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Nitin Joseph
Associate Professor, Department of Community Medicine, Kasturba Medical College, Manipal University, Light House Hill Road, Mangalore, India.

Maria Nelliyanil
Assistant Professor, Department of Community Medicine, A.J. Institute of Medical Sciences, Mangalore, India.

Shashidhar M Kotian
Selection Grade Lecturer, Department of Community Medicine, Kasturba Medical College, Manipal University, Light House Hill Road, Mangalore, India.

Mohammed Omar
MBBS student, Kasturba Medical College, Light House Hill Road, Manipal University, Mangalore, India.

R. Srikanth Aswin
MBBS student, Kasturba Medical College, Light House Hill Road, Manipal University, Mangalore, India.

Saiteja Donkena
MBBS student, Kasturba Medical College, Light House Hill Road, Manipal University, Mangalore, India.

Smita Jugnu
MBBS student, Kasturba Medical College, Light House Hill Road, Manipal University, Mangalore, India

Panam Chabra
MBBS student, Kasturba Medical College, Light House Hill Road, Manipal University, Mangalore, India.

For Correspondence:
Nitin Joseph
Associate Professor, Department of Community Medicine, Kasturba Medical College, Manipal University, Light House Hill Road, Mangalore, India.

Awareness, practices and expenditure towards mosquito bite prevention methods in urban and semi-urban areas of South India

Nitin Joseph, Maria Nelliyanil, Shashidhar M Kotian, Mohammed Omar, R. Srikanth Aswin, Saiteja Donkena, Smita Jugnu, Panam Chabra

Abstract
The present study was done to find out awareness, practices and expenditure towards mosquito bite prevention methods. Data was collected by interviewing any adult per household.
Out of 150 participants, 136 (90.7%) were aware that mosquitoes transmit diseases. Fourteen (9.3%) were not aware of any potential breeding sources. Only 96 (64%) households used integrated vector control methods. Median cost on permanent mosquito bite prevention methods was more in urban (p=0.011) while the percentage of total family income spent on temporary prevention methods was more in semi urban areas (p<0.001) and among low socio economic families (p<0.001). Breeding sites for mosquitoes like open wells (p=0.026) and open drains (p<0.001) was seen more in semi urban areas. Spraying operations was poor in households of semi urban areas (p=0.02). Awareness and practices of mosquito control methods needs further improvement in the settings. Provision of ITNs by government will reduce cost on temporary methods.

Keywords: Awareness, mosquito bite prevention methods, breeding sites, expenditure, semi urban areas, urban areas.

1. Introduction
India contributes to about two-third of the malaria incidence in South-east Asian region. Fortunately by the large scale containment measures under National Vector Borne Disease Control Programme its incidence has shown a continued decline by 28% from 2000 to 2010 and the annual parasite incidence has reduced to 1.0 in 2011 [1]. Karnataka state situated in south India has an ideal environment which facilitates prolific growth of mosquitoes and transmission of malaria by virtue of its vast semi-urban areas, rich irrigated lands and good monsoon every year [2]. The most malaria endemic city in this state is Mangalore with an Annual Parasite Incidence above five. The South Canara district contributes to about 70% of malaria cases reported in this state of which Mangalore alone contributes to an astonishing 55% cases [3]. In the months between January and July 2014 in the city corporation limits as many as 4,000 confirmed cases of malaria have been reported [4]. When compared to the last year's statistics during the same time period, the current year has witnessed a substantial increase in 2 to 3% malaria cases. This is in contrary to national figures which shows a continued decline. The likely explanation to this scenario has been postulated to be a rapid urbanization in the form of multiplication of industrial and residential sites witnessed in Mangalore over recent years. As a consequence, there has also been a concentration of migrant families and labour population at the construction sites which has also contributed to increase in transmission of malaria in the city [4].
In spite of several thousands of free insecticide treated nets being distributed in the city by Mangalore City Corporation and a penalty imposed on the people who create breeding grounds for mosquitoes there has been so far no containment of malaria cases in Mangalore [5].
WHO with all associated countries including India is planning to eliminate malaria and other diseases by 2015 by implementing millennium development goals. Therefore, it is imperative for researchers to address the reasons behind high malaria endemicity in Mangalore and to suggest suitable and immediate corrective measures.
To achieve best results in malaria control, it is obvious that active community participation is necessary for organized vector control strategies. Community participation in turn depends on

people's knowledge and attitude towards the disease and its prevention [6]. The present study was hence done to find out the awareness of the participants about various mosquito-borne diseases and to study the various preventive methods used by them. For comparison of findings, the study was also done in neighbouring semi urban areas of the same district.

The present study also seeks to identify how much households spent on various temporary and permanent mosquito bite prevention methods. Expenditure was also analyzed across socio-economic groups and areas, which would help in developing a suitable and effective evidence based health education and prevention strategy in study region.

2. Materials and methods

2.1 Settings

A cross sectional study was done during April 2012 in Lady Hill area of Mangalore city and two semi urban areas namely Jeppinamogaru and Shivanagar, all field practice areas of Department of Community Medicine, Kasturba Medical College, Mangalore situated in South Canara district of Karnataka state.

2.2 Ethics approval

Ethical approval was obtained from the institutional ethics committee.

2.3 Sample size and sampling method

A sample size of 109 was calculated based on the expected prevalence of awareness that mosquitoes transmit malaria as reported by 62% participants from the findings of another Indian study [7] and keeping the power at 85% with 95% confidence intervals. A total of 75 respondents from as many households each from urban and semi-urban areas were selected by systematic random sampling in which every 10th house (starting from the first house chosen simple randomly) in a randomly chosen lane was surveyed. In case the house was locked or members were ineligible for inclusion in the present study or were nonconsenting, the next adjacent house was selected.

2.4 Data collection

Mangalore is situated 22 m above sea level and its weather favours vector-borne diseases. It receives about 95% of its total annual rainfall between May to October [8]. The study was done just prior to the start of monsoons in the month of May in Mangalore and thus the participants could also be educated about preventive measures to be practiced in the high transmission season to follow. Any consenting adult member (≥18 years) in the household preferably head of the household present at the time of visit was enrolled in the study after explaining to them the nature and purpose of the study. Data was collected using a pre-designed structured interview schedule. The questionnaire contained questions regarding socio-demographic characteristics, perceptions of people on mosquitoes as a serious problem in their household, its breeding places and diseases transmitted, personal protection measures and source reduction measures practiced in houses and their monthly expenditure towards these methods. Methods were categorized as temporary *viz*., coils, mats, repellents, sprays, etc., and permanent namely, nets, electric rackets, screening of windows, etc. The treatment seeking behaviour of all those who suffered from mosquito-borne diseases over the past year was also enquired by the investigators. The investigators later inspected the peridomestic environment surrounding the houses to identify potential mosquito breeding sites. At the end of the interview, each respondent was provided a pamphlet containing information about mosquito-borne diseases and its control.

2.5 Data analysis

Socio economic status (SES) was assessed using Modified Kuppuswamy's classification of 2012 [9]. Overcrowding was assessed by enquiring the number of house hold members and number of rooms within houses and comparing it with standards [10]. Data entry and analysis were done using SPSS Inc., Chicago, IL version 16. Chi‐ square test, Fisher exact 't' test, Kruskal-Wallis test and Mann-Whitney U test was used to test association. $P \leq 0.05$ was taken as statistically significant association.

3. Results

Mean age of the participants was 41.2 ±14.1 years. In the present study, majority of participants were females 112(74.7%), graduates/post graduates 49(32.7%), house wives 77(51.4%) and of middle SES 76(50.7%). Half of the participants were from urban areas. (Table 1)

Table 1: Socio demographic distribution of participants.

Characteristics	No.	Percentage (%)
Age group (years)		
18 – 29	33	22
30 – 39	37	24.7
40 – 49	42	28
50 – 59	18	12
60 – 69	14	9.3
70 – 79	6	4
Gender		
Males	38	25.3
Females	112	74.7
Marital status		
Unmarried	20	13.3
Married	126	84
Widow	4	2.7
Educational status		
Illiterates	8	5.3
Primary	13	8.7
Middle school	14	9.3
High school	35	23.3
Intermediate/ Diploma	21	14
Graduate/ Post graduate	49	32.7
Professional	10	6.7
Occupation		
Housewives	77	51.4
Student	11	7.3
Unskilled	21	14
Skilled	12	8
Businessman/Farmer/Clerk	6	4
Semi-professional	11	7.3
Professional	12	8
Socio economic status		
Lower	52	34.7
Middle	76	50.7
Upper	22	14.6
Type of family		
Nuclear	99	66
Joint	36	24
Three generation	15	10
Area of residence		
Urban	75	50
Semi urban	75	50
Total	150	100

Out of 150 households visited, 108(72%) were pukka (well-constructed) houses, 40(26.7%) were semi-pukka houses and 2(1.3%) were katcha (poorly constructed) houses. Overcrowding within houses was present in 16(10.7%) houses. One hundred and thirty six (90.7%) participants considered mosquitoes as a severe menace in their households.

One hundred and thirty six (90.7%) were aware that mosquitoes transmit diseases (malaria). Twenty six (19.1%) participants knew that mosquitoes transmit filariasis, 25(18.4%) about dengue and 18(13.2%) about chikungunya. Awareness about role of mosquitoes in transmitting diseases was not associated with the educational status of participants ($X^2 = 6.325$, p=0.388).

One hundred and eleven (74%) participants were aware that stagnant water was a breeding source for mosquitoes. Only one participant knew that empty coconut shells and eight knew that open drains were breeding sites for mosquitoes. Fourteen (9.3%) were not aware of any potential breeding sources of mosquitoes.

All of the households surveyed were using one or other mosquito bite prevention methods. Majority of households used liquid repellents 97(64.7%). (Table 2)

Table 2: Distribution of various mosquito bite prevention methods used by participants (n=150).

Methods	No.	Percentage (%)
Liquid repellents	97	64.7
Nets	53	35.3
Coils	46	30.7
Burning neem leaves	33	22
Electric rackets	29	19.3
Sprays	17	11.3
Mats	10	6.7
Repellant creams	3	2.0
Others*	6	4.0

*Fans, Closing doors and windows

Table 3: Area wise distribution of expenditure on mosquito bite prevention methods in households.

Monthly expenditure on temporary methods (Rs)	Households in urban areas Number	Percentage (%)	Households in semi urban areas Number	Percentage (%)	Total
0-50	13	20.3	21	33.3	34
50-100	20	31.3	23	36.5	43
100-200	21	32.8	12	19.1	33
>200	10	15.6	7	11.1	17
Total	64	100.0	63	100.0	127
				X^2=5.07, DF=3, p=0.167	
Expenditure on permanent methods (Rs)	**Households in urban areas Number**	**Percentage (%)**	**Households in semi urban areas Number**	**Percentage (%)**	
0-250	2	6.4	14	46.7	16
250-500	7	22.6	6	20.0	13
500-1000	5	16.1	3	10.0	8
1000-2000	7	22.6	5	16.6	12
>2000	10	32.3	2	6.7	12
Total	31	100.0	30	100.0	61
				X^2=15.2, DF=4, p=0.004	

Ninety six (64%) households used integrated method of vector control. Most participants 57(38%) felt liquid repellents to be the most effective personal protective method to prevent mosquito bites compared to other methods.

Side effects/discomfort following usage was reported by few users of coils and nets. Amongst the mosquito coil users, one complained of headache, one of nausea and vomiting, six of breathlessness and two of skin allergies. Among mosquito net users suffocation was complained by four users. Spraying operations in their households by government officials, did not take place in 58(38.7%), was once a month in 55(36.7%), once in 6 months in 22(14.7%), once a year in 5(3.3%) and occasionally in 10(6.7%) houses.

The mean monthly expenditure on temporary mosquito bite prevention methods was Rs.117 (USD 1.95). The median expenditure was Rs.75 and it ranged from Rs.0 to Rs.600 per month.

Forty three (33.9%) of the 127 houses reported spending between Rs. 50 to Rs. 100 per month on temporary bite prevention methods (Table 3). The mean monthly expenditures on temporary personal protection measures was Rs. 110.5 in households in urban and Rs. 87.6 in semi urban areas.

The mean expenditure on permanent mosquito bite prevention methods (nets, electric bats) was Rs. 1091.30 (median Rs. 500). Majority of the houses 16(26.2%) spent less than Rs.250 on these methods and these houses were significantly more in semi urban areas (p=0.004) (Table 3). The mean expenditure on permanent personal-protection measures was Rs. 1381 in urban households and Rs. 695.3 in semi urban households. The median cost on permanent mosquito bite prevention methods in urban areas was Rs.700 compared to Rs.300 in semi urban areas. (p=0.011 by Mann-Whitney U test) (Table 5).

The percentage of total family income spent on temporary methods of protection was 0.76% of monthly income, 9.2% of annual income and 2.47% of per capita annual income in households. In urban areas, 0.6 ±0.6 percentage of their total monthly family income was spent on temporary prevention methods in comparison to 1.2 ±1 percentage in semi urban areas. (t=4.36, p<0.001) The mean annual expenditure on temporary protection measures in urban areas constituted 1.7% of the per capita income in comparison to 3.3% in semi urban areas. The median comparison was 1% in urban to 2% in semi urban areas. (p=0.017 by Mann-Whitney U test)

Table 4: Distribution of households based on percentage of expenditure on temporary methods spent of their monthly income.

SES of households	0-0.5%	0.5-1%	1-2%	>2%	Total
Lower	10(22.7)	4(9.1)	21(47.7)	9(20.5)	44
Middle	35(55.5)	24(38.1)	2(3.2)	2(3.2)	63
Upper	12(60)	4(20)	1(5)	3(15)	20
				X^2=53.3, p<0.001	
Area					
Urban	40(62.5%)	14(21.9%)	8(12.5%)	2(3.1%)	64
Semi urban	17(27%)	18(28.6%)	16(25.4%)	12(19%)	63
Total	57	32	24	14	127
				X^2=19.584, p<0.001	

Percentage of total monthly family income spent on temporary methods of protection was also significantly more in low SES households (p<0.001) (Table 4).

Table 5: Association between socio demographic variables with expenditure towards mosquito control methods among households.

Socio demographic variables	Median monthly expenditure on temporary methods in Rupees. (n=127)	Median expenditure on permanent methods in Rupees. (n=61)
Area		
Urban	100	700
Semi urban	60	300
	p=0.064	*p*=0.011
Education of head of household		
Professional	42.5	1000
Graduate/Post graduate	100	500
Intermediate/Diploma	80	650
High school	100	450
Middle school	55	1100
Primary	75	175
Illiterate	47.5	300
	p=0.276	*p*=0.487
Occupation of head of household		
Profession	60	750
Semi-Profession	105	2000
Clerical/Shop owner/farmer	100	500
Skilled	60	500
Unskilled	50	300
Unemployed	92.5	180
Retired	100	425
	p=0.046	*p*=0.343
Type of family		
Nuclear	75	450
Joint family	100	500
Three generation	60	1100
	p=0.370	*p*=0.611
Socio economic status		
Lower	60	250
Middle	100	500
Upper	80	1075
	p=0.103	*p*=0.057
Type of house		
Pucca	100	500
Semi Pucca	50	200
Katcha	17.5	150
	p=0.01	*p*=0.124

In the present study, monthly expenditure on temporary methods for mosquito bite prevention was found to be significantly associated with occupation of head of household (*p*=0.046) and type of house (*p*=0.01) by Kruskal-Wallis test. Expenditure on permanent methods was found to significantly more in urban areas (*p*=0.011) by Mann-Whitney U test (Table 5).

Table 6: Area wise distribution of households with mosquito breeding sites.

	Urban (n=75)	Semi urban (n=75)	Total (n=150)	*p* value
	No.(%)	No.(%)		
Water storage open tanks	39(52)	49(65.3)	88	0.097
Open wells	7(9.3)	17(22.7)	24	0.026
Open drains	4(5.3)	36(48)	40	<0.001
Ornamental ponds/aquarium	5(6.7)	0(0)	5	0.023
Miscellaneous	10(13.3)	12(16)	22	0.644

Of the total houses surveyed, 114(76%) had potential mosquito breeding sites, of which the commonest breeding site was water storage tanks 88(77.2%) followed by open drains 40(35.1%). The open wells (0.026) and open drains (*p*<0.001) were seen significantly more in semi-urban areas (Table 6).

In the previous one year, malaria cases were reported in 14 houses and chikungunya in one house. Out of the 14 malaria cases, 11 were males, five (majority) were in the age group between 31 and 40 years, seven from low SES and rural areas, and all of them were put on allopathic treatment. Of the total cases, 10 patients took treatment form private practitioners and rest from government health centers.

The lone case of chikungunya was a female, aged 58 years belonging to low SES, who took both ayurvedic and allopathic treatment from private practitioners. No socio demographic variables were associated with presence of vector-borne diseases. Vector-borne diseases over the past one year was present in 3(18.8%) houses with overcrowding in comparison to 12(8.9) houses without overcrowding (X^2=1.52, *p*=0.217).

Table 7: Association between spraying operations in their households with area and presence of vector-borne diseases among household members.

	Urban (%)	Semi urban (%)	Total (%)
Spraying operations			
Not done	27(36)	31(41.3)	58
Done at least once in 6 months	45(60)	32(42.7)	77
Done once a year or more	3(4)	12(16)	15
Total (%)	75(100)	75(100)	150
		X^2=7.87, df=2, p=0.02	
	Disease present (%)	Disease absent (%)	Total
Spraying operations			
Not done	6(10.3)	52(89.7)	58(100)
Done at least once in 6 months	5(6.5)	72(93.5)	77(100)
Done once a year or more	3(20)	12(80)	15(100)
Total	14	136	150
		X^2=2.82, df=2, p=0.244	

Spraying operations within households were significantly less frequent or absent in semi urban areas (*p*=0.02). There was no association between frequencies of spraying operations within houses with presence of vector-borne diseases among household members (Table 7).

4. Discussion

An important aspect with respect to vector-borne diseases is its ecology which is greatly influenced by the behavior of susceptible population. The behavior of people as to how they respond to this threat is influenced based on their current understanding and conceptualization about these diseases [11]. Evidence from prior researches also support this fact as effective reduction of vector breeding sites was observed to be achieved by community education alone rather than use of chemical methods [12].

In the present study, 90.7% participants considered mosquitoes as a severe menace in their households which was more than that reported by participants in other studies done in India and abroad where it ranged from 27.1% to 90% clearly indicating that the settings were problematic. [7, 11, 13, 14] In present study, 136(90.7%) participants knew mosquitoes transmit diseases. In

other studies, 21.7% to 99.3% knew mosquitoes transmit diseases. [7, 13-17] If every person residing in an endemic area are aware about this fact it would lead to full-fledged mosquito control measures among residents in that area. It is awareness which initiates behavioral change in disease prevention initiatives.

With respect to type of diseases transmitted by mosquitoes, awareness about malaria was known to 51% to 91% in other studies which was lesser than our observations. [7, 16-20] However awareness of other diseases transmitted by mosquitoes was only 8.8% to 39% in other studies [7, 18-20] which was similar to the present findings. This aspect need to be also stressed in educational campaigns as other vector-borne diseases are also dangerous in terms of morbidity and mortality and are easily preventable.

In a study done in Rajkot, India, 30.4% respondents did not know about breeding sites of mosquitoes which was poorer than the findings in present study [7]. This could be because of better literacy status in the present study settings. In studies done in Guntur, India [18], 8.5% people and Jaffna, Sri Lanka [13] 12% people were unaware of mosquito breeding places which was similar to observations in the present study. The wide spread knowledge about mosquito breeding places amongst study population reflects the impact of effective health education activities in this region [19].

Similarly in other studies, 25.2% to 68% people were aware of drains or polluted water as breeding sources for mosquitoes which was again lesser than the awareness level reported in the present study [7, 16, 20-22]. The importance of source reduction as a method for mosquito control needs to be further improved upon in the community. For instance, in spite of availability of abundant coconuts in the study settings which is a coastal area, only one participant knew coconut shells as one of the potential breeding source for mosquitoes as also reported by just 4.2% of respondents in a study done in Puducherry, India [16].

In the present study, all participants were using one or other bite prevention methods. In other studies 3% to 39% were not using any bite prevention methods [7, 13, 17-20, 22, 23].

This shows lack of knowledge about diseases caused by mosquito bites results in not practicing any measures of personal protection. Additionally, individuals may not be serious about keeping their surroundings free from potential mosquito breeding sites and may leave the responsibility totally to the government officials [24].

The commonest bite prevention method used in present study was liquid repellents which was similar to findings of studies done in Rajkot, India [7] (61.4%) and in Delhi, India [22] (60%). However in several other studies, mosquito coils were the most frequently used method [13, 14, 17-19, 23]. In a study done in Jamnagar, India majority of participants (55.8%) used mats. [20] Thus, there is evidently varying practices against mosquito bite from place to place.

In the present study traditional methods like burning neem leaves was reported by 22% houses. In the study done in Orissa, India 10% of urban and 8% of rural households used traditional methods like burning dried dung or vegetation indoors so as to produce smoke to drive mosquitoes away [23]. Burning of neem leaves was reported by 4.5% participants in a study done in Gujarat, India [19] and by 10.85% participants in a study done in Guntur, India [18].

In the present study usage of repellent creams was seen in very few respondents which was lesser than that reported in studies done in Virginia, USA [11] (17.5%) and in Guntur, India[18] (15.85%). This method of protection needs to be more encouraged among construction workers in Mangalore so as to prevent bites during working hours.

Mosquito coil users in the present study reported maximum number of side effects. In a study done in Delhi, India 32.2% of the users reported side-effects on using personal protective methods (PPMs) which comprised of irritation to smell of PPMs (51.7%) followed by headache (44.8%) [22].

Few participants also complained of suffocation using mosquito nets. Various reasons for not using nets as stated in a study done in Nigeria were cost, fears of suffocation, maintenance issues and feeling uncomfortable under them at night [25]. Similarly, residents in Thailand reported that bed nets were not convenient to use [26]. A study done in Iran also reported that many people did not allow spraying inside their houses as they do not like the odour of the fumes [27].

Due to worries associated with side effects of personal protective measures, few participants probably developed their own remedies like sleeping under fans or closing doors and windows to prevent mosquito bites. In other studies, 15.4% to 20.4% people were making use of fans to get rid the mosquitoes which was more than the findings of the present study [7, 17, 28]. Mosquito killing rackets were used by 4.5% participants in a study done in Gujarat, India [19] and by 10.6% in a study done in Guntur, India [18] which was lesser than the present findings.

In a study done in Tanzania, households spent an average of USD 0.82 per month on malaria prevention which was about half of the expenditure on temporary methods noted in the present study. Also in the former study, it was observed that investment on permanent methods like nets was minimal by households because of non-affordability [29]. In a study done in Jaffna district, Sri Lanka the monthly expenditure for personal protective measures varied from USD 0.19 to USD 3.40 which was lesser than the present observations [13].

The expenditure towards permanent methods was less among lower SES and significantly less in semi-urban households in the present study. Therefore, propagating screening windows as means to prevent mosquito entry inside houses may be considered unacceptable in the sub urban communities as several respondents have limited financial capabilities. This infers that governments' campaigns should emphasize more on cost effective interventions in the form of environmental measures such as source reduction for mosquito control [28].

The percentage of total monthly family income spent on temporary methods of protection was seen significantly less among middle and upper SES households in the present study. This could also be because of their greater investment towards permanent protection methods like nets, screening of windows which would have led to minimal expenses towards temporary methods.

Similar observations were made in other studies where it was observed that the poor spent a larger proportion of household income on these prevention activities than the rich [30, 31]. Therefore, government need to support all sections of the society by activities like free distribution of insecticide treated bed nets and spraying of houses periodically to minimize household expenditure on temporary methods. In a study done in Tanzania, the expenditure on all forms of malaria prevention increased with socioeconomic status which was similar our findings although not statistically significant [29]. A former study also found a disproportionate expenditure on bite prevention methods like bed nets across different socio economic groups as also observed in the present study [29]. Similarly, a Center for Disease Control study [32] found that households with lower incomes were more dependent on

personal protective methods.

Area wise disproportion in expenditure to personal protection methods as observed in the present study was also noted in other studies. For instance, a study done in Orissa, India the mean monthly expenditure on personal protection measures was Rs. 101 in urban areas and Rs. 72 in rural areas was similar to our findings [23]. But a study done in areas which was Pondicherry, India found the average monthly expenditure on these measures as Rs. 62.17 in urban areas and Rs. 8.03 in rural areas which was much lesser than our observations. In the same study, annual expenditure on personal protection measures in urban areas constituted 0.63% of the per capita income which was again lesser than 1.7% observed in the present study [14].

A study done in Tanzania reported that expenditure towards prevention methods increased with years of education of head of household which was not seen in the present study.[29] The study done in Tanzania however found heads who were businessmen spent significantly more compared to other professions to anti bite methods which was similar to our observations [29].

Of the total houses surveyed, 114(76%) had potential mosquito breeding sites. In a study done in Portugal, 79.6% houses had mosquito breeding sites which was slightly more than our observations [15]. The commonest breeding site identified in the present study was water storage tanks 88(77.2%) followed by open drains 40(35.1%). In a study done in Portugal, commonest breeding sites were flower-pot dishes (52.7%) followed by out-door sinks (35.7%).[15] The breeding site of mosquitoes like open wells and drains were significant more in semi urban indicating poorer containment measures by people residing in these areas. Similarly, absence or less frequent spray operations seems significantly more in semi urban areas indicates poorer government response. These aspects can be hence rectified by a collaborative effort between people and government to contain vector-borne diseases.

Of the total malaria cases, considerable proportions went to private medical practitioners. Therefore, the competency of these practitioners in the private sector needs to be strengthened for management of cases and for imparting health education to patients and their family members.

5. Conclusion

The overall awareness regarding mosquitoes transmit diseases was good but awareness on diseases other than malaria spread by mosquitoes was poor. About 10% of participants being not aware of breeding sites of mosquitoes is a cause of concern as this can adversely affect community participation activities on source reduction. Active participation of stakeholders, community volunteers and self-help group members should be used to maximize community awareness in these issues. Mass media could be an ideal means to disseminate widespread community awareness generation.

Integrated vector control methods practiced by 64% houses needs further improvement as the settings is a highly malaria endemic zone. This could also be a solution to certain side effects/ discomfort experienced by users of coils or nets.

The increased expenditure among poor SES groups and semi urban population on temporary methods can be minimized with greater provision of permanent methods freely available by the government such as insecticide treated bed nets. Breeding sites like open drains and wells seen significantly more in semi urban households and spraying operation being more infrequent in these areas need to be addressed by collaborative efforts between government officials and community.

The present study has brought out certain important findings in the sampled population, the understanding of which is deemed vital for planning of health education programmes as far as vector borne diseases are concerned.

The other regional strategies could be to map all ongoing construction sites in Mangalore and periodically inspecting them to ensure that no breeding of vectors take place here. Similarly, registration of labour population at these sites will help in tracking them for screening activities so as to check disease transmission. Government should also supply all labourers with insecticide treated nets free of cost with adequate training on its proper usage and maintenance. Sprayers have to be instructed to spray every floor at construction sites and not the easily accessible areas alone so as to destroy all mosquito breeding sites. Usage of window mesh and mosquito nets needs to be emphasized at common places of overcrowding like hospitals, clinics, boarding schools and hostels. By these means it will be possible to eliminate malaria from Mangalore by 2015.

6. Limitations

There may be recall and reporting biases on the part of participants of the present study particularly when asked to identify their personal behaviors. Also not all individuals were comfortable revealing their true income status along with expenditure on various mosquito bite protection methods. This could have resulted in inaccuracies in the reported values.

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9. Conflict of interest: None declared

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