over 50 and below 16 had significantly less knowledge. In Malawi, education and income both were found to be significant predictors of prevention practices related to malaria, this finding didn't match with our study[12].

As we observe from our study that predictors of knowledge not only vary across countries but also with the country, it may be inferred that improvement in knowledge, attitudes and practices related to malaria may be attained only after looking at its predictors at micro level. However, strategic framework at national level certainly need to provide directions at local level.

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Corresponding author: Dr. Arun Kumar Sharma, Reader, Department of Community Medicine, University College of Medical Sciences, Dilshad Garden, Delhi–110 095, India.
E-mail: arsharma62@gmail.com

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