

Knowledge, Attitudes and Practices of Personal Mosquito-Repellent Methods Among Adult Filipinos

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ABSTRACT

Background: Vector-borne infections account for over 17% of all infectious diseases, which are prevalent in tropical and subtropical regions. Low-income communities have limited access to physical and chemical vectors, which reduce the chance of cutaneous symptoms, allergic reactions, secondary bacterial infections, and eventually, systemic disease.

Objectives: This study aims to identify the knowledge, attitudes, and practices on personal mosquito-repellent methods among adult Filipinos.

Methods: A descriptive, observational study was conducted among adult Filipinos aged 18 to 59 years old in the outpatient department of a tertiary referral hospital and in the partner community or barangay health center.

Results: Among the 215 participants, most were female, single, between the ages of 18 and 37, lived in Barangay Tapuac, Dagupan City and reside in concrete houses. Low knowledge scores were found in 80.47%, and positive overall attitude scores in 92.09%. The majority of mosquito-repellent methods used were insecticide sprays (71.16%), but other unconventional methods like mosquito-repelling plants (14.42%), and vitamin B and garlic pills (3.26%) were also utilized. Over 90% of respondents said they would consult a healthcare provider for information regarding mosquito-repellent measures.

Conclusion: Understanding adult Filipinos' knowledge, attitudes, and practices regarding personal mosquito-repellent use enables dermatologists in both community and institutional settings to provide evidence-based patient education on effective, cost-efficient vector control and to contribute meaningfully to collaborative public health initiatives.

Keywords: Mosquito repellents, community dermatology, prospective descriptive

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INTRODUCTION

Vector-borne illnesses consist of approximately 17% of all infectious diseases, with dengue considered as the most rapidly spreading mosquito-borne viral disease worldwide. Pathogens such as parasites, virus, and bacteria are transmitted by these vectors, which include mosquitoes, fleas, lice, ticks, and bugs.¹ Developing countries in the tropical and subtropical areas are at risk, including the Philippines, where more than 13,000 cases were reported in March 2021.^{1,2,3} In 2019, Region 1 of the Philippines reported 9% increase in the number of cases, involving 25 mortalities. Majority of confirmed dengue cases in the Philippines were males, while most deaths were female patients. Children aged 5-9 years old were the most severely affected population.⁴ Aside from dengue, mosquitoes transmit many other diseases including malaria, Chikungunya virus, Zika virus, and West Nile virus. Thus, emphasis on the prevention of these disease is essential. These include, but are not limited to,

environmental cleaning, protective clothing, limited time outdoors, and safe use of mosquito repellents.^{5,6} A significant milestone is that a dengue vaccine was first licensed in 2015.⁷

Various mosquito repellents are available in the market. Physical and chemical vector control augment mosquito bite prevention, leading to decrease in incidence of cutaneous manifestations, allergic reaction, and systemic disease.^{8,9} Most individuals complain of intense pruritus, and skin manifestations may be aggravated by scratching or manipulation and may lead to secondary bacterial infection.¹⁰ Physical vector control include wearing of light-colored clothing with good coverage, staying indoors, sanitation of possible mosquito habitats, and use of mosquito nets and lanterns.^{3,9,11} Chemical vector control are composed of synthetic compounds such as DEET, picaridin, and IR3535, and as DEET, picaridin, and IR3535, and natural compounds

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such as oil of lemon eucalyptus, citronella oil, and catnip oil.⁹ Broad-spectrum DEET is the most widely used active ingredient in mosquito repellents, which generally has an effective safety profile, and are safer in 10% to 35% concentrations.^{3,6,9,12} Examples of non-topical mosquito repellents are bracelets, wristbands, patches, candles, coils, and stickers, which usually contain citronella.^{3,11} Access to effective product is often limited in developing countries. In one online survey, unconventional strategies arose such as use of a telephone application, burning animal dung, and avoidance of sugar, meat, and bananas.³ Indigenous people in the Philippines use numerous plant species to drive off mosquitoes.¹³

In developing countries where there is a high incidence of mosquito-borne illnesses, there is often limited access to effective repellent products. Because of this, various traditional and home remedies are used across a variety of groups and cultures.³ Among the Ayta people in Pampanga, Philippines, different parts of native plants such as stems of *ipil-ipil*, leaves of *kakawati*, fruit of *kupang*, and root of *pandakake*, are used for their repellent activity. In addition, there is cultural heritage perseveration through these methods.¹³ Grown in tropical and subtropical regions are *Azadirachta indica* or commonly known as neem, in which seed kernels exhibited repellent efficacy against female *Anopheles* mosquitoes which induce malaria.¹⁴ In Southeast Asia, dried peel of lanzones are also burned exuding aromatic smoke to deter mosquitoes.¹⁵

Many patients not only present with cutaneous manifestations, but also allergic reaction and systemic infections, due to mosquito bites. The clinicians' working knowledge on the primary and secondary strategies and the patients' understanding of the disease transmission and knowledge, attitudes, and practices on mosquito-repellent methods will help the reduction of individuals having mosquito-related illness. Information on registered, readily available, and effective prophylactic mosquito repellents would not only prevent disease, but also mitigate allergic reaction severity.^{8,9,16} This study aims to identify the knowledge, attitudes, and practices on personal mosquito-repellent methods among adult Filipinos.

METHODS AND MATERIALS

A descriptive, observational study design was employed. Participants, selected through convenience sampling, completed a validated questionnaire available

in both English and Filipino languages. The survey gathered information on demographic data, environmental history, past medical history of mosquito-borne diseases, knowledge of various mosquito-borne diseases and mosquito-repellent types, attitudes toward environmental modification and health-seeking behavior, and practices and traditions involving mosquito repellents. The study was conducted over a six-month period at the outpatient department of a tertiary government hospital and a partner municipal health center. Respondents were adult Filipinos aged 18 to 59 years old without serious psychological illnesses requiring emergent intervention. A sample size of 215 was calculated using Slovin's formula.

RESULTS

Among the participants, 161 (74.88%) were in the range of 18 to 37 years old (Table 1). More than half were female (68.37%), single (64.19%), and Roman Catholic (78.14%). Most were college graduates (43.26%), followed by those who finished post-graduate (25.12%) and high school levels (25.12%). Eighty-three (38.6%) were unemployed, and 56 (26.05%) were students. Almost 30% (64 participants) have an estimated family income of less than 11,000 pesos. A great majority of respondents are from Dagupan City (53.49%), followed by Calasiao (13.02%) and Binmaley (6.05%) [Table 2]. Three respondents were not from Pangasinan. Of those from Dagupan, most are from Barangay Tapuac (32.17%), followed by Bonuan (21.74%). Of those from Calasiao, most reside in Nagsaing (17.86%). At 70.23% (151 participants), a vast majority reside in a stand-alone houses, with buildings made of concrete material (83.26%), living with 2-5 household members (60.47%) [Table 3]. More than half have flush type with tanks (60.93%), with water supplied through pipes (79.53%). Less than half have no presence of body of water nearby their house (49.77%), very closely. Majority also have presence foliage nearby at 80.47% (42 participants) [Table 3]. Respondents get most of their information on mosquito-repellent methods on television (54.42%) followed by internet search engines (41.86%) and from healthcare workers (40%) [Table 4].

Table 1. Demographic profile (n = 215)

Demographic Profile	Frequency	%
Age group (in years)		
18-37	161	74.88
38-59	54	25.12
Sex		
Female	147	68.37
Male	68	31.63
Civil status		
Single	138	64.19
Married	74	34.42
Widowed	2	0.93
Annulled	1	0.47
Religion		
Roman Catholic	168	78.14
Born Again Christian	25	11.63
Iglesia ni Cristo	8	3.72
Baptist	5	2.33
Atheist	2	0.93
Latter-day Saints	2	0.93
Unanswered	2	0.93
Jehovah's Witness	1	0.47
Orthodox Catholic	1	0.47
Seventh-day Adventist	1	0.47
Education		
College graduate	93	43.26
Post-graduate	55	25.58
High school graduate	54	25.12
Less than high school	13	6.05
Jehovah's Witness	1	0.47
Occupation		
Unemployed	83	38.6
Student	56	26.05
House wife	13	6.05
Business owner	7	3.26
Post-Graduate Intern	7	3.26
Physician	6	2.79
Sales	5	2.33
Government Employee	3	1.4
Pharmacist	3	1.4
Driver	2	0.93
Jeepney Driver	2	0.93
Accountant, Architect, Cashier, Casual Employee, Construction Worker, Driver, Farmer, Fisherman, Healthcare Worker, Housekeeper, Housewife, Medical Representative, Medical Technician, Online Seller, Pharmacy Assistant, Policeman, Sail Officer, Seller (Unspecified), Teacher, Tricycle Driver, Turbine Specialist, Vendor, Welder	1	0.47

Estimated family income (in Philippine peso)		
Less than 11,000	64	29.77
11,001-23,000	48	22.33
23,001-47,000	42	19.53
47,001-82,000	21	9.77
234,001 and above	19	8.84
140,001-234,000	12	5.58
82,001-140,000	7	3.26
Not specified	2	0.93

Table 2. Demographic profile of participants (n = 215)

City/Town	Barangay	Frequency	%
Alaminos (n=3)	Not specified	3	100
Balungao (n=1)	Poblacion	1	100
Bayambang (n=2)	Telbang	1	50
	Not specified	1	50
Binalonan (n=1)	Not specified	1	100
Binmaley (n=13)	Naguilayan	3	23.08
	Dulag	2	15.38
	Baybay Lopez	1	7.69
	Buenlag	1	7.69
	Canaoalan	1	7.69
	Poblacion	1	7.69
	San Isidro Norte	1	7.69
	Not specified	3	23.08
Bolinao (n=1)	Luna	1	100
Bugallon (n=3)	Banaga	2	66.67
	Bolaoen	1	33.33
Calasiao (n=28)	Nagsaing	5	17.86
	Bued	3	10.71
	San Miguel	3	10.71
	Dinalaoan	2	7.14
	Longos	2	7.14
	Macabito	2	7.14
	Ambunao	1	3.57
	Gaban	1	3.57
	Lucao	1	3.57
	Malabago	1	3.57
	Mancup	1	3.57
	Poblacion West	1	3.57
	Not specified	5	17.86
Dagupan (n=115)	Tapuac	37	32.17
	Bonuan	25	21.74
	Lucao	10	8.7
	Pantal	10	8.7
	Malued	6	5.22
	Mangin	3	2.61
	Mayombo	3	2.61
	Salapingao	3	2.61
	Calmay	2	1.74
	Amado	1	0.87
	Arellano	1	0.87
	Bateng	1	0.87

	Maligaya	1	0.87
	Poblacion	1	0.87
	Poblacion Oeste	1	0.87
	Pogo Grande	1	0.87
	Pugaro	1	0.87
	Not specified	8	6.96
La Union (n=2)	Rabon	1	50
	Not specified	1	50
Lingayen (n=6)	Domalandan	1	16.67
	Libsong	1	16.67
	Libsong West	1	16.67
	Poblacion	1	16.67
	Tonton	1	16.67
	Wawa	1	16.67
Manaoag (n=4)	Bucao	1	25
	Calaocan	1	25
	Inamotan	1	25
	Pantal	1	25
Mangaldan (n=8)	Bari	2	25
	Banaoang	1	12.5
	Davin	1	12.5
	Malabago	1	12.5
	Nibaliw	1	12.5
	Salay	1	12.5
	Not specified	1	12.5
Mangatarem (n=1)	Paul	1	100
San Carlos (n=6)	Colingling	1	16.67
	Malacanang	1	16.67
	Parayao	1	16.67
	PNR Station Site	1	16.67
	San Pedro	1	16.67
	Not specified	1	16.67
San Fabian (n=5)	Bolasi	1	20
	Cayanga	1	20
	Poblacion	1	20
	Poblacion	1	20
	Sagud-Bahley	1	20
San Fernando City (n=1)	Parian	1	100
San Jacinto (n=4)	Guibel	1	25
	San Guillermo	1	25
	Not specified	2	50
San Manuel (n=1)	Cabacaraan	1	100
San Quintin (n=1)	Alac	1	100
Sta. Barbara (n=4)	Maningding	1	25
	Not specified	3	75
Sual (n=2)	Tondol	1	50
	Not specified	1	50
Urdaneta (n=2)	Nancamaliran East	1	50
	San Vicente	1	50
Not specified (n=1)	Not specified	1	100

Table 3. Environmental history (n = 215)

Demographic Profile	Frequency	%
Type of house		
Stand-alone house	151	70.23
Apartment	56	26.05
Informal settlement	5	2.33
Condominium	3	1.40
Material of house		
Mostly concrete	179	83.26
Mostly wood	28	13.02
Nipa hut	6	2.79
Mostly corrugated metal	2	0.93
Number of household members		
2-5	130	60.47
6 and above	43	20
Lives alone	42	19.53
Type of toilet facility		
Flush type with tank	131	60.93
Pour flush toilet	77	35.81
Pit latrine	7	3.26
Main water source		
Piped water supply	171	79.53
Handpumps	42	19.53
Shallow wells	1	0.47
Streams and/or ponds	1	0.47
Presence of body of water nearby house		
None	107	49.77
Natural	98	45.58
Artificial	10	4.65
Presence of foliage nearby house		
Yes	173	80.47
No	42	19.53

Table 4. Sources of basic knowledge of mosquito-repellent methods (n = 215)

Source	Frequency	%
Television	117	54.42
Internet search engines	90	41.86
Healthcare workers	86	40
Social media	83	38.6
Family or peers	49	22.79
Print advertisements	29	13.49

Questions on knowledge were on the kinds of mosquito-borne disease, possible modes of transmission, symptoms, mosquito habitat and types of repellents (Table 5). A significant majority had poor knowledge scores at 80.47% (173 participants).

Table 5. Knowledge scores on personal mosquito-repellent methods among adult Filipinos (n = 215)

	Frequency	%
Good	12	5.58
Fair	30	13.95
Poor	173	80.47

Interestingly, 85.12% (184 participants) and 89.3% (192 participants) have positive attitude scores with the intention to modify the environment, and health-seeking attitudes, respectively (Table 6). Overall, 92.09 (198 participants) have positive attitude scores.

Table 6. Attitude scores on personal mosquito-repellent methods among adult Filipinos (n = 215)

	Frequency	%
Intention to modify environment		
Negative	32	14.88
Positive	183	85.12
Health-seeking behaviors		
Negative	23	10.7
Positive	192	89.3
Overall Attitude scores		
Negative	17	7.91
Positive	198	92.09

Not surprisingly, among the 215 respondents, there was a vast majority of mosquito-repellent methods used (Table 7). Insecticide sprays (153 respondents, 71.16%) were the most used, followed by mosquito coils (119 respondents, 55.35%), spray-in mosquito repellents with DEET (113 respondents, 55.35%), bed nets (108 respondents, 50.23%), long sleeves and/or pants (62 respondents, 28.84%), electric insect zapper, swatter or racket (62 respondents, 28.84%), essential oils or humidifiers (56 respondents, 26.05%), wearing of light-colored clothing, citronella candles, and mosquito repelling plants (31 respondents each, 14.42% each), patch or stickers (26 respondents, 12.09%), sonic repellents (9 respondents, 4.19%), wristbands or bracelets (8 respondents, 3.72%), and medications such as vitamin B or garlic pills (7 respondents, 3.26%). Although multiple mosquito-repellent methods are employed, only 45.58% (98 respondents), and 50.23% (108 respondents) use of

adult Filipino respondents only use these always and occasionally, respectively (Table 7). More than 90% (202 participants) responded that they will consult health workers for mosquito bites or symptoms of mosquito-borne diseases, while 3% will not consult, and almost 2% will go to a faith healer (Table 7).

Table 7. Practices on personal mosquito-repellent methods among adult Filipinos (n = 215)

	Number of responses (Yes)	%
Mosquito-repellent methods used		
Insecticide spray	153	71.16
Mosquito coils	119	55.35
Spray-in mosquito repellent with DEET	113	52.56
Bed nets	108	50.23
Long sleeves and/or long pants	62	28.84
Electric insect zapper, swatter or racket	62	28.84
Essential oils or humidifiers	56	26.05
Light-colored clothing	31	14.42
Citronella candles	31	14.42
Mosquito repelling plants	31	14.42
Patches or stickers	26	12.09
Sonic repellents	9	4.19
Wristbands or bracelets	8	3.72
Medications such as vitamin B or garlic pills	7	3.26
Frequency of practicing mosquito-repellent methods		
Frequent	98	45.58
Occasional to rare	108	50.23
Never	9	4.19
Person to consult for mosquito bites or symptoms of mosquito-borne diseases		
Count of Healthcare worker (doctor, nurse, and/or barangay health worker)	202	93.95
Faith healer	4	1.86
I will not consult	7	3.26

DISCUSSION

Vector-borne diseases comprise of more than 700,000 deaths per year worldwide, which mostly affect the tropical and subtropical countries, and inexplicably burden the poverty-stricken population remarkably during outbreaks. Substantial health, economic, and social burden are inflicted in the gravely affected geographic areas.² In this study, the low knowledge scores highlight the need for health education about the various mosquito-borne diseases, including their transmission,

environmental factors, cutaneous symptoms, and potentially serious side effects. Since college graduates and current students made up the majority of the respondents, fundamental health education may be targeted at these groups.

The World Health Organization (WHO) looks into preventing disease and responding to outbreaks by promoting behavioral change, improving access to water and sanitation, and vector control.¹ Most participants in this study live in areas with ponds, swamps, and other wetland habitats that may be infested by mosquitoes. Furthermore, pit latrines, which can harbor mosquito eggs, are still being used as toilet facilities. Fortunately, given that the majority of participants scored highly on attitude items overall, they are likely to be more inclined to make environmental adjustments and to follow medical recommendations. Given that most respondents reside in concrete houses, it is beneficial to note that one study found that the risk of mosquito bites was reduced in structures with cement walls.¹⁷

Access to efficacious repellent products can be challenging in developing nations with high rates of mosquito-borne illnesses. As a result, many different traditional and home treatments are utilized by a variety of communities and cultures.³ Based on their estimated monthly family income, most participants either live on or below the poverty threshold.¹⁸ Inevitably, a minority of the participants used some unconventional mosquito control methods such as mosquito-repelling plants and vitamin B or garlic pills. In more areas, many consumers may still have trouble in choosing the most cost-effective options due to the vast number of products. These may contain diverse active ingredients in different concentrations are available in the market, especially in the modern age where some non-registered ones are sold online.¹⁰ This is supported by the fact that a significant portion of our respondents use internet search engines to find information about mosquito-repellent methods. Some repellents used come in contact with the skin such as patches or stickers, wristbands, bracelets or oils, which may predispose patients to cutaneous diseases such as contact dermatitis.⁹

CONCLUSION

Data gathered on the knowledge, attitudes, and practices regarding personal mosquito-repellent methods among adult Filipinos, will guide patient education and serve as a reference for future studies on insect- or arthropod bite-related issues in the field of dermatology, particularly at the community level. Beyond treatment, emphasis should be prioritized on prevention and the

promotion of collaborative public efforts, with dermatologists playing a key role in both community and institutional settings.

RECOMMENDATIONS

Repellent methods for other insects not covered in this research, such as, but not limited to, ants, cockroaches, and ticks, may be further investigated at the community level, and extended to include pediatric and geriatric population.

REFERENCES

1. World Health Organization. *Vector-borne diseases*. Published 2021. Accessed May 2021. <https://www.who.int/news-room/fact-sheets/detail/vector-borne-diseases#:~:text=Key facts,infection transmitted by Anopheline mosquitoes.>
2. Scott TW. Dengue. In: Resh VH, Cardé RT, eds. *Encyclopedia of Insects*. 2nd ed. Elsevier; 2009:257-259. doi:10.1016/B978-0-12-374144-8.00078-3
3. Moore EL, Scott MA, Rodriguez SD, et al. An online survey of personal mosquito-repellent strategies. *PeerJ*. 2018;2018(7):1-25. doi:10.7717/peerj.5151
4. Department of Health. *2019 Dengue Monthly Report No. 8*. Published online 2019.
5. Lucas JB. The National Institute for Occupational Safety and Health. *Contact Dermatitis*. 1977;3(2):96-101. doi:10.1111/j.1600-0536.1977.tb03696.x
6. Katz TM, Miller JH, Hebert AA. Insect repellents: Historical perspectives and new developments. *J Am Acad Dermatol*. 2008;58(5):865-871. doi:10.1016/j.jaad.2007.10.005
7. Nolan T, O'Brien K, Farrar J, et al. *SAGE Working Group On Dengue Vaccines And Vaccination*. Published 2018.
8. Elston DM. Prevention of arthropod-related disease. *J Am Acad Dermatol*. 2004;51(6):947-954. doi:10.1016/j.jaad.2004.06.011
9. Nguyen Q-BD, Vu M-AN, Hebert AA. Insect repellents: An updated review for the Clinician. *J Am Acad Dermatol*. Published online 2018. doi:10.1016/j.jaad.2018.10.053
10. Lo WL, Mok KL, Dorothy S, Pui Y. Which insect repellents should we choose? Implications from results of local market survey and review of current guidelines. *Pac J Public Health*. Published online 2018. doi:10.1177/1024907918773630

11. Rodriguez SD, Chung HN, Gonzales KK, et al. Efficacy of some wearable devices compared with spray-on insect repellents for the yellow fever mosquito, *Aedes aegypti* (L.) (Diptera: Culicidae). *J Insect Sci.* 2017;17(1). doi:10.1093/jisesa/iew117
12. Yoon JK, Kim KC, Cho Y, et al. Comparison of repellency effect of mosquito repellents for DEET, citronella, and fennel oil. *J Parasitol Res.* 2015;2015:361021. doi:10.1155/2015/361021
13. Obico J, Ragragio E. A survey of plants used as repellents against hematophagous insects by the Ayta people of Porac, Pampanga Province, Philippines. *Philipp Sci Lett.* 2014;7(2):179-186.
14. Dapar M., Okwori V. E al. Mosquito repellent property of *Azadirachta Indica* extract (fruit bark and seed kernel). *Sci Res J.* 2015;3(6):1-4. www.scirj.org
15. Techavuthiporn C. *Langsat—Lansium Domesticum*. In: Preedy VR, ed. *Handbook of Food Chemistry*. Elsevier Inc.; 2018. doi:10.1016/b978-0-12-803138-4.00036-8
16. Steen CJ, Carbonaro PA, Schwartz RA. Arthropods in dermatology. *J Am Acad Dermatol.* 2004;50(6):819-842l. doi:10.1016/j.jaad.2003.12.019
17. Ngadjeu CS, Doumbe-Belisse P, Talipouo A, et al. Influence of house characteristics on mosquito distribution and malaria transmission in the city of Yaoundé, Cameroon. *Malar J.* 2020;19(1):1-14. doi:10.1186/s12936-020-3133-z
18. Philippine Statistics Authority. *Poverty Statistics Update First Semester 2021*. Published online 2021.