



Vector Contact Prevention Behaviors During Filariasis Mass Drug Administration: 2023 Indonesian Health Survey

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Abstract

Filariasis remains a public health problem in Indonesia, where disease control includes mass drug administration (MDA), management of chronic cases, and prevention of contact with mosquito vectors. Vector-contact prevention behaviours should be considered during MDA implementation to support the national goal of eliminating filariasis by 2030. This study aimed to examine vector-contact prevention behaviours associated with positive filariasis cases using secondary data from the 2023 Indonesian Health Survey. A cross-sectional design was applied to data from 877,531 respondents across all provinces of Indonesia. Multivariate logistic regression was used to identify behavioural factors associated with filariasis positivity. Sleeping without a non-insecticide-treated mosquito net was associated with a higher risk of filariasis (PR = 1.182; 95% CI: 1.138–1.227). Similarly, not using an insecticide-treated mosquito net for less than three years (PR = 1.450; 95% CI: 1.353–1.555), not using one for more than three years (PR = 1.439; 95% CI: 1.336–1.550), and not using mosquito repellent (PR = 1.130; 95% CI: 1.075–1.188) were associated with increased filariasis positivity. The strongest behavioural predictor was not using an insecticide-treated mosquito net for less than three years. Promoting its use in filariasis-endemic areas with *Anopheles* as the main vector may strengthen MDA implementation. However, the cross-sectional design precludes causal inference.

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1. INTRODUCTION

Filariasis is a disease caused by infection with nematode worms from the genus *Filaria*, which consists of 3 types in Indonesia, namely *Wuchereria bancrofti*, *Brugia malayi*, and *Brugia timori* (WHO, 2026). WHO (World Health Organization) data states that filariasis affects more than 120 million people in 72 countries throughout the tropical and subtropical regions of Asia, Africa, the Western Pacific, and parts of the Caribbean and South America (WHO, 2026). Accumulated data on filariasis prevalence indicates that more than 657 million people in 39 countries worldwide are still threatened by lymphatic filariasis and require mass drug administration (MDA) (WHO, 2024). The manifestation of this disease is that it can cause lymphedema and also elephantiasis if the positive case of worms in the blood is more than 5 years, and can cause permanent disability (WHO, 2026). Filariasis is transmitted by various mosquito genera, including *Culex*, *Anopheles*, *Aedes*, *Armigeres*, and *Mansonia*. In Indonesia, *Culex* is often found in endemic urban areas as the primary vector of filariasis (Nafilata et al., 2025). Furthermore, other mosquito genera are commonly found in rural filariasis-endemic areas (WHO, 2026).

Filariasis control includes a mass drug administration program to break the chain of transmission in endemic areas and treatment of chronic cases, as well as vector control by avoiding contact (bites) with vectors. More than 9.7 billion cumulative treatments have been administered to stop the spread of infection since 2000, with approximately 51 million people infected, leading to a 74% reduction in the number of cases in 2018, since the start of the Global Programme to Eliminate Lymphatic Filariasis (GPELF) (WHO, 2024). The success of the WHO's implementation strategy in the program means that 871 million people no longer need mass drug administration (WHO, 2024). Furthermore, vector control is an additional strategy supported by the WHO to reduce the transmission of filariasis and other mosquito-borne infections. Vector control, such as the use of insecticide-treated mosquito nets, indoor residual spraying, and personal protection, can protect against filariasis infection (WHO, 2026). In areas endemic for filariasis with the main vector being *Anopheles*, the use of insecticide-treated mosquito nets is effective in preventing the transmission of filariasis, both during and after mass drug administration. Data suggest that vector control in some endemic areas has contributed to the elimination of filariasis without mass drug administration interventions (WHO, 2026).

Based on data from the 2023 Indonesian Health Survey, the prevalence of filariasis across age groups shows that Central Papua Province has the highest prevalence of 4.8%, compared to other provinces. Whereas the lowest proportion of mass drug administration was in South Sulawesi Province at 13.4%, compared with other provinces. The lowest proportion of filariasis medication consumption was in the Papua Mountains Province at 47.6%, compared to other provinces in Indonesia (Kementerian Kesehatan Republik Indonesia, 2023). Previous research showed that the first stage of the Transmission Assessment Survey (TAS) in the endemic area of Ambon City showed that the Mf (microfilaria) rate was 0.08%, which indicates that the transmission of filariasis in Ambon City has been successfully reduced (Tulak et al., 2024). Furthermore, based on 2023 SKI data, there was a behaviour to prevent contact with vectors during the implementation of the mass drug administration program. These preventive behaviours are sleeping using mosquito nets without insecticide, sleeping using mosquito nets with insecticide for <3 years, sleeping using mosquito nets with insecticide for >3 years, use of repellents, use of mosquito repellents (burning, spraying, electric). Other data suggest that a positive diagnosis of filariasis is also related to behaviours that prevent contact with vectors, furthermore, to control mass drug administration.

While Mass Drug Administration (MDA) remains the cornerstone of filariasis elimination programs, its effectiveness may be influenced by individual behaviours related

to vector exposure (Mohanty et al., 2024). Antifilarial drugs, including Diethylcarbamazine citrate (DEC), Albendazole, and Ivermectin, primarily target microfilariae and have limited direct effects on adult worms (Hanalily et al., 2025; Khaemba et al., 2025). As a result, transmission may persist in endemic communities when exposure to mosquito vectors continues, particularly among individuals who do not participate in MDA (Lawford et al., 2025). However, evidence on protective behaviors that reduce human-vector contact during MDA implementation is limited, especially at the national level. This knowledge gap highlights the need to investigate behavioral factors associated with filariasis occurrence in order to support more comprehensive elimination strategies. This research with secondary data aims to explain the behaviour of preventing contact with vectors during the implementation of mass filariasis treatment in association with filariasis diagnosis data. This needs to be done to find out whether preventive measures, such as contact with vectors, need to be increased or not, furthermore, to determine the effectiveness of mass drug administration, to achieve filariasis elimination by 2030.

2. METHODS

This research was based on secondary data in the form of the Indonesia Health Survey 2023, which was conducted by the Indonesian Health Ministry. The research design is cross-sectional, with individual data collection using a structured questionnaire. This research explored the Indonesian Health Survey 2023 about the preventive behaviour of contact with vectors for filariasis diagnosis, as a prediction towards filariasis elimination by 2030 in Indonesia. The total sample was 877.531 respondents covering all districts/cities endemic to filariasis in all provinces in Indonesia. A cluster-stratified proportional sampling approach was employed in this study. The inclusion criteria comprised provinces classified as filariasis-endemic areas and covered by the Mass Drug Administration (MDA) program. Records with missing or incomplete information on behaviours related to the prevention of vector contact were excluded from the analysis. This study aimed to develop a predictive model for filariasis diagnosis based on behavioral determinants associated with vector-contact prevention. The independent variables included sleeping using a mosquito net without insecticide, sleeping using a mosquito net with insecticide for <3 years, sleeping using a mosquito net with insecticide for >3 years, and use of mosquito repellents including coils, sprays and electric repellents. All independent variables were dichotomized into “Yes” and “No” categories. No adjustment for potential confounding variables was performed in the present analysis. The national survey weighting procedure has been applied in this study and data analysis using logistic regression with a 95% confidence interval.

3. RESULTS AND DISCUSSION

This study employed multivariate logistic regression. The following section presents the results of (1) frequency distributions of respondents' characteristics and behaviours, (2) chi-square analysis examining the relationship between preventive behaviours and contact with vectors, and (3) multivariate logistic regression identifying behaviours most strongly associated with filariasis diagnosis. The results are presented below:

Table 1. Frequency distribution of respondent characteristics and behaviour (n = 877531)

Variable	Frequency	Percentage (%)
Gender		
Male	414262	47.2
Female	463269	52.8
Age		

Infants, Toddlers, Children	198901	22.7
Adolescent	85327	9.7
Adult	495964	56.5
Old	97339	11.1
Marital Status		
Single	351053	40.0
Marriage	469895	53.5
Divorce	12267	1.4
Divorce by death	44316	5.1
Highest Education		
Unknown	86364	9.8
Never/ Never been to school	74437	8.5
Did not finish primary school	127445	14.5
Graduated from primary school	188274	21.5
Graduated from junior high school	131201	15.0
Graduated from senior high school	197391	22.5
Graduated from Diploma 1, Diploma 2, Diploma 3	30224	3.4
Graduated from college	42195	4.8
Employment Status		
Unknown	166244	18.9
Doesn't work	205942	23.5
School	105301	12.0
Civil servants/ military/police/ state-owned enterprises/regionally-owned enterprises	31143	3.5
Private employees	51255	5.8
Self-employed	89178	10.2
Farmer	130733	14.9
Fisherman	9070	1.0
Labourer/ driver/ domestic helper	35920	4.1
Other	52745	6.0
Sleeping using mosquito nets without insecticide		
Yes	208875	23.8
No	668656	76.2
Sleeping using insecticide-treated mosquito net for <3 years		
Yes	38281	4.4
No	839250	95.6
Sleeping using insecticide-treated mosquito net for >3 years		
Yes	33013	3.8
No	844518	96.2
Use of repellents		
Yes	100829	11.5
No	776702	88.5
Use of mosquito repellents (burning, spraying, electric)		
Yes	462103	52.7

No	415428	47.3
Diagnosed with filariasis		
Never	863250	98.4
Ever Diagnosed	14281	1.6

Females constituted the highest proportion of respondents (52.8%), compared to males. Adults represented the largest age group (56.5%). Married respondents accounted for the largest proportion (53.3%). Respondents who graduated from high school represented the largest educational group (22.5%). Unemployed respondents constituted the largest employment category (23.5%). The majority of respondents (76.2%) did not use mosquito nets without insecticide while sleeping, compared to those who used insecticide-treated nets. The proportion of respondents who had not used insecticide-treated mosquito nets for less than 3 years was 95.6%. Similarly, 96.2% had not used such nets for more than 3 years. A majority of respondents (88.5%) did not use repellents. Respondents who used mosquito repellents (burning, spraying, or electric) accounted for 52.7%, compared to those who did not. Most respondents (98.4%) had never been diagnosed with filariasis.

Table 2. Association contact with vectors behaviour preventive with filariasis diagnosis (n = 877531).

Variable	Diagnosed with filariasis				PR (95% CI)	p
	Never		Ever Diagnosed			
	n	%	n	%		
Sleeping using mosquito nets without insecticide						
Yes	205054	98.2	3821	1.8	1.173 (1.130-1.217)	<0.001
No	658196	98.4	10460	1.6		
Sleeping using insecticide-treated mosquito net for <3 years						
Yes	37329	97.5	952	2.5	1.580 (1.479-1.689)	<0.001
No	825921	98.4	13329	1.6		
Sleeping using insecticide-treated mosquito net for >3 years						
Yes	32181	97.5	832	2.5	1.598 (1.488-1.715)	<0.001
No	831069	98.4	13449	1.6		
Use of repellents						
Yes	99026	98.2	1803	1.8	1.115 (1.061-1.172)	<0.001
No	764224	98.4	12478	1.6		
Use of mosquito repellents (burning, spraying, electric)						
Yes	454789	98.4	7314	1.6	0.943 (0.912-0.975)	0.001
No	408461	98.3	6967	1.7		

Chi-square analysis indicated that respondents who did not use non-insecticide-treated mosquito nets had a 1.173 times higher risk of testing positive for filariasis (PR = 1.173, 95% CI: 1.130–1.217) compared to those who used such nets. Respondents who

did not use insecticide-treated mosquito nets for less than 3 years had a 1.580 times higher risk of testing positive for filariasis (PR = 1.580, 95% CI: 1.479–1.689) compared to those who used them. Similarly, respondents who did not use insecticide-treated mosquito nets for more than 3 years had a 1.598 times higher risk (PR = 1.598, 95% CI: 1.488–1.715). Respondents who did not use repellent had a 1.115 times higher risk of testing positive for filariasis (PR = 1.115, 95% CI: 1.061–1.172) compared to those who used repellent.

Based on the data analysis, variables with a p-value < 0.25 were included as candidates in the multivariate logistic regression analysis. The final results of the multivariate logistic regression model are as follows:

Table 3. Final modelling of vector contact prevention behaviour with filariasis diagnosis results (n = 877531).

Variable	p-value	PR	95% CI	
			Lower	Upper
Sleeping using mosquito nets without insecticide				
Yes	< 0.001	Ref	1.138	1.227
No		1.182		
Sleeping using insecticide-treated mosquito net for <3 years				
Yes	< 0.001	Ref	1.353	1.555
No		1.450		
Sleeping using insecticide-treated mosquito net for >3 years				
Yes	< 0.001	Ref	1.336	1.550
No		1.439		
Use of repellents				
Yes	< 0.001	Ref	1.075	1.188
No		1.130		

The final multivariate logistic regression modelling obtained a fit model to predict vector contact prevention behaviour against a positive diagnosis of filariasis, namely a model that includes 4 variables: Sleeping using mosquito nets without insecticide, Sleeping using mosquito nets with insecticide for <3 years, Sleeping using mosquito nets with insecticide for >3 years, and Use of repellents. Respondents who slept without using mosquito nets without insecticide had a 1,182 times (95% CI : 1.138-1.227) of developing a positive filariasis compared to respondents who used mosquito nets without insecticide after controlling for the variables sleeping using mosquito nets with insecticide for <3 years, sleeping using mosquito nets with insecticide for >3 years and Use of repellents. Respondents who slept without using mosquito nets with insecticide for <3 years had a 1,450 times (95% CI : 1.353-1.555) higher of developing a positive filariasis compared to respondents who slept using mosquito nets with insecticide for <3 years after controlling for the variables sleeping using mosquito nets without insecticide, sleeping using mosquito nets with insecticide for <3 years and use of repellents. Respondents who slept without using mosquito nets with insecticide for >3 years had a 1,439 times (95% CI : 1.336-1.550) higher of developing a positive filariasis compared to respondents who slept using

mosquito nets with insecticide for >3 years after controlling for the variables sleeping using mosquito nets without insecticide, sleeping using mosquito nets with insecticide for <3 years and use of repellents. Respondents who do not use repellents had a 1,130 times (95% CI : 1.075-1.188) higher of a positive filariasis compared to respondents who use repellents after controlling variables for sleeping using mosquito nets without insecticide, sleeping using mosquito nets with insecticide for <3 years and sleeping using mosquito nets with insecticide for >3 years. The dominant variable predicting positive filariasis incidents is the behavior of sleeping using mosquito nets with insecticide for <3 years, which is shown by the largest PR value.

DISCUSSION

Sleeping using mosquito nets without insecticide

In the multivariate logistic regression model, the results showed that sleeping without using a mosquito net without insecticide had a risk of 1,182 times (95% CI: 1,138-1,227) for positive filariasis. Sleeping using a mosquito net is something that is done in areas endemic to filariasis, especially areas with anopheles mosquitoes as the vector, because anopheles is the main vector for malaria transmission, so in areas endemic to filariasis with anopheles vectors, it is recommended to use mosquito nets, adopting the behaviour carried out in malaria endemic areas (Center Disease Control and Prevention, 2024). Therefore, although mosquito nets are generally used in malaria endemic areas, they are also used in filariasis endemic areas with anopheles as the vector. Insecticide-free mosquito nets can prevent contact with vectors, but are less effective in killing mosquitoes that transmit filariasis. This is because the mosquito net does not contain chemicals to kill the vector that transmits filariasis, namely mosquitoes. Insecticides that are usually added to mosquito nets contain active chemicals from the pyrethroid group which are recommended by WHO to reduce the number of disease vectors (Uliviana et al., 2021). Previous research has shown that insecticide-treated mosquito nets are better for use in endemic urban and rural areas in terms of behaviour in preventing contact with disease vectors, but there is still a need to increase knowledge in the use and utilization of insecticide-treated mosquito nets (Hermawan, 2021).

Furthermore, housing characteristics and surrounding environmental conditions may influence the effectiveness of vector-contact prevention measures. Previous research found that the absence of wire netting on household ventilation was associated with a higher likelihood of filariasis infection, potentially due to increased indoor exposure to nocturnally active mosquito vectors ($p = 0,441$ OR : 2,04) (Rahmat et al., 2020). Similarly, the presence of bushes around household areas has been reported as a significant environmental risk factor for filariasis because such vegetation provides suitable resting habitats for mosquito vectors (Bulu & Weraman, 2021). Filariasis vectors that rest in bushes at night can enter the house through ventilation that is not fitted with wire netting, to carry out biting activities. Therefore, behavioural interventions such as the installation of wire netting on the household ventilation system require to be implemented, because it is difficult to implement environmental modification.

Sleeping using insecticide-treated mosquito net for <3 years

In the multivariate logistic regression model, the results showed that sleeping without using an insecticide-treated mosquito net for <3 years had a risk of 1,450 times (95% CI: 1,353-1,555) for positive filariasis. This is because insecticide-treated mosquito nets contain chemicals that can kill mosquitoes that transmit diseases, including filariasis. Based on previous research, insecticide-treated mosquito nets used for <3 years,

including use for <1 year, have an effectiveness of knocking down mosquitoes by 92% and causing 80% mortality, and use for 1-2 years is able to knock down mosquitoes by 92.6% and causing 78% mortality (Pahlepi et al., 2024). This indicates that the use of insecticide-treated mosquito nets for <3 years is still effective for controlling vector-borne diseases, including filariasis. The insecticide contained in Long-lasting insecticide-treated nets (LLINs) is usually a type of pyrethroid insecticide along with other addictive substances, in mosquito nets made from synthetic polymers including polyethylene and polyester (Brake et al., 2022). Furthermore, the efficacy of insecticidal mosquito nets can decrease after washing. Previous research stated that a mixture of lambda cyhalothrin and deltamethrin insecticides can kill 100% of mosquitoes up to 30 times after washing the mosquito net compared to permethrin insecticide (Hakim et al., 2008).

Sleeping using insecticide-treated mosquito net for >3 years

In the multivariate logistic regression model, the results showed that sleeping without using insecticide-treated mosquito nets for >3 years had a risk of 1.439 times (95% CI: 1.336-1.550) for positive filariasis, this shows a smaller PR value than not using insecticide-treated mosquito nets for <3 years. Based on previous research, it was stated that the use of insecticide-treated mosquito nets for >2 years was able to knock down 75.2% of mosquitoes and cause mortality of 67.8%, this shows a decrease in effectiveness compared to the use of mosquito nets for <1 year and 1-2 years (Pahlepi et al., 2024). This shows that the longer insecticide-treated mosquito nets are used, the more the effectiveness of the insecticide-treated mosquito nets will decrease. Other research states that sleeping under insecticide-treated mosquito nets is effective in reducing vector-borne diseases (Wubishet et al., 2021). Furthermore, other research also states that the best period of use for mosquito nets is less than 6 months, taking into account the correct method of washing mosquito nets (Nurmaliani & Arisanti, 2021).

Use of repellents

In the multivariate logistic regression model, the results showed that not using repellents had a 1.130 times risk (95% CI: 1.075-1.188) of being positive for filariasis. Repellents are mosquito repellents with various types, one of which is a repellent in the form of a cream with various ingredients contained in the cream repellent. One of them is Citronella oil (lemongrass oil) which can produce a natural aroma to repel mosquitoes (Ambari & Sueni, 2019). Repellents containing natural ingredients or repellents containing other ingredients can be used at night because most filariasis vector bionomics have biting activity at night, one of which is from the genus *Culex* (Shidqon, 2016). Furthermore, mosquitoes from the genera *Anopheles*, *Armigeres* and *Mansonia* also have biting activity at night (Djafar et al., 2023).

While this study focused on behaviours aimed at preventing contact with mosquito vectors (sleeping using mosquito nets without insecticide, sleeping using insecticide-treated mosquito net for <3 years, sleeping using insecticide-treated mosquito net for >3 years, Use of repellents). Environmental conditions such as inadequate sewerage systems and the presence of mosquito breeding places may increase opportunities for vector proliferation and human-vector contact. Evidence from Kuningan District demonstrated that poor sewerage systems were significantly associated with filariasis incidence ($p = 0,041$, $OR = 3,667$) (Annashr & Amalia, 2021). Likewise, research conducted in Semarang City found that the presence of mosquito breeding places was a significant risk factor for filariasis ($0,017$, $OR = 8,636$; $CI\ 95\%: 1,593-46,807$) (Pertiwi & Darundiati, 2019). Therefore, effective filariasis control requires not only behavioral

interventions to reduce vector contact but also environmental management such as sewerage system improvement measures aimed at reducing vector breeding habitats.

Based on the explanation above, it is still necessary to carry out preventative behaviour regarding contact with vectors during the implementation period of the mass filariasis treatment program, such as the use of repellents and the use of insecticide-treated mosquito nets while sleeping. This is important to decrease cases of vector-borne diseases, especially filariasis. Consistent with previous evidence, mosquito net use has been demonstrated to reduce vectors exposure to humans and important role in preventing filariasis transmission in endemic areas (Ismili et al., 2024).

4. CONCLUSION

Filariasis prevention during the implementation of mass treatment programs, particularly in endemic areas where *Anopheles* is the primary vector, should include the use of insecticide-treated mosquito nets for less than 3 years and the replacement of nets after more than 3 years of use. Furthermore, the use of repellents at night should be increased. These measures aim to support the elimination of filariasis by 2030. The limitation of this study is secondary cross-sectional data without longitudinal evidence that unexplained temporality of causal relationship. Therefore, It can't imply direct effectiveness.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Ikrimah Nafilata contributed to the conceptualization and design of the study, data collection, formal analysis, interpretation of the findings, and preparation of the initial manuscript draft. Yuli Puspita Devi contributed to the study design, methodological supervision, data analysis, interpretation of the findings, and critical revision of the manuscript for important intellectual content. Roma Yuliana contributed to the literature review, data collection, interpretation of the findings, and critical revision of the manuscript. Aulia Rahman contributed to interpretation of the findings, and critical revision of the manuscript for important intellectual content. All authors reviewed and approved the final version of the manuscript for publication and agreed to be accountable for all aspects of the work.

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DECLARATION OF ARTIFICIAL INTELLIGENCE USE

The authors declare that artificial intelligence (AI) tools were used solely to assist with language editing, grammar checking, and improving the clarity and readability of the manuscript. AI tools were not used to generate, fabricate, or manipulate research data, results, or scientific findings. All content produced or revised with AI assistance was critically reviewed and verified by the authors, who retain full responsibility for the accuracy, integrity, originality, and final content of the manuscript.

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