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Factors associated with mosquito nest eradication behavior for DHF in Boyolali Regency in 2023

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Abstract

Purpose: DHF cases in Boyolali Regency have experienced an increase in cases over the last four years, and this has been accompanied by a decrease in the ABJ index by 89%, which is an indicator of the success of the Mosquito Nest Eradication (PSN) program. This research aims to identify factors that influence PSN behavior in society. **Method:** This research uses an observational analytical study design with a cross-sectional approach. Data was collected from 331 respondents in 30 cluster analyses, namely univariate, bivariate, and multivariate, using logistic regression. **Results:** 331 respondents were found to have good PSN behavior (59.8%). The results of the multivariate analysis showed that the influencing factors were high education level (aOR 2.80; 95%CI 1.31–6.00; p-value 0.008) and region of residence, live in urban areas (aOR 0.42; 95%CI 0.26-069; p-value <0.001), have good knowledge (aOR 1.67; 95%CI 1.01-2.76; p-value <0.042), and have a good attitude (aOR 1.75; 95%CI 1.07-2.86; p-value <0.025). **Conclusion**: Factors influencing PSN behavior in Boyolali Regency include education level, place of living, attitudes, and knowledge

Keywords: behavior; dengue; eradication of mosquito nests

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INTRODUCTION

Dengue hemorrhagic fever (DHF) is an infectious disease transmitted through the mosquitoes *Aedes aegypti* and *Aedes albopictus*, which are found in many tropical and subtropical areas worldwide [1]. The World Health Organization (WHO) estimates that 2.5 billion, or 40%, of the world's population is at risk of dengue disease, especially those living in urban areas in tropical and subtropical countries. It is also estimated that 390 million dengue infections occur worldwide yearly [2]. In 2021, cases significantly increased in several countries, namely Brazil, Colombia, the Cook Islands, Fiji, India, Kenya, Paraguay, Peru, the Philippines, Vietnam, and Indonesia [3].

Seven provinces in Indonesia will have the highest number of DHF cases in 2022, including West Java, East Java, Central Java, North Sumatra, DKI Jakarta, and Banten [4]. DHF cases in Indonesia in 2023 were reported as 114,435 with 894 deaths [5]. Java is the most densely populated island, so more than 50% of DHF cases in Indonesia are found in Java [6]. DHF cases 2023 in Central Java Province were reported as 6,157, with an incidence rate of 17.86 per 100,000 population and a case fatality rate (CFR) of 2.2% [7].

DHF in Boyolali District is also a health problem that is of priority. Boyolali District is one of 35 districts or cities in Central Java that tended to increase cases in 2020–2023. In 2023, Boyolali District had the highest DHF IR compared to previous years, at 40 per 100,000 population, with 442 cases and a CFR of 1.2% (5 cases). DHF endemic areas in Boyolali District consist of 17 sub-districts spread across 20 health centers and 48 villages [8].

The primary vector of DHF is the *Aedes aegypti* mosquito, which lives in hot areas, making this disease more prevalent in urban areas than rural areas. Risk factors for DHF transmission are rapid urban population growth, population mobilization due to improved transportation infrastructure, and disrupted or weakened population control, thus allowing outbreaks to occur [9]. Prevention and control of dengue transmission to prevent the bite of the *Aedes aegypti* mosquito through 3M Plus mosquito nest eradication activities, larvacidation, and fogging, so that dengue transmission can be prevented or reduced [10].

Prevention and control of dengue vectors still rely on PSN through draining, covering, and recycling activities, and biological and chemical control activities such as temephos, mosquito repellents, and repellents [9]. Effective implementation of mosquito nest eradication will result in a house or building that is free of *Aedes aegypti* mosquito larvae, which will be evident from ABJ > 95% and HI <5% [11]. Eradicating mosquito nests is the shared responsibility of all elements of society. The community plays a vital role in vector eradication, which is the most critical effort to break the chain of transmission to eradicate DHF. One of the smallest elements is the family level [12].

Factors that influence mosquito nest eradication activities, by Lawrence Green's theory in Notoatmodjo (2003), are influenced by (predisposing factors), which are manifested in attitudes, motivation, and some individual characteristics of jumantik cadres; (enabling factors), which are manifested in the availability of information; and (reinforcing factors), which are manifested in terms of agency and family support in carrying out mosquito nest eradication [13,14].

The research results by Faizah et al. (2018) show that community participation in PSN activities greatly influences the presence of *Aedes aegypti* mosquito larvae [15]. Research conducted by Castro et al. (2013) has concluded that a person's knowledge and perception of dengue disease influence a person's mosquito nest eradication behavior [16]. These results are supported by Selvarajoo et al. (2020), who found that a person's knowledge and attitude about dengue disease influence a person's PSN behavior [17]. Based on the data and the results of the current study, the researchers wanted to know the factors associated with dengue hemorrhagic fever mosquito nest eradication behavior in Boyolali district, Central Java.

METHODS

This type of research was an observational study with a cross-sectional approach. This study shows the factors influencing mosquito nest eradication behavior in the Boyolali Regency community. The independent variables in this study are sociodemographic variables (respondent age, respondent gender, respondent education level, occupation, region, and history of illness), knowledge, attitude, information availability, and health workers' role. While the dependent variable is mosquito nest eradication behavior, Ethics Committee for Medical and Health Research, Faculty of Medicine, Public Health, and Nursing, Gadjah Mada University-RSUP Dr. Sarjito (No.. KE/FK/0191/EC/2024).

The study population consisted of people in Boyolali Regency who met the inclusive criteria: people who lived for at least one year, were more than 18 years old, and were willing to be respondents. Exclusive criteria include people who have mental disorders or physical disabilities and are not at home. Sample size calculations were obtained using the openEPI application.

(n=[DEFF*Np(1-p)]/ [($d^2/Z^2_{1-\alpha/2}$*(N-1)+p*(1-p)])

An estimated outcome of 89% (derived from the average Breeding Place Index in Boyolali District) with a degree of confidence of 95%, a precision level of 5%, and a design effect of 2 was obtained, where the total population of households in Boyolali District in 2022 was 323,269 households. This number was then added with a non-response rate of 10% so that a minimum sample size of 331 households was obtained. Data were collected from sixteen sub-districts in twenty dengue-endemic villages and thirty household clusters. Figure 1 describes sampling.

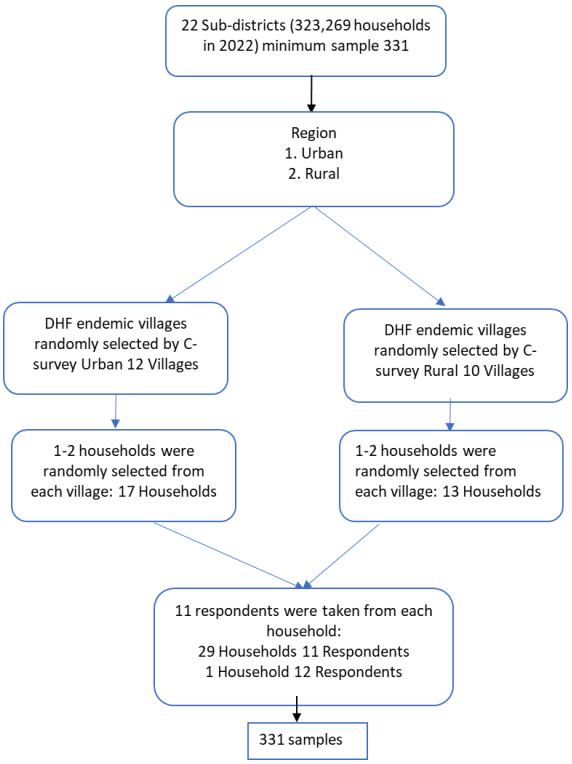

Figure 1. Flow of sampling

RESULTS

Table 1 shows characteristics of the respondent. Most respondents (77.6%) were female in the age group of 26–45 years (45%). The average education level of respondents was junior high (33.84%), with employment in the housewife/non-working group (55.9%). Based on self-reported data, almost all respondents had never been infected with dengue (97.6%), and 56.8% lived in urban areas. Most respondents' knowledge about mosquito nest eradication behavior in Boyolali Regency is good (59.8%). A total of 51.1% of attitude variables are in the good category. Availability of information in the category of 2-3 available information (69.2%), variable role of officers in the category of getting 2-3 roles (81%), and variable health counseling in the category of not getting health counseling media (58.6%).

Table 1. Characteristics of respondent (n=331)

Characteristic	n	(%)
Gender		
Female	257	77.6
Male	74	22.4
Age (years)		
18-25	16	4,8
26-45	149	45
46-55	95	28.7
>56	71	21.5
Education level		
High	48	14.5
Low	283	85.5
Work		
Employed	146	44.1
Not Working	185	55,9
History of dengue disease		
Ever	17	5.1
Never	323	94.9
Region of residence		
Urban	188	56.8
Rural	143	43.2
Knowledge		
Less	111	33.5
Good		66.5
Attitude		
Less	162	48.9
Good	169	51.1
Availability of information		
Not available	42	48.9
1-2 information available	60	18.1
3-4 information available	229	69.2
Officer role		
None	24	7.3
1 officer role	39	11.8
2 officer role	148	44.7
3 officer roles	120	36.2
Health promotion		
Did not get media	194	58.6
Get media	137	41.4

Factors associated with mosquito nest eradication behavior. The results of the bivariate test analysis showed that the variable related to mosquito nest eradication behavior ($p<0.05$) was the age category variable, with mosquito nest eradication behavior in the community being 2.38 (95% CI: 0.77–7.34; p-value <0.021). This indicates that people with an age category of>56 years have a 2.38 times higher chance of good PSN behavior than those aged 18–25. (95% CI: 1.23-5.24; p-value <0.008). The correlation between education level and mosquito nest eradication behavior in the community was 2.54 (95% CI: 1.23-5.24; p-value <0.008). This indicates that people with a high education category are 2.54 times more likely to have good mosquito nest eradication behavior than those with low education.

The variable of region of residence with mosquito breeding behavior in the community was 0.38 (95% CI: 0.24-0.61; p-value<0.001). This result significantly correlates with people living in rural areas having a 62% lower chance of good PSN behavior than those living in urban areas. The correlation between knowledge category and community mosquito nest eradication behavior was 1.78 (95% CI: 1.11-2.85; p-value<0.014). This result is significantly related to the fact that people with good knowledge have a 1.78 times higher chance of having good mosquito nest eradication behavior than people without knowledge.

Table 3. Multivariate analysis results: factors associated with mosquito nest eradication behavior in Boyolali District

Variabel	aOR	CI 95%	*P-value*
Gender			
Female	1.38	0.75-2.53	0.294
Male	Ref		
Age (years)			
18-25	1.86	0.57-6.05	0.297
26-45	1.65	0.53-5.15	0.382
46-55	0.91	0.30-2.74	0.871
>56	Ref		
Education level			
High	2.80	1.31-6.00	**0.008**
Low	Ref		
Region of residence			
Urban	0.42	0.26-0.69	**<0.001**
Rural	Ref		
Knowledge			
Less	1.67	1.01-2.76	**0.042**
Good	Ref		
Attitude			
Less	1.75	1.07-2.86	**0.025**
Good	Ref		
Officer role			
3 officer roles	0.40	0.14-1.17	0.082
2 officer roles	0.59	0.22-1.62	0.313
1 officer roles	0.69	0.21-2.29	0.554
No officer role	Ref		

The variable category of attitude with mosquito nest eradication behavior in the community is 1.82 (95% CI: 1.16-2.86; p-value <0.008). This result significantly correlates with people with good attitudes having a 1.82 times higher probability of having good mosquito nest eradication behavior than people with poor attitudes. Table 2 describes the bivariate analysis.

After conducting bivariate analysis, multivariate analysis was continued to determine the relationship of more than one independent variable to one dependent variable. Variables that had a p-value <0.25 in the bivariate analysis, namely age category, gender, education level, region, knowledge level, attitude, and officer role, were included in the multivariate analysis using logistic regression.

After adjusting for multivariate analysis, it was found that education level was the most influential variable on mosquito nest eradication behavior in the community. This result is significantly related to the fact that people with higher education levels have 2.80 times higher odds of having good mosquito breeding behavior compared to those with poor mosquito breeding behavior after adjusting for other variables. Table 3 describes multivariate analysis.

Table 2. Bivariate analysis results: factors associated with mosquito nest eradication behavior in Boyolali District

Variables	Behavior of mosquito nest eradication				OR	CI 95%	*P-value*
	Good		Less				
	n	%	n	%			
Gender							0.070
Female	51	68.9	23	31.8	1.65	0.95-2.88	
Male	147	57.2	110	42.8	Ref		
Age (years)							**0.021**
18-25	50	70.4	21	29.6	2.38	0.77-7.34	
26-45	63	66.3	32	33.7	1.96	0.66-5.80	
46-55	77	51.7	72	48.3	1.06	0.38-3.00	
>56	8	50	8	50	Ref		
Education level							**0.008**
High	37	77	11	23	2.54	1.23-5.24	
Low	161	56.9	122	43.1	Ref		
Work							0.547
Employed	90	61.6	56	38.4	1.14	0.73-1.78	
Not Working	108	58.4	77	41.6	Ref		
History of dengue disease							0.931
Ever	188	59.9	126	40.1	1.04	0.38-2.82	
Never	10	58.8	7	41.2	Ref		
Region of residence							**<0.001**
Urban	67	46.9	76	53.1	0.38	0.24-0.61	
Rural	131	69.7	57	30.3	Ref		
Knowledge							**0.014**
Less	142	64.6	78	35.4	1.78	1.11-2.85	
Good	56	50.5	55	49.5	Ref		
Attitude							**0.008**
Less	113	66.9	85	52.4	1.82	1.16-2.86	
Good	56	33.1	77	47.5	Ref		
Availability of information							0.338
3-4 information available	131	57.2	98	42.8	0.39	0.37-1.47	
1-2 information available	40	66.7	20	33.3	0.80	0.48-2.55	
Not available	27	64.3	15	35.7	Ref		
Health promotion							0.641
Get media	84	61.3	53	38.7	1.11	0.71-1.74	
Did not get media	114	58.8	80	41.2	Ref		
Officer role							0.243
3 officer roles	64	53.3	56	46.6	0.57	0.37-3.36	
2 officer roles	91	61.5	57	38.5	0.79	0.31-1.99	
1 officer roles	27	69.2	12	30.7	1.12	0.37-3.36	
No officer role	16	66.7	8	33.3	Ref		

DISCUSSION

The prevention and eradication of DHF can be carried out effectively and entirely if there is community participation in eliminating mosquito larvae, which we usually call the behavior of eradicating mosquito nests, and implementing 3M plus actions [10]. The main objective of the 3 M+ behavior is to eliminate the causative vector from the time it becomes a mosquito larva. By eradicating mosquito larvae early on, there will be no adult mosquitoes, thus reducing the number of dengue transmissions.

The indicator used in the mosquito nest eradication program is the presence of mosquito larvae around the house, which is the main factor causing dengue infection. In his study [18], he explained that the larva-free rate is a good parameter for implementing mosquito nest eradication. During the last four years, the number of dengue cases has increased in Boyolali District [8]. Therefore, mosquito nest eradication activities continue to be one of the dengue control measures.

Age category variables are not associated with mosquito nest eradication behavior, which aligns with Dewi and Azam's research (2017), which states that there is no relationship between age and the practice of eradicating DHF mosquito nests [12]. Most respondents' age variables, namely 26–45 years, are productive. The results obtained seem to contradict the reality that occurs in society. Most people place great expectations on population groups with older ages.

The gender variable was predominantly female. Pujiyanti and Irawan (2015) suggested that there is a relationship between gender and mosquito nest eradication behavior [19]. Still, on the contrary, the findings in this study were that there was no significant relationship between gender and mosquito nest eradication behavior [19]. Since the prevention and control of DHF are everyone's full responsibility, men and women have the same responsibility to carry out vector eradication measures. In addition, the respondents in this study were primarily women and housewives.

The cultural factor in Indonesia that considers women more responsible for maintaining family health by preventing dengue vectors certainly influences people's desires. Homemakers usually spend more time at home doing cleaning activities. The task and responsibility of cleaning the house are routine tasks, not the essence of dengue prevention [6].

The education level category is related to mosquito nest eradication behavior, which aligns with Rusadi & Putra's research (2020), which states that education is significantly associated with dengue prevention efforts [20]. The higher a person's level of education, the easier it will be. Education is needed to obtain information that supports health and improves quality of life. Education affects how a person thinks, acts, and makes decisions when taking action. The higher the mother's education, the better her knowledge and understanding of health. A person with a good education will have the effort to achieve goals and have behavior guided by the guidance of health values [21].

A history of dengue disease has no relationship with mosquito nest eradication behavior. This study differs from Kulsum et al. (2023), which states that respondents with PSN and 3M+ activities are not good and have a 23% higher risk of DHF than respondents whose PSN and 3M+ activities are good [22]. Research from Wong et al. (2014) found a weak positive association between preventive measures and the incidence of dengue IgG seropositives [23]. In addition, Wiratama (2014) said that good preventive behavior does not necessarily reduce the risk of dengue disease incidence. The specific target of these preventive measures is unclear, so it will be difficult to achieve [24]. However, individuals who have a previous history of dengue disease usually feel more at risk and worry if other family members get dengue disease. They will actively seek information about prevention and control from health workers and the media.

There is no relationship between work and mosquito nest eradication behavior in Boyolali District, in line with Dewi & Azam's research (2017) showing that there is a relationship between work and the practice of eradicating DHF mosquito nests in Mulyoharjo Village, Jepara District, Jepara Regency [12]. In contrast, Wulandari's research (2013) states that work is associated with mosquito nest eradication behavior in mothers. The type of work of respondents was generally not working (75.9%) and daily only in the home environment [21]. In contrast to the analytical study in Boyolali District, the type of work was dominated by not working, but there was no association with mosquito nest eradication behavior. Although respondents were busy with their work, they still took the time to practice mosquito nest eradication at least once a week or on holidays for mosquito nest eradication activities.

The region of residence has a relationship with mosquito nest eradication behavior in the community, which is a weak positive relationship that people living in rural areas have a positive relationship with mosquito nest eradication behavior. In line with research by Safira (2022), it is stated that the low level of mosquito nest eradication in villages compared to urban areas is influenced by low knowledge due to low

education level [25]. The low knowledge in question reduces the potential for inundation caused by ignorance in sorting out what items can cause inundation, adding to the potential for increased mosquito breeding.

The knowledge variable has a relationship with PSN behavior in the community, in line with researchers Sutriyawan (2022), who stated that a person who takes action to eradicate mosquito nests through 3M Plus can be influenced by their level of knowledge [9]. Most of the respondents in this study who performed good mosquito nest eradication behaviors were respondents who had good knowledge about mosquito nest eradication, and vice versa. According to the researcher, the higher a person's knowledge about mosquito nest eradication, the more awareness they will have to carry out mosquito nest eradication actions.

Knowledge motivates people to take action, but it does not always determine their actions. People will behave healthily if they think it is good for them or what they want. People know how to eradicate mosquito nests to eradicate mosquito larvae, but do they believe that doing so will eliminate *Aedes aegypti* mosquitoes or reduce the number of mosquito larvae, thereby protecting them from dengue infection [26].

Attitude is a reaction or response that remains closed to a stimulus or object. As a result, the manifestation of attitudes cannot be seen directly but can only be interpreted [14]. This research shows a significant relationship: people with good attitudes behave better in eradicating mosquito nests than people with nasty attitudes. This is in line with research that states that a positive attitude towards the implementation of eradicating mosquito nests will encourage someone to carry out actions to eliminate mosquito nests well [12].

Green's theory states that attitudes influence health behavior. The findings of this study support this theory. The more positively someone views something, the better they act [13]. A person's attitude towards dengue fever is influenced by knowledge about dengue fever; both are essential components of mosquito nest eradication practices [27]. Knowledge and attitudes will undoubtedly lead to good practices for eradicating mosquito nests. In line with this research, behavior is significantly related to attitudes and knowledge regarding mosquito nest eradication behavior.

The availability of information does not have a significant relationship with mosquito nest eradication behavior, in line with research by Widiyaning (2018), which states that there is no relationship between the availability of information facilities and respondents' practices in preventing dengue fever [28]. In contrast to research, Liestyana (2019) states that there is a significant relationship between the availability of information and behavior in eradicating mosquito nests [29]. Green's theory states that the availability of information is a medium for health education to convey health information using educational tools to make it easier for the public to receive health messages. Green stated that the availability of information is an enabling factor for the occurrence of a behavior.

The variable role of officers has no relationship with the behavior of eradicating mosquito nests, in line with research Liestyana (2019) that states that the role of health officers is not a factor related to the behavior of eradicating mosquito nests [29]. Health workers are essential members of a health group because of their knowledge about local conditions. The health education variable was not related to the behavior of eradicating mosquito nests, in line with research by Elisabeth (2023), which stated that there was no significant effect when pretesting and posttesting were carried out in the control group [30]. The information obtained by the control group was still lacking, so information regarding eradicating mosquito nests was still lacking. And respondents also still lack awareness about the benefits of adequately eradicating mosquito nests. The poor implementation of 3M Plus mosquito nest eradication measures shows that there is still a lack of public awareness of the importance of maintaining the cleanliness of the house and the environment around the residence to prevent the occurrence of dengue fever.

CONCLUSION

Factors related to the behavior of eradicating mosquito nests in communities are the education level at risk, area of residence, attitudes, and knowledge in Boyolali Regency. People with higher education are 2.80 times more likely to have good PSN behavior; people who live in urban areas are 68% more likely to have good PSN behavior; people with good knowledge are 1.67 times more likely to have good PSN behavior; and people who have good PSN attitudes are 1.75 times more likely to behave well.

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