



**USE OF MOSQUITO REPELLENT: A COMPARATIVE ANALYSIS  
BETWEEN SLUM AND PLANNED RESIDENTIAL AREAS OF  
KHULNA CITY CORPORATION IN THE SOUTH-WEST  
BANGLADESH**

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KUS:19/05: 130519

Manuscript received: May 13, 2019

Accepted: September 04, 2019

**Abstract:** People in developing countries like Bangladesh often ignore the harmful effect of using mosquito repellents on health as well as environment. This is a cross-sectional study among adult individuals selected from planned residential (60) and slum (60) areas of Khulna City Corporation in the south-west Bangladesh considering the user (64) and non-user (56) of repellents chosen through applying a stratified systematic random sampling method. Most of the surveyed people use mosquito repellents at evening and at night while sleeping. Poor slum people mainly use local brand coil, while a comparatively high income earner planned residential people use variety of repellents. This study finds that the planned residential people spend more on repellent purchase per month than slum people. The smoke congestion of living room due to use of repellent is more evident in slum areas compared to planned residential areas. Feeling sick due to this smoke is also more evident in the slum areas compared to planned residential areas. Similarly, the severity of disease due to use of mosquito repellent is higher in the slum areas compared to planned residential areas. The planned residential area people are more aware about the negative health effect of using mosquito repellents. The ordered logit estimation result shows that disease awareness of using repellent is higher among educated and planned residential people in comparison with less educated and slum people. Hence, activities under different public health program might be develop to enhance awareness, especially among poor, less educated slum people toward the negativity of using repellents and encourage them towards using alternative means for preventing mosquito.

**Keywords:** Mosquito repellents, respiratory diseases, diseases awareness

**Introduction**

Mosquito repellent is usually called 'bug spray' (Tsuji *et al.*, 2002). Repellent was considered as a perfect solution to control mosquito when it was introduced in the middle of 20<sup>th</sup> century. However, later, it was proved to be a less effective solution for long term mosquito control, despite some early success (Axtell, 1979). Currently mosquito repellents are used in agricultural and domestic environment to control mosquito in many countries (Tsuji *et al.*, 2002). Use of mosquito repellents create congestion in unventilated situations and contribute to indoor air pollution (Waleed *et al.*, 2013).

Evidences from literature show the deadliness of using repellent in indoor environment (Liu *et al.*, 2003). A study in Pakistan states that excessive use of mosquito repellent during post-monsoon cause congestion and surrounding people are affected with different allergic diseases like asthma

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(Waleed *et al.*, 2013). Use of repellent during sleep is very risky for health, as long time exposure generates congestion and prolonged inhalation causing different health effects. Evidence shows that a person using these repellent products while sleeping has 1.957 times more risk of developing some form of congestion as compared to those who avoid use of such items during sleep (Sinha *et al.*, 2004). Data reveal that nearly 4 percent people suffer from different respiratory diseases due to indoor air pollution globally (Albalak *et al.*, 1999; Bruce *et al.*, 2000a; Collings *et al.*, 1990; Niklas and Robert, 2013).

Pyrethroid repellents have been used for more than 40 years because of their availability and these repellents account for 25 percent of the world insecticide market (Kakko *et al.*, 2003; Shafer *et al.*, 2005). People use these repellents in their day to day life without knowing the composition of the product and safety measure (Mehta *et al.*, 2010). Use of mosquito coil has a longer term toxic impact, as once they enter into human body through inhalation or in other way, remain forever or for a longer period. Continuous or prolonged use of different repellents (at least 8-10 hour/day) highly affects blood, plasma, different tissues, red cells etc. (Kulkarni and Hodgson, 1980). Repellents like aerosol, coil etc. are responsible for causing lung diseases and continuous use of these repellents can cause asthma (Sharma, 2001). Use of these repellents can also cause acute and chronic health effects such as skin and eye irritation, headache, dizziness, weakness, ear, nose and throat infection, vomiting, allergy, pregnancy complication, immune system disorder and even cancer (Liu *et al.*, 2003). The survey respondents of a study claimed that they face allergic respiratory and skin problems for using mosquito repellents (Majid and Daniel, 2002).

Several studies exhibit relationship between indoor air pollution and exposure of repellents. However, there are very little information regarding exposure level and associated risk among people living indoor (Bruce *et al.*, 2000b). A study showed an increasing trend in respiratory diseases with decreasing air quality. Children and elderly are the main victims of the respiratory diseases due to congested housing patterns and indoor air pollution. Smoky indoor air and polluted ambient air play a crucial role in causing ill health in both developed and developing countries (WHO, 2004). By 2003, about 812 deaths among 8,439 cases were recorded worldwide and the economic loss was estimated to \$50-\$100 billion due to respiratory diseases. WHO has estimated that 50 percent of the global burden of chronic respiratory illnesses like asthma, lung cancer etc. is associated with indoor air pollution (Bency *et al.*, 2003).

Various forms of atmospheric pollution affect human health and the environment from local to global level from diverse sources (Jassim *et al.*, 2013). Solid, liquid, odourless, colourless gases are mixed in air (Kumar and Libidinsky, 2000). WHO stated that household air pollution is causing 40 percent of various diseases. Moreover, indoor air pollution is causing more deaths than outdoor air pollution (Brook *et al.*, 2004). Awareness is increasing among people regarding risk from indoor air pollution in the home and workplace as indoor pollutants act as respiratory irritants, toxicants and carriers of allergens (Bernstein *et al.*, 2008). Use of herbal repellents such as *neem* oil, soybean oil, lemon eucalyptus oil etc. are comparatively safer (Fradin and Day, 2002). Mosquito cream consist of *neem* oil may be considered as an effective repellent (Floore, 2002).

This research thus aims to observe the frequency of using mosquito repellents among the residents of planned residential areas and slums of Khulna City Corporation in the south-west Bangladesh.

### **Materials and Method**

This study is conducted on purposively selected two slums (Rail Station, *Rapsba*) and two planned residential areas (*Nirala*, Sonadanga) of Khulna City Corporation. Following a stratified systematic random sampling procedure, 120 adults (user: 64, non-user: 56) are selected during January-June 2016 as respondents.

This study considers repellent use time, brand, expenses, smoke congestion, evidence of sickness, severity of diseases and awareness as the main issues to compare between the planned residential area people and slum people of Khulna City Corporation.

This study contemplates creation of indoor congestion and potential health risks such as suffering from different respiratory diseases due to use of mosquito repellents as well as disease awareness of using harmful mosquito repellents among respondents in the slum and planned residential areas.

An ordered logistic regression model (equation 1) is used to identify the factors influencing disease awareness of using repellents. Ordered logistic regression model is the extended form of logistic regression. This model is used when the dichotomous dependent variable allows more than two ordered/ranked response categories.

$$\Pr\left(Y = \frac{1}{x_1, x_2, x_3, \dots, x_9}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_9 X_9 = X_i \tau \beta \quad (1)$$

Where, X implies explanatory variables.

People find it effective to use repellent for controlling mosquito. Most of them are not aware enough about the negative health impact of using repellent. Here, in the model (equation 1), dependent variable is disease awareness of using repellent and the corresponding explanatory variables that are responsible for it are age ( $X_1$ ), education level ( $X_2$ ), area of residence ( $X_3$ ), gender ( $X_4$ ), participation in NGO program ( $X_5$ ), watch health related program ( $X_6$ ), sick people due to congestion ( $X_7$ ), respiratory disease ( $X_8$ ), and consult with doctor ( $X_9$ ).

### Results and Discussion

Mosquito repellents are used to control mosquito by people residing in both slum (n=30) and planned residential (n=34) areas. Slum dwellers are mostly living in congested, less spacious housing area, having lack of ventilation facility in comparison to people living in planned residential area. In planned residential area, mosquito problem is not that much severe as in slum area. Most of the people use repellent at evening and at night during sleep (slum: >8 hour/day; 80 percent; and planned residential area: >8 hour/day; 88 percent).

Poor slum people mainly use coil (local brand). A comparatively high income earner planned residential area people use variety of repellents like coil, spray, liquid vaporizer, mosquito cream etc. In slum area, about 50 percent respondents use local brand, while the rest 50 percent use ACI, Mortein, Heet and Good Night (Table 1). In planned residential area around 23 percent use ACI, 26 percent use Mortein, 12 percent use Heet, 24 percent use Good night and 15 percent use other brand like ATN, Black Fight, Super King etc. (Table 1).

Table 1: Preferred brand of mosquito repellent

Name of brand	Slum		Residence	
	Frequency	Percentage	Frequency	Percentage
ACI	6	20	8	23
Mortein	5	17	9	26
Heet	2	6	4	12
Good Night	2	7	8	24
Other	15	50	5	15
<b>Total</b>	<b>30</b>	<b>100</b>	<b>34</b>	<b>100</b>

People use these repellents frequently or sometimes according to their brand preference which they find effective to control mosquito (Table 2).

Table 2: Pattern of using repellent

Item	Using pattern	Frequency	Percentage
Coil	Never	0	0
	Very rare	2	3
	Sometimes	23	36
	Frequently	19	30
	Very frequently	20	31
	<b>Total</b>	<b>64</b>	<b>100</b>
Spray	Never	48	75
	Very rare	1	2
	Sometimes	8	12
	Frequently	3	5
	Very frequently	4	6
	<b>Total</b>	<b>64</b>	<b>100</b>
Liquid vaporizer	Never	48	76
	Very rare	0	0
	Sometimes	7	11
	Frequently	3	5
	Very frequently	5	8
	<b>Total</b>	<b>64</b>	<b>100</b>
Mosquito cream	Never	62	97
	Very rare	2	3
	Sometimes	0	0
	Frequently	0	0
	Very frequently	0	0
	<b>Total</b>	<b>64</b>	<b>100</b>

People buy various repellents considering the factors such as price, effectiveness, good quality, no smoke etc. (Table 3 and 4).

Table 3: Reasons for using specific mosquito repellent (%)

Reasons	Coil user	Spray user	Liquid vaporizer user	DEET user
Low price	17	6	0	0
Effectiveness	50	67	67	13
Easy to use	11	13	6	34
Can place them anywhere	3	0	7	20
Good quality	11	7	7	33
No smoke	8	7	13	0
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

Table 4: Factors influencing purchase decision of repellents

Factors	Opinion (Percent)
Price	11
Advertisement	8
Effectiveness	49
Retailer opinion	7
Quality	14
Color	7
Quantity	4

It is found that planned residential area people spend more (US\$ 3.95) on repellent purchase per month than slum people (US\$ 3.58). Whereas, slum people are more satisfied with use of mosquito repellent to control mosquito than planned residential area people (3.73 vs. 2.56 satisfaction score in a five-point scale).

This study tries to understand repellent related information collected from slum and planned residential area respondents. About 71 percent respondents in both slum and planned residential area use repellent during sleep. In the slum area, three or more people stay in one room during sleep for about 73 percent cases, while, in the planned residential area, three or less people stay in one room during sleep in 71 percent cases. About 70 percent respondents in the slum area and 68 percent in the planned residential area agreed on the smoking status of living room. About 70 percent respondents in the slum area and 56 percent in the planned residential area agreed on congestion of room with smoke due to use of repellent. About half of the respondents in the slum area and 38 percent respondents in the planned residential area claim that they feel sick due to smoke. About half of the respondents in slum area and 71 percent in planned residential area agreed on seasonal variation of using repellent (Table A1).

Table 5: Ordered logit regression on disease awareness of using repellent

Disease awareness of using repellent	Unit	Symbol	Coefficient	Odd ratio
Age	Year	$\beta_1$	0.01	0.00
Education level	Year of schooling	$\beta_2$	0.12**	0.02**
Area of residence	Residence=1, Slum =0	$\beta_3$	0.85*	0.12*
Gender	Male=1, Female=0	$\beta_4$	0.37	0.05
Participation in NGO program	Yes =1, No =0	$\beta_5$	1.27***	0.22***
Watch health related program	Yes =1, No =0	$\beta_6$	0.41	0.06
Sick people due to congestion	Number	$\beta_7$	-0.11	0.02
Respiratory disease	Yes =1, No =0	$\beta_8$	0.25	0.04
Consult with doctor	Yes =1, No =0	$\beta_9$	0.88**	0.13**
/cut1			0.37	
/cut2			1.65	
/cut3			2.71	
/cut4			4.16	

Dependent variable: Disease awareness of using repellent  
 Number of observation: 120                      Log Likelihood: -166.36  
 Pseudo R<sup>2</sup> = 0.13

N.B.: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

According to the study findings, the severity of disease due to use of repellent is higher in slum area (63 percent) than in planned residential area (56 percent). The slum people are suffering more from asthma, heart disease and respiratory allergy compared to people living in planned residential area. Planned residential area people are more aware of the negative health effect of using mosquito repellent than slum people (52 vs. 48 percent).

The ordered logit estimation result (Table 5) shows that disease awareness of using repellent is higher among educated and planned residential area people in comparison with less educated and slum people. It is also found that awareness about disease is higher among people who participate in different NGO programs and does consult with doctor while suffering from illness.

## Conclusion

The findings of this study demonstrate that both slum and planned residential area people use various mosquito repellents due to their availability, inexpensiveness and control over mosquito. Long time and excessive use of these repellents develop congestion in indoor environment. People residing in such a congested situation and continuous and prolonged inhalation of harmful exposure from repellent inflate health risks and associated respiratory diseases. As awareness about disease of using repellent is higher among educated and planned residential area people in comparison with less educated and slum people, activities under different public health program should be developed to enhance awareness, especially among poor, less educated slum people toward the negativity of using repellents and encourage towards using safe alternatives.

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Annex

Table A1: Repellent related information

Repellent related information	Opinion of respondents	Slum		Residence	
		Frequency	Percentage	Frequency	Percentage
Use of repellent during sleep	Yes	27	71	24	71
	No	3	29	10	29
	Total	30	100	34	100
No. of people living in a room during sleep	1-2	2	7	24	71
	3-4	22	73	9	26
	Above 4	6	20	1	3
Total	30	100	34	100	
Smoking status of living room due to use of repellent	Yes	21	70	23	68
	No	9	30	11	32
	Total	30	100	34	100
Room become congested with smoke and odor	Yes	21	70	19	56
	No	9	30	15	44
	Total	30	100	34	100
No. of sick people due to smoke	Not sick	15	50	21	62
	1-2	11	37	13	38
	3-4	4	13	0	0
Total	30	100	34	100	
Seasonal variation of using repellents	Yes	15	50	24	71
	No	15	50	10	29
	Total	30	100	34	100