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Adherence to mass drug administration and environmental factors related to lymphatic filariasis incidence: A case-control study in endemic area, Papua, Indonesia

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Abstract

Papua has the highest number of lymphatic filariasis cases in Indonesia. Despite the implementation of mass drug administration (MDA), adherence to MDA remains low in this region. The aim of this study was to evaluate the influence of adherence to MDA and environmental factors on the incidence of lymphatic filariasis. The study was conducted in 11 areas in Sarmi Regency, Papua, in 2024. This case-control study included 135 respondents (45 cases and 90 controls) selected through a proportional random sampling method. Data were collected via structured interviews, observations, and medical record reviews. Data analysis was performed using logistic regression with the backward likelihood ratio method to identify risk factors. The study revealed that male (aOR: 4.88; 95%CI: 1.39–17.06; p=0.013), age ≥40 years (aOR: 4.65; 95%CI: 2.26–7.00; p=0.002), low education level (aOR: 0.24; 95%CI: 0.07–0.84; p=0.025), and income below the regional minimum wage (aOR: 15.66; 95%CI: 1.84–30.26; p=0.012) were significant risk factors for lymphatic filariasis incidence. Non-consumption of complete antifilarial drugs (aOR: 3.24; 95%CI: 1.00–10.50; p=0.050), not taking antifilarial drugs at the recommended time (aOR: 7.36; 95%CI: 1.99–27.23; p=0.003), and delayed consumption of antifilarial drugs (aOR: 3.73; 95%CI: 1.09–12.73; p=0.036) were adherence-related factors associated with an increased risk. Furthermore, not wearing long-sleeved clothing at night (aOR: 6.73; 95%CI: 1.81–24.94; p=0.004) was significantly associated with lymphatic filariasis incidence. The dimensions of MDA medication adherence, including the consumption of preventive antifilarial drugs, night-time dosing, and immediate consumption of antifilarial drugs after distribution, were associated with lymphatic filariasis incidence in Papua. This study suggests that MDA programs against filariasis in endemic areas need to be supported by adherence-focused interventions to enhance the effectiveness of prevention efforts.

Keywords: Lymphatic filariasis, medication adherence, environment, endemic, Papua

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Introduction

Lymphatic filariasis is an infectious disease caused by filarial worms that inhabit the lymphatic vessels and nodes, leading to permanent disability and weakening of the body [1]. Lymphatic filariasis remains a significant public health problem, particularly in tropical and subtropical

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countries [2]. Globally, the prevalence of lymphatic filariasis in 2021 was 52%, with an estimated 51.4 million people infected [3]. In Southeast Asia, the prevalence is approximately 3%, with Indonesia accounting for 7,955 cases [4,5]. Papua is the region with the highest number of cases in Indonesia, reporting 3,019 cases or 37.8% of the national total in 2023 [5].

The World Health Organization (WHO) Global Programme to Eliminate Lymphatic Filariasis (GPELF) has set an ambitious target to eliminate lymphatic filariasis as a public health problem by 2020, primarily through the implementation of mass drug administration (MDA) programs [6]. In Indonesia, MDA has been implemented since 2015 using a combination of ivermectin, diethylcarbamazine citrate, and albendazole (IDA) [7]. In several regions of Indonesia, MDA has proven effective in reducing the prevalence of lymphatic filariasis, as reported in Belitung and Flores Islands following multiple MDA rounds [8,9]. However, the success of MDA programs relies heavily on coverage and adherence to the MDA protocol [10,11]. Studies in various endemic areas have reported adherence rates ranging from 61.6% to 86.8% [12,13]. A cohort study in Andhra Pradesh, India, revealed that non-adherence to MDA increased the risk of microfilaremia infection by 1.8 times [14].

Previous studies on adherence to MDA have been conducted extensively in both Indonesia and other endemic countries [15-18]. Adherence to MDA is influenced by various factors, including sex, age, societal perceptions, occupation, forgetfulness, fear of side effects, and difficulty in swallowing medications [15-18]. In addition to adherence, environmental and sociodemographic factors are key risk factors for lymphatic filariasis [19-21]. A study in Nepal found that transmission hotspots persisted despite the comprehensive implementation of MDA due to environmental factors and community behaviors [22]. Environmental factors such as stagnant water, proximity to rivers or swamps, bushes, and livestock pens provide breeding grounds for vector mosquitoes, increasing the risk of transmission [19,21]. Additionally, individual behaviors, including going outdoors at night, inconsistent use of bed nets, limited knowledge, and occupational exposure, further increase the risk of filariasis transmission in endemic areas [19,20].

Despite extensive research on adherence to MDA, no studies have specifically explored the dimensions of adherence, such as the consumption of preventive filariasis medication, adherence to night-time dosing schedules, compliance with medical recommendations, routine biannual medication in April and October, habits of not completing prescribed doses, and immediate consumption of medication upon distribution, with the incidence of filariasis. These aspects warrant investigation, considering that challenges such as difficulty taking medication and forgetfulness are among the primary causes of non-adherence [15]. Other indicators, such as fear of side effects after consuming medication, should also be evaluated, as they may affect the success of MDA [18]. Therefore, the aim of this study was to evaluate the influence of adherence dimensions, environmental factors, and sociodemographic characteristics on the incidence of filariasis. The findings are expected to provide evidence-based recommendations to enhance the effectiveness of filariasis control programs and reduce the disease burden in endemic regions.

Methods

Study design and setting

This study employed a case-control design to evaluate the effect of medication adherence and environmental factors on lymphatic filariasis incidence. The study was conducted in filariasis-endemic areas in the Sarmi District, Papua, Indonesia. In Sarmi District of Papua Province, while MDA coverage in 2023 reached 96%, medication adherence was only 71.02% [23]. Furthermore, the Sarmi District has environmental characteristics that facilitate the proliferation of filariasis vectors. Surveys in this region have identified over 200 mosquito species capable of serving as vectors for filariasis [24]. The topography of Sarmi District is diverse, ranging from coastal areas to mountainous regions, with land use dominated by production forests and plantations [25]. Most of the population works in the plantation and fishing sectors, with coconut as a primary commodity [26]. The district's climatic conditions, with an average temperature of 21.9–34.5°C and high annual rainfall, provide an ideal environment for the life cycle of vector mosquitoes [25].

The study locations included rural and semi-urban areas across eleven villages in Sarmi District. The district had implemented a primary prevention program through the MDA, aiming to reduce microfilaria prevalence and interrupt disease transmission by routinely distributing preventive medication to residents. The medication provided consisted of a combination of 100 mg diethylcarbamazine and 400 mg albendazole. Data collection was carried out from March to October 2024. The case group was defined as individuals who had participated in the MDA program and tested positive for microfilaria through night-time finger-prick blood examinations using filariasis test strips and microscopic analysis. The control group consisted of individuals residing in the Sarmi District who had participated in the MDA program and tested negative for microfilaria infection.

Study size

The sample size was determined using Lemeshow's formula with a 95% confidence level, 80% power, and an odds ratio (OR) of 1.8 based on a previous study [14]. The calculation yielded 45 participants for the case group. With a case-to-control ratio of 1:2, the control group comprised 90 participants, resulting in a total sample size of 135. Participants were selected using proportional random sampling to distribute the sample size according to the population distribution in the study area. This approach ensured balanced population representation, particularly within the control group, minimizing potential bias.

Participants

The study involved two groups of participants: the case group and the control group. The case group included individuals registered in the MDA program and received a combination of 100 mg diethylcarbamazine and 400 mg albendazole, who were confirmed positive for microfilaria through microscopic examination. Data for the case group were obtained from the 2023 Sarmi District Health Office reports. The control group consisted of individuals residing in the Sarmi District who had participated in the MDA program and received the treatment as a case group, and tested negative for microfilaria during blood examinations.

Inclusion criteria for both groups included being a permanent resident of Sarmi District for at least one year. Participants with a history of allergies to MDA medications, medical conditions mimicking filariasis symptoms, or unwillingness to provide written consent were excluded from the study. Information on the receipt of preventive medication was obtained from MDA distribution records maintained by local health centers. Participants were recruited from rural and semi-urban areas in Sarmi District in collaboration with local health centers and healthcare workers. Control group participants were randomly selected from the list of MDA recipients in the same areas, ensuring adherence to the inclusion criteria.

Variables

In this study, the outcome variable was the incidence of lymphatic filariasis infection. The independent variables comprised three main groups: medication adherence, environmental factors, and preventive actions. Medication adherence was assessed based on seven dimensions: consumption of preventive filariasis medication (Yes/No), adherence to night-time dosing schedules (Yes/No), compliance with medical recommendations (Yes/No), routine biannual medication in April and October (Yes/No), immediate consumption of medication upon distribution (Yes/No), and the occurrence of side effects after medication consumption (Yes/No).

Environmental factors, including stagnant water, bushes, swamps, and livestock pens near the house, were assessed with direct observation. Each factor was categorized as "Yes" if presented and "No" if absent. Preventive actions were defined as behaviors aimed at reducing the risk of exposure to filariasis vector mosquitoes, use of long-sleeved clothing at night and using bed nets while sleeping, and they were classified as "Yes" and "No."

Sociodemographic variables that could act as confounders included ethnicity (Papuan/non-Papuan), age (<40/ ≥40 years), sex (male/female), education level (elementary-junior high/high school-tertiary), type of occupation (indoor/outdoor), and income (<regional minimum wage/ ≥regional minimum wage).

Data collection

Data collection was conducted through interviews, observations, and medical record reviews. Medication adherence variables were measured using a self-report approach through structured interviews with a questionnaire. Self-reports were verified by cross-referencing MDA program drug distribution records, interviews with key informants such as community health workers or medical personnel, and triangulating information from respondents' family members or neighbors to ensure the consistency and accuracy of responses. The self-report questionnaire included questions about the consumption of preventive filariasis medication, adherence to night-time dosing schedules, compliance with medical recommendations, routine biannual medication in April and October, immediate medication consumption, and side effects after consumption. Medical records from healthcare facilities also confirmed data on medication side effects.

Environmental factor data were collected through direct observations in the participants' residential environments by enumerators using a standardized checklist. Environmental data included stagnant water, bushes, swamps, and livestock pens near participants' homes. Observations were conducted during field visits to ensure the collected data accurately reflected environmental conditions. Preventive actions against mosquito bites were measured using a self-report approach. Data were collected through interviews with a questionnaire in which participants reported the consistency of these actions. Responses were categorized as "Yes" if the actions were performed routinely and "No" if not. The use of bed nets during sleep was verified through observations of the availability of anti-mosquito bed nets in the household.

Sociodemographic variables included ethnicity, age, sex, education level, type of occupation, and family income. The participants' ages were categorized into <40 years and ≥40 years [27]. Occupations were categorized into indoor jobs, such as office workers, teachers, or administrative staff, and outdoor jobs, such as farmers, fishermen, or field laborers, which pose a higher risk of exposure to vector mosquitoes [28]. Family income was assessed based on participants' reports and categorized into two groups: below the Sarmi District regional minimum wage or equal to above the regional minimum wage. The regional minimum wage standard for Sarmi District was Indonesian Rupiah (IDR) 4,024,270. Trained enumerators conducted all interviews and observations. Data verification was done using official records, including drug distribution data from local health centers and medical records.

Bias

This study implemented some steps to address potential selection bias, information bias, and confounding bias. The case and control group participants were selected using strict inclusion and exclusion criteria to reduce selection bias. The case group was drawn from documented positive filariasis cases reported by the Sarmi District Health Office. In contrast, the control group was randomly selected from the population that had received preventive medication through the MDA program. Both groups were sourced from the same community to ensure homogeneity in access to healthcare services.

Information bias was minimized by employing a self-report approach through structured interviews conducted by trained enumerators and verified using drug distribution records, indirect questioning, and information from family members. To ensure data accuracy, reports of medication side effects were confirmed using medical records. Additionally, using standardized checklists, environmental variables were measured by directly observing participants' residential areas. Confounding bias was controlled through multivariate analysis, including potential confounding variables in evaluating the relationship between medication adherence and environmental factors with filariasis incidence.

Statistical methods

Chi-squared tests were applied to categorical variables to evaluate the relationship between MDA adherence, environmental factors, preventive actions, and sociodemographic characteristics with filariasis incidence. The relative risk of filariasis-associated factors was calculated based on odds ratios (OR) with 95% confidence intervals (CI) for unadjusted and adjusted OR (aOR) values. The influence of confounding variables was controlled through multivariate analysis using logistic regression. The backward likelihood ratio method determined risk factors for filariasis incidence through multivariate logistic regression. Variables included in the logistic regression model were selected based on univariate analysis results with $p<0.25$. The final model was evaluated using the goodness-of-fit test (Hosmer-Lemeshow test) and Nagelkerke R^2 values to assess how well the model explained the variation in filariasis incidence. Data analysis was performed using SPSS version 20 (IBM, New York, USA).

Results

Respondent characteristics

A total of 135 respondents were included in this analysis (**Table 1**). Of the respondents, 55.6% were male. The majority of respondents were aged ≥40 years (52.6%) and had completed senior high school or tertiary education (57.8%). Additionally, 72.6% of the respondents were of Papuan ethnicity, worked in outdoor occupations such as farmer, traditional market trader, motorcycle taxi driver, or fisher (74.8%), and had a family income below the regional minimum wage (75.6%).

Table 1. Respondent characteristics (n=135)

Characteristic	Frequency	Percentage
Sex		
Male	60	55.6
Female	75	44.4
Age group		
<40	64	47.4
≥40	71	52.6
Education		
Elementary and junior high school	78	42.2
Senior high school/tertiary education	57	57.8
Ethnicity		
Non-Papuan	37	27.4
Papuan	98	72.6
Occupation		
Outdoor jobs	101	74.8
Indoor jobs	34	25.2
Family income		
Less than regional minimum wage	102	75.6
Higher or equal to regional minimum wage	33	24.4

Association between sociodemographic factors and lymphatic filariasis incidence

The results of unadjusted analysis are presented in **Table 2**. Some sociodemographic variables were significantly associated with lymphatic filariasis incidence included sex (OR: 2.25; 95%CI: 1.08–4.67; p=0.043), education (OR: 0.38; 95%CI: 0.18–0.80; p=0.016), occupation (OR: 5.12; 95%CI: 1.67–15.64; p=0.004), and family income (OR: 11.29; 95%CI: 2.56–49.77; p<0.001). In the adjusted analysis using multivariate logistic regression, the variables age group (aOR: 2.58; 95%CI: 1.08–6.17; p=0.033;), education (aOR: 0.27; 95%CI: 0.11–0.67; p=0.004), occupation (aOR: 5.01, 95%CI: 1.38–18.09; p=0.014), and family income (aOR: 10.89; 95%CI: 2.18–54.47; p=0.004) were significantly associated with lymphatic filariasis incidence (**Table 2**).

Table 2. Association between sociodemographic factors and lymphatic filariasis incidence

Sociodemographic factors	Filariasis (n=45)	No filariasis (n=90)	Unadjusted OR (95%CI)	*p*-value	Adjusted OR (95%CI)	*p*-value
	n (%)	n (%)				
Sex						
Male	26 (43.3)	34 (56.7)	2.25 (1.08–4.67)	0.043*	2.24 (0.95–5.26)	0.064
Female	19 (25.3)	56 (74.7)	Ref.		Ref.	
Age group						
<40	29 (40.8)	42 (59.2)	2.07 (0.99–4.33)	0.077	2.58 (1.08–6.17)	0.033*
≥40	16 (25.0)	48 (75.0)	Ref.		Ref.	
Education						

Sociodemographic factors	Filariasis (n=45)	No filariasis (n=90)	Unadjusted OR (95%CI)	*p*-value	Adjusted OR (95%CI)	*p*-value
	n (%)	n (%)				
Elementary and junior high school	19 (24.4)	59 (75.6)	0.38 (0.18–0.80)	0.016*	0.27 (0.11–0.67)	0.004*
Senior high school/tertiary education	26 (45.6)	31 (54.4)	Ref.		Ref.	
Ethnicity						
Non-Papuan	11 (29.7)	26 (70.3)	0.79 (0.35–1.80)	0.733	1.70 (0.60–4.78)	0.313
Papuan	34 (34.7)	64 (65.3)	Ref.		Ref.	
Occupation						
Outdoor jobs	41 (40.6)	60 (59.4)	5.12 (1.67–15.64)	0.004*	5.01 (1.38–18.09)	0.014*
Indoor jobs	4 (11.8)	30 (88.2)	Ref.	Ref.	Ref.	
Family income						
Less than regional minimum wage	43 (42.2)	59 (57.8)	11.29 (2.56–49.77)	<0.001*	10.89 (2.18–54.47)	0.004*
Higher or equal to regional minimum wage	2 (6.1)	31 (93.9)	Ref.		Ref.	

*Statistically significant at $p<0.05$

Association between medication adherence and lymphatic filariasis incidence

The impacts of dimensions of medication adherence during MDA on lymphatic filariasis incidence are presented in **Table 3**. In the unadjusted analysis, adherence dimensions significantly associated with filariasis incidence included consumption of complete medication (OR: 3.86; 95%CI: 1.78–8.36; *p*=0.001), night-time dosing adherence (OR: 4.57; 95%CI: 2.02–10.36; *p*<0.001), compliance with medical recommendations (OR: 3.34; 95%CI: 1.44–7.75; *p*= 0.007), immediate consumption after distribution (OR: 2.64; 95%CI: 1.24–5.63; *p*=0.017), and side effects occurrence (OR: 1.58; 95%CI: 2.82–15.34; *p*=0.043). In the adjusted analysis using multivariate logistic regression, only consumption of complete medication (aOR: 3.60; 95%CI: 1.10–11.72; *p*=0.033), night-time dosing adherence (aOR: 5.76; 95%CI: 1.73–19.15; *p*=0.004), immediate consumption after distribution (aOR: 3.32; 95%CI: 1.01–4.94; *p*=0.048), and side effect occurrence (aOR: 1.82; 95%CI: 1.03–4.13; *p*=0.045) were found to have significant effects on filariasis incidence.

Table 3. Association between adherence to preventive medication and lymphatic filariasis incidence

Variables	Filariasis (n=45)	No filariasis (n=90)	Unadjusted OR (95%CI)	*p*-value	Adjusted OR (95%CI)	*p*-value
	n (%)	n (%)				
Consumption complete medication						
No	32 (47.8)	35 (52.2)	3.86 (1.78–8.36)	0.001*	3.60 (1.10–11.72)	0.033*
Yes	13 (19.1)	55 (80.9)	Ref.		Ref.	
Night-time dosing adherence						
No	35 (47.3)	39 (52.7)	4.57 (2.02–10.36)	<0.001*	5.76 (1.73–19.15)	0.004*
Yes	10 (16.4)	51 (83.6)	Ref.		Ref.	
Compliance with medical recommendations						
No	36 (42.4)	49 (57.6)	3.34 (1.44–7.75)	0.007*	1.22 (0.35–4.26)	0.747
Yes	9 (18.0)	41 (82.0)	Ref.		Ref.	
Routine biannual medication						
No	34 (36.6)	59 (63.4)	1.62 (0.72–3.64)	0.324	1.19 (0.34–4.16)	0.777
Yes	11 (26.2)	31 (73.8)	Ref.		Ref.	
Immediate consumption after distribution						
No	41 (56.9)	31 (43.1)	2.64 (1.24–5.63)	0.017*	3.32 (1.01–4.94)	0.048*
Yes	49 (77.8)	14 (22.2)	Ref.		Ref.	

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Variables	Filariasis (n=45)	No filariasis (n=90)	Unadjusted OR (95%CI)	*p*-value	Adjusted OR (95%CI)	*p*-value
	n (%)	n (%)				
Occurrence of side effects						
Yes	33 (40.7)	48 (59.3)	2.40 (1.10–5.24)	0.040*	1.82 (1.03–4.13)	0.045*
No	12 (22.2)	42 (77.8)	Ref.		Ref.	

*Statistically significant at $p<0.05$

Association between environmental factors and preventive actions with lymphatic filariasis incidence

The results of the unadjusted analysis of the effect association between environmental factors and preventive actions with lymphatic filariasis incidence are presented in **Table 4**. The presence of stagnant water (OR: 3.13; 95%CI: 1.48–6.60; *p*=0.004) and the habit of wearing long-sleeved clothing during night-time activities (OR: 3.00; 95%CI: 1.37–6.55; *p*=0.008) were associated with lymphatic filariasis incidence. In the adjusted multivariate logistic regression analysis, only the variable of wearing long-sleeved clothing at night (aOR: 3.41; 95%CI: 1.32–8.85; *p*=0.011) significantly influenced lymphatic filariasis incidence (**Table 4**).

Table 4. Association between environmental factors and preventive actions with lymphatic filariasis incidence

Environmental Factors	Filariasis (n=45)	No filariasis (n=90)	Unadjusted OR (95%CI)	*p*-value	Adjusted OR (95%CI)	*p*-value
	n (%)	n (%)				
Bushes						
Yes	31 (35.6)	56 (64.4)	1.34 (0.62–2.87)	0.567	1.25 (0.50–3.09)	0.631
No	14 (29.2)	34 (70.8)	Ref.		Ref.	
Swamps						
Yes	22 (36.7)	38 (63.3)	1.30 (0.63–2.68)	0.582	0.75 (0.30–1.88)	0.553
No	23 (30.7)	52 (69.3)	Ref.		Ref.	
Stagnant water						
Yes	29 (46.8)	33 (53.2)	3.13 (1.48–6.60)	0.004*	2.35 (0.96–5.74)	0.060
No	16 (21.9)	57 (78.1)	Ref.		Ref.	
Livestock pens						
Yes	26 (32.9)	53 (67.1)	0.95 (0.46–1.97)	1.000	1.14 (0.47–2.78)	0.759
No	19 (33.9)	37 (66.1)	Ref.		Ref.	
The habit of wearing long-sleeved clothing at night						
No	33 (43.3)	43 (56.6)	3.00 (1.37–6.55)	0.008*	3.41 (1.32–8.85)	0.011*
Yes	12 (20.3)	47 (79.7)	Ref.		Ref.	
The habit of using bed nets						
No	37 (63.8)	21 (36.2)	1.25 (0.61–2.57)	0.667	1.44 (0.57–3.65)	0.436
Yes	53 (68.8)	24 (31.2)	Ref.		Ref.	

*Statistically significant at $p<0.05$

Risk factors for lymphatic filariasis incidence

Multivariate logistic regression was then conducted using backward likelihood ratio method to determine the risk factors for filariasis incidence. Several sociodemographic variables, medication adherence, and preventive actions that significantly contributed to lymphatic filariasis incidence are presented in **Table 5**. Males had 4.88 times higher odds of having filariasis than females (aOR: 4.88; 95%CI: 1.39–17.06; *p*=0.013). Individuals aged ≥40 had 4.65 times the risk compared to those aged younger than 40 (aOR: 4.65; 95%CI: 2.26–3.00; *p*=0.002). Interestingly, lower education levels (elementary or junior high school) were associated with reduced odds of having filariasis compared to higher education levels (senior high school or tertiary) (aOR: 0.24; 95%CI: 0.07–0.84; *p*=0.025). Families with an income below the regional minimum wage had 1.66 times higher odds of having filariasis compared to those with incomes higher or equal to regional minimum wage (aOR: 1.66; 95%CI: 1.84–3.026; p=0.012).

Table 5. Final model of multivariate logistic regression analysis results showing the risk factors for lymphatic filariasis

Variable[a]	β	SE	Wald	Adjusted OR (95%CI)	p-value
Sex	1.585	0.639	6.163	4.88 (1.39–17.06)	0.013
Age group	2.158	0.683	9.985	4.65 (2.26–7.00)	0.002
Education	-1.396	0.624	5.009	0.24 (0.07–0.84)	0.025
Family income	2.752	1.091	6.356	1.66 (1.84–3.02)	0.012
Consumption full medication	1.176	0.600	3.841	3.241 (1.00–10.50)	0.050
Night-time dosing adherence	1.997	0.667	8.953	7.36 (1.99–27.23)	0.003
Immediate consumption after distribution	1.317	0.627	4.416	3.73 (1.09–12.73)	0.036
A habit of wearing long-sleeved clothing at night	1.908	0.668	8.157	6.73 (1.81–24.94)	0.004
Constant	-9.947	2.018	24.296	-	-

SE: standard error
[a]Only variables with p<0.25 were included in the analysis
Nagelkerke R^2 of 0.670. Hosmer and Lem show Test for Goodness-of-fit: p-value of Chi-squared=0.054, indicating the data fit the model

Non-compliance with the consumption of preventive medication for lymphatic filariasis increased the risk of filariasis by 3.24 times (aOR: 3.24; 95%CI: 1.00–10.50; p=0.050), while failing to take the medication at night increased the risk by 7.36 times (aOR: 7.36; 95%CI: 1.99–27.23; p=0.003) (**Table 5**). Individuals who did not take the medication immediately after it was provided had a 3.73 times higher risk (aOR: 3.73; 95%CI: 1.09–12.73; p=0.036). Regarding preventive actions, individuals who did not wear long-sleeved clothing at night had a 6.73 times higher risk of filariasis compared to those who wore long-sleeved clothing (aOR: 6.73; 95%CI: 1.81–24.94; p=0.004) (**Table 5**).

The multivariate analysis yielded a Nagelkerke R^2 value of 0.670, indicating that this model could explain 67% of the variation in lymphatic filariasis incidence. The goodness-of-fit test using Hosmer-Lemeshow yielded a p-value of 0.054, suggesting that the model fits the data well (**Table 5**).

Discussion

This study revealed that lymphatic filariasis incidence was influenced by sociodemographic factors (sex, age, education, family income), medication adherence (consumption of preventive medication, night-time dosing, immediate consumption upon distribution), and the habit of wearing long-sleeved clothing during night-time activities. Sex was a significant risk factor, with males having 4.88 times higher odds than females. This is likely due to outdoor activities frequently performed by males, such as farming or construction work, which increase exposure to mosquito bites, the primary transmission route for filariasis [29].

Individuals aged ≥40 were at greater risk than younger age groups. Older individuals are prone to more severe complications, such as lymphedema and hydrocele, due to prolonged exposure and the cumulative effects of the disease [30]. This is attributed to the ability of microfilariae released by adult *Wuchereria bancrofti* or *Brugia malayi* to persist in the human host for extended periods [31]. Conversely, younger populations often have lower awareness of filariasis, leading to delayed interventions and higher disease incidence [28]. Low family income significantly increases the risk of filariasis.

Families with limited financial resources often face barriers to accessing health information and preventive tools, such as insecticide-treated bed nets or health education programs [32]. These families also live in poor sanitation and inadequate housing, facilitating disease transmission [30,33]. Financial constraints may further delay access to healthcare services, exacerbating the risk of untreated infections [34]. The present study found that wearing inadequate protective clothing, especially at night, significantly increases filariasis risk. A previous study emphasized that behaviors like not wearing long-sleeved clothing and engaging in outdoor activities at night contribute to the persistence of filariasis in certain regions [35].

Additionally, the lack of protective clothing and failure to use bed nets during sleep is common in endemic areas, leading to high infection rates [35,36]. Tropical climates and increased human-vector contact during summer months further correlate with higher filariasis cases, particularly when individuals opt for lighter clothing or sleep outdoors [37].

The present study results indicated that non-compliance with MDA increased the risk of infection by 3.24 times. Failure to take prescribed medication, as mandated by the MDA program, increases the risk of infection because non-compliant individuals remain susceptible to filarial infections. This situation allows them to act as reservoirs, sustaining ongoing community transmission [38,39]. Additionally, individuals who never consumed MDA drugs exhibited significantly higher circulating filarial antigen levels, indicative of active infections. A study in Egypt found that individuals who reported not consuming MDA doses had higher antigenemia rates than those who completed the regimen [40]. Specifically, antigenemia was reported at 13.8% among those who did not consume MDA doses compared to only 2.7% among those who completed all five doses [40].

Furthermore, failing to take medication at night increased the risk by 7.36 times. Studies have shown that consuming medication outside the recommended schedule can reduce drug effectiveness [41]. Some anti-filarial drugs, such as diethylcarbamazine, are more effective at night due to the nocturnal periodicity of microfilariae in the bloodstream [42]. For instance, diethylcarbamazine, a commonly used drug for filariasis, is most effective when consumed following specific guidelines to maximize absorption and its action against parasites [43]. This study also highlights that individuals who delayed taking medication after distribution had a 3.73 times higher risk of infection. Deviations from prescribed medication schedules can lead to suboptimal treatment, allowing the disease to progress and increasing the likelihood of severe manifestations, such as elephantiasis [44]. Individuals who delay medication are more likely to forget or choose not to consume it [13]. Such delays may also undermine community-level protection, creating gaps in preventive coverage that enable continued transmission [45]. Moreover, delayed medication intake, particularly without food, increases the risk of side effects, potentially exacerbating future non-compliance.

This study has some limitations that should be acknowledged. First, the self-reported data on medication adherence and preventive behaviors may be subject to recall or social desirability bias, potentially compromising the accuracy of respondents' answers. Second, although multivariate analysis was performed to control for confounding variables, unmeasured factors—such as individual immune status, respondent mobility, and specific environmental factors, including housing infrastructure quality—may still have influenced the results. Third, this study was conducted in a specific endemic area of Sarmi District, Papua, which may limit the generalizability of its findings to regions with different environmental, demographic, or cultural characteristics. These limitations highlight the need for further research employing a prospective design, broader geographic coverage, additional variables, and a longitudinal approach to confirm these findings and address existing gaps.

Conclusion

This study demonstrated that dimensions of MDA medication adherence, including the consumption of preventive filariasis medication, night-time dosing, and immediate consumption after distribution, were associated with lymphatic filariasis incidence in Papua. Similarly, preventive behaviors, such as wearing long-sleeved clothing during outdoor activities, were also significantly associated. Additionally, sociodemographic factors, such as male, age ≥40 years, lower educational attainment, and family income below the regional minimum wage, were identified as risk factors for filariasis. In endemic areas, MDA programs need to be supported by adherence-focused interventions to enhance the effectiveness of prevention efforts. Future research and the development of intervention programs to improve medication adherence are essential for advancing filariasis elimination in endemic regions.

Ethics Statement

This study adhered to ethical standards to ensure the safety and confidentiality of participant information. The Health Research Ethics Committee of the Health Polytechnic of Jayapura reviewed and approved the research protocol under ethical approval number 008/KEPK-J/II/2024. Before participation, all participants provided informed consent after receiving a comprehensive explanation of the study's objectives, procedures, potential risks, and benefits. The confidentiality of participants' personal information was strictly maintained, and data were anonymized during the analysis process to protect participants' privacy. Participation in this study was entirely voluntary, and decisions to participate or withdraw did not affect participants' access to healthcare services.

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Competing interests

All the authors declare that there are no conflicts of interest.

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Underlying data

Derived data supporting the findings of this study are available from the corresponding author on request.

Declaration of artificial intelligence use

This study used artificial intelligence (AI) tools and methodologies in manuscript writing support. AI-based language model, ChatGPT, was employed to technical writing assistance (providing suggestions for structuring complex technical descriptions more effectively). We confirm that all AI-assisted processes were critically reviewed by the authors to ensure the integrity and reliability of the results. The final decisions and interpretations presented in this article were solely made by the authors.

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