

Cost Effectiveness and Pattern of Personal Protective Measures used against Mosquitoes in a Rural Coastal Region of Ernakulam District in Kerala

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ABSTRACT

Published on 14th September 2020

Background and Objectives: Mosquito borne diseases including Dengue, Chikungunya, Malaria, Japanese encephalitis, Filariasis, Zika fever and Yellow fever are a growing public health concern. The state of Kerala in Southern India has been a hot bed for vector borne diseases with epidemics of Dengue and Chikungunya in 2003 and 2006 respectively. The present study was undertaken in a rural panchayath in Ernakulam district with an aim to understand the pattern of use of personal protection measures against mosquitoes, its socio-demographic determinants and the economic burden it imposes.

Methods: A cross sectional study was conducted in June 2015 in Elamkunnappuzha Panchayath, a rural coastal area located in Ernakulam District of Kerala in Southern India. 200 households were visited using multistage sampling technique using pretested semi-structured questionnaire. Data was entered in MS Excel and data analysis done in Statistical Package for Social Science version 19. Ethical approval was obtained from the institutional ethical committee.

Results: Among the 194 families consented to share data, more than two-third (68%) of the study households experienced mosquito menace. 94.8 % of the households used PPM, but only 67.5% of the households used on a daily basis. The most commonly used PPM among the study households were vaporizer (52.1%) followed by coil (42.3%) and fumes (19.1%). Mosquito menace and expenditure showed association with various factors.

Conclusion: Personal protective measures remain the corner stone of integrated vector management. PPM shall remain significant even in the wake of development of vaccines against mosquito-borne diseases.

Keywords: Mosquito Borne Diseases, Personal Protective Measures, Coastal Region, Kerala, Southern India, Cost Effective Analysis

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INTRODUCTION

Mosquito borne diseases including Dengue, Chikungunya, Malaria, Japanese encephalitis, Filariasis, Zika fever and Yellow fever are a growing public health concern.¹ Mosquito borne diseases account for about 17% of all communicable diseases, thus contributes to a major proportion of the total morbidity. The countries in the South East Asian Region (SEAR) including India bear a huge burden of mosquito borne diseases.^{2,3} More than 40 million cases are being reported from India alone every year causing higher health care costs, school absenteeism, loss of productivity and pressure on the limited public health resources.^{4,6}

The state of Kerala in Southern India has been a hot bed for vector borne diseases with epidemics of Dengue and Chikungunya in 2003 and 2006 respectively. Ernakulam district in Kerala is endemic for Dengue.⁷ Rampant urbanization, environmental degradation, improper garbage removal, loosely thrown plastic or rubber containers and favourable climatic conditions has led to an explosion in the mosquito density, especially the *Aedes* mosquitoes.⁸ Though there is adequate technical savvy on the vector and its control using integrated control measures with community participation, these measures were not utilized to its full potential resulting in the annual epidemics.⁹ As a result, preventing mosquito bites at a personal level have become more imperative

Cite this article as: Lalu JS, Arjun B, Sreedevi A, K K, Narayanan TK, Anish TS, et al. Cost Effectiveness and Pattern of Personal Protective Measures used against Mosquitoes in a Rural Coastal Region of Ernakulam District in Kerala. IMA Kerala Medical Journal. 2020 Sep 14;13(3):101–6.

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due to the unavailability of effective vaccines and chemoprophylaxis.^{7,10}

The Government of India (GOI) through the National Vector Borne Disease Control Programme (NVBDCP) has suggested many personal protective measures to prevent mosquito borne diseases. The Insecticide treated Nets introduced by NVBDCP have been found to be very effective in reducing the morbidity of mosquito borne diseases.⁴ The use of personal protective measures has been advocated as an effective tool against vector borne diseases. However, success of these measures depends on the knowledge, access, acceptability and appropriate utilization by the target population. Therefore the present study was undertaken in a rural panchayath in Ernakulam district with an aim to understand the pattern of use of personal protection measures against mosquitoes, its socio-demographic determinants and the economic burden it imposes.

MATERIALS & METHODS

Setting:

A cross sectional study was conducted in June 2017 in Elamkunnapuzha Panchayath, a rural coastal area located in Ernakulam District of Kerala in Southern India. The Elamkunnapuzha panchayat has 23 wards with a population of 26,997, literacy rate of 97.27%. and the predominant occupation is fishing.¹¹

Sample size and sampling method:

As per a study conducted in Trivandrum, 80% of the rural households used atleast one personal protective measure.¹² With 95% confidence, 10% relative error and Design effect (DEFF) of 2 for cluster sampling, the minimum sample was calculated to be 192, rounded off to 200.

Multistage sampling was done by dividing the panchayath in to four zones in the first stage. In the second stage, one ward was selected randomly from each zone and in the last stage each household was considered as a unit and 50 households was selected from each ward. From the midpoint junction of each selected ward, one of the directions was chosen using lottery method and houses were visited consecutively till a sample of 50 households were collected.

Data collection:

Data was collected using a pretested semi-structured questionnaire. The questionnaire was pilot tested in 20 households. The investigators and trained social workers personally interviewed the head of the family from each household. We included families who are permanent residents of Ezhamkulam Panchayath i.e. those who has resided in the area for more than one year. Houses which denied access and houses which remained locked after

three consecutive visits were excluded from the study. Details on socio-demographic parameters, knowledge about mosquito breeding sites, awareness on mosquito borne diseases, expenses on mosquito control measures and personal protection measures were enquired into.

Data Analysis:

Data was entered in MS Excel and data analysis done in Statistical Package for Social Science version 16. Descriptive statistics were expressed as mean, standard deviation, median, proportions and inter-quartile range. Since the expenditure of households on PPM was not normally distributed, median value was used. Categorical variables were analyzed using Chi square test to find associations and a p value <0.05 was considered significant.

RESULTS

In this study total 194 families comprising of 785 individuals were interviewed. The mean age of the respondents were 57.79 (± 15.22) years. The proportion

Table 1. Socio demographic characteristics of the study population

Sl no	Variable	Frequency (%)
1	Total number of members	785
2	Mean family size (n=787)	4.04 (±1.3)
3	Gender (n=785)	
	Male	390 (49.68%)
	female	395 (50.31%)
4	House type (n=194)	
	Kutcha	007 (3.6%)
	Pucca	164 (84.5%)
	Mixed	23 (11.9%)
5	Median of rooms per household (n=194)	5
6	Family type (n=194)	
	Nuclear	60 (30.9%)
	Joint	5 (2.6%)
	Three Generation	129 (66.5%)
7	Religion (n=194)	
	Hindu	44 (22.7%)
	Christian	144 (74.2%)
	Muslim	6 (3.1%)
8	Education (n=785)*	
	Illiterate	18 (02.3%)
	Primary	202 (25.7%)
	Upper primary	32 (04.0%)
	High school	168 (21.4%)
	Higher secondary	85 (10.8%)
	University	164 (20.9%)
9	SES** (n=194)	
	Upper	04 (02.1%)
	Upper middle	31 (16.0%)
	Middle	41 (21.1%)
	Lower middle	73 (37.6%)
	Lower	45 (23.2%)

*children not yet started schooling not included

**BJ Prasad SE Classification

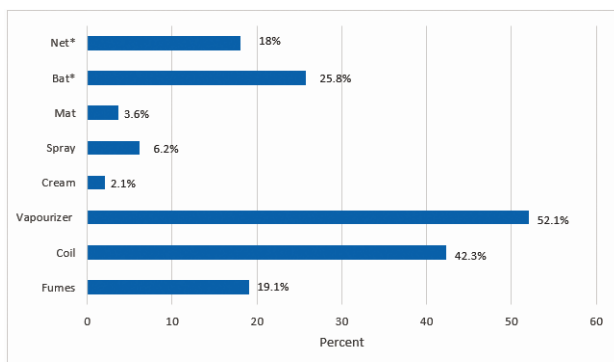
Table 2. Knowledge regarding Mosquito borne diseases and practice of protective measures

Sl No	Variable	N (%)
1	Knowledge regarding mosquito borne disease	
	< 2 diseases	92 (73.2%)
	>2 disease	52 (26.8%)
2	Knowledge regarding mosquito breeding sources	
	<2 sources	152 (78.3%)
	>2 sources	034 (17.5%)
3	Frequency of use of personal protective measure	
	Daily	131 (67.5%)
	During monsoon	021 (10.8%)
	Occasionally	031 (16.0%)
4	Preferred time of use of personal protective measure	
	All day	018 (09.3%)
	Only at bed time	127 (65.5%)
	Occasionally	039 (20.1%)

of males (49.69%) to females (50.31%) was almost equal. Majority of the families were Christians (74.2%) and three-generation families (66.5%). While 2.3% were illiterates, 20.9% had university education. About 3.6% of the families were living in kutch type of house. The socio demographic characteristic of the study population is shown in **table1**.

Table 2 shows the knowledge regarding mosquito borne diseases and practices followed to protect against it in among the study population. Every respondent (100%) knew the name of at least one mosquito borne disease. Among the 194 household that gave consent to share data, more than two-third (68%) of the study households experienced mosquito menace. About 95 % of the households used PPM but only 67.5% of the households used it on a daily basis.

Figure 1 shows the distribution of the pattern of personal protective measures (PPM) used. The most commonly used PPM among the study households were vaporizer (52.1%) followed by coil (42.3%) and fumes (19.1%). Fixing net on windows and doors were done by 18% of the houses and 25.8% of the households used bats for getting



*fixed investment on personal protective measure

Figure 1. Distribution of the pattern of PPM used

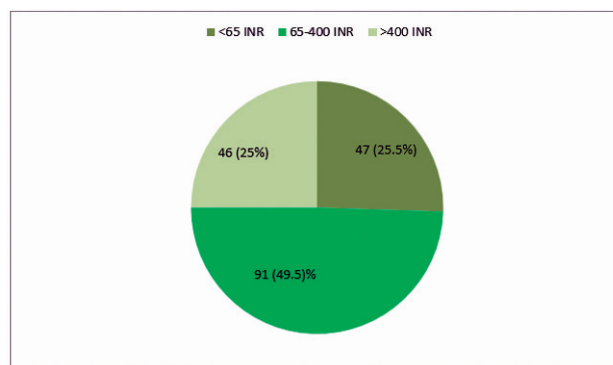


Figure 2. Distribution of households based on expenses incurred towards PPM per month

rid of mosquitoes. The average monthly expenditure on PPM is Rs127.50. **Figure 2** shows the distribution of expenses.

The level of satisfaction was more (49.5%) with vaporizer followed by coils. The least satisfaction was expressed towards cream (2%) followed by mat (3.6%) and spray (4.1%). Among the expendable PPM the average monthly expense was highest with mat (Rs. 120) followed by Vaporizer (Rs. 110). **Table 3** shows the level of satisfaction and mean monthly expenses of PPM.

Table 4 shows the association of various factors with mosquito menace. It was found that knowledge of the respondents, level of satisfaction of PPM used, number of PPM used were significantly associated with mosquito menace.

Association between the expenses and various factors were analyzed and is shown in **table 5**. Type of house and knowledge was found to be two factors associated with the expenses inquired towards PPM against mosquito borne diseases.

DISCUSSION

We interviewed 194 households consisting of 785 study population. As high as 68% of the household living in the coastal areas of Elamkunnappuzha panchayath were

Table 3. Level of satisfaction and mean monthly expense of personal protective measure

Sl no	Type of personal protective measure	level of satisfaction	Average Monthly Expense (Rs)
1	Fumes	17.5%	38.6
2	Coil	37.6%	65.8
3	Vaporizers	49.5%	110.9
4	Cream	02.0%	96.0
5	Spray	04.1%	75.8
6	Mat	03.6%	120.6
7	Bat*	23.7%	275.0
8	Net*	18.0%	1000

*fixed investment on personal protective measure

Table 4. Association of mosquito menace with various factors

Sl no	Variable	Menace		P value
		Mild/moderate	Severe Menace	
6/1999	Knowledge of the respondents			
	Poor (<2 correct answers)	26 (41.9%)	36 (58.1%)	0.001
	Fair (2-3 correct answers)	31 (37.3%)	52 (62.7%)	
	Good (>4 correct answers)	05 (10.2%)	44 (89.8%)	
Level of satisfaction (n=184)				
1/2000	Highly satisfied	09 (69.2%)	04 (30.8%)	0.003
	Satisfied	44 (29.1%)	107(70.9%)	
	Not satisfied	03 (15.0%)	17 (85.0%)	
9/2000	Methods used			
	No PPM	06 (60.0%)	04 (40.0%)	0.03
	Single method	22 (43.1%)	29 (56.9%)	
	2 methods	19 (27.1%)	51 (72.9%)	
≥ 3 methods	15 (23.8%)	48 (76.2%)		
6/2004	History of mosquito borne disease			
	Yes	08 (18.2%)	36 (81.8%)	0.03
	No	54 (36.0%)	96 (64.0%)	

experiencing mosquito menace in the present study. About 95% of our study population was under the protection of any of the PPM which was in conjunction with a study conducted in Chennai and Jamnagar which reported use of PPM by study population as 93% and 83% respectively.^{4,13}

A higher proportion of the households in our study were using Vaporizer with high satisfaction followed by coils. Whereas a study conducted in Trivandrum reported that majority in rural area preferred fumes while vaporizers were preferred by the urban residents.¹² Similarly studies conducted in various parts of India also reported common use of vaporizer as PPM among households respectively.^{3,14-16} Whereas, in a rural region in Jhansi, coils were commonly used.⁵

The median expense to purchase PPM was estimated to be Rs 127.5 in the present study. Another study conducted in Trivandrum reported a monthly purchase expenditure of INR 17 in rural setting where fumes were majorly used and Rs 75 where vaporizers were commonly used.¹² Whereas, a study conducted in Chennai found an average expenditure of Rs 59.⁴ Similarly, another study conducted by Snehalatha et al in Pondicherry reported an average expenditure for purchasing PPM to be Rs 62 and a study conducted by Vijayakumar et al in Chennai reported much lesser expense.^{17,18} The difference in expenditure may be because of the annual inflation (our study was conducted about 5-10 years later than other studies mentioned above) and higher tax in Kerala as compared

Table 5. Association between Expenses on PPM and various factors

Sl no	Variable	Expense (n=184)			P value
		< 65 INR	65-400 INR	>400 INR	
1	Type of house				0.003
	Kutchra	05 (83.3%)	00 (00.0%)	01 (16.7%)	
	Pucca	42 (23.6%)	91 (51.1%)	45 (25.3%)	
2	Type of Family				0.57
	Nuclear				
	Joint	16 (27.1%)	25 (42.4%)	18 (30.5%)	
	Three Generation	30 (25.0%)	64 (53.3%)	26 (21.7%)	
3	History of mosquito borne disease				0.60
	Yes	09 (20.5%)	22 (50.0%)	13 (29.5%)	
	No	38 (27.1%)	69 (49.3%)	33 (23.6%)	
4	Level of satisfaction				0.09
	Highly satisfied	03 (23.1%)	04 (30.8%)	06 (46.2%)	
	Satisfied	35 (23.2%)	79 (52.3%)	37 (24.5%)	
	Not satisfied	09 (45.6%)	08 (40.0%)	03 (15.0%)	
5	Knowledge				0.03
	Poor	17 (29.8%)	31 (54.4%)	09 (15.8%)	
	Fair	25 (31.6%)	33 (41.8%)	21 (26.6%)	
	Good	05 (10.4%)	27 (56.3%)	16 (33.3%)	

to Tamil Nadu.

Knowledge regarding mosquito borne diseases and mosquito breeding sites were good among the community dwellers perceiving severe mosquito menace in our study. Similar findings were reported from a study conducted by Kishor M et al, Sharma et al and Niraj Pandit in Jamnagar, Pune and Gujarat respectively.^{13,19,20} In contradictory to this, a low percentage of awareness was reported among individuals residing in Thar desert, Rajasthan.²¹ Similarly, in rural regions of Nepal with hilly terrains similar in socio demographic features with North Eastern part of India showed only an average level of awareness regarding MBD and PPM.²²

As the level of satisfaction improved, the level of mosquito menace was shown to be significantly reduced in our study. In a rural setting in Trivandrum, Mangalore and Jamnagar, about 3%, 10% and 17% respectively were not satisfied with any of the modern PPM.^{12,13,15} This is a proxy indicator of the effectiveness of the PPM used. Several studies conducted across the world has proved about the level of satisfaction and effectiveness in bringing down mosquito borne diseases by using PPM like insecticide treated bed nets and di-ethyl 3-methyl benzamide.²³⁻²⁶

Multiple PPM were used among households experiencing severe mosquito menace and this was found to be a significant relation. This can also be an indication to the fact that some of the PPM is becoming less effective

in bringing down the menace. This finding was further strengthened by the significant association observed by the relation between mosquito borne diseases and severe mosquito borne diseases in this community. Even though the practice of PPM used in the study area was satisfactory, the mosquito menace was found to have little effect. World Health Day 2014 was dedicated to bring down the crisis caused by this arthropods.⁶

The kutcha type households spent less than INR 65 as compared to the pucca type households and this finding was found to be a significant finding and the expenditure towards PPM was found to be significantly more in the category INR 65-400 across all level of knowledge but comparatively higher proportion of respondents with good knowledge were found to be spending 65-400 INR towards PPM. A study conducted in a semi-rural setting in Delhi and Assam also reported similar findings.^{27,28} It was noted in a vector borne disease (VBD) analysis report published by the World Health Organization in 2014 that about 70% of the health budget allocated for VBDs were not been utilized. This was excluding the financial aid provided by other agencies.²⁹ Therefore a strong stewardship function to tackle such bottle necks based on surveillance system that provides data for taking appropriate measures to bring down the burden caused by mosquitoes in this country.³⁰

CONCLUSION

Personal protective measures remain the corner stone of integrated vector management. PPM shall remain significant even in the wake of development of vaccines against mosquito-borne diseases. While acceptance of PPM is high, this has to be leveraged by promoting the most efficacious method suitable for the geographic epidemiology and local culture.

END NOTE

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Conflict of Interest: None declared

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