Original Article

Use Of Eucalyptus Oil In Mobile And Migrant Populations As A Positive Deviance To Prevent Malaria On Buru Island, Indonesia: An Efforts To Accelerate And Maintain Malaria Elimination In Specific Populations

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Abstract

Malaria is still a public health problem worldwide, which is increasingly difficult to handle due to the Covid-19 pandemic. Indonesia is a country targeted by WHO to become a Malaria-free country by 2030. Mobile and migrant populations (MMPs) on Buru Island, as a Malaria-vulnerable group, pose a particular challenge in efforts to accelerate and maintain elimination. The use of eucalyptus oil as a positive deviation (PD) in this group is an innovative strategy in Malaria control programs in this population.

Methods: This research is an analytic observational study with a cross-sectional design to see the relationship between PD and Malaria in MMPs. Multivariate analysis with logistic regression was performed to determine the most associated PD with Malaria in the MMPs group. Primary data was collected through interviews with a structured questionnaire and observation of 72 people from the MMPs group who met the criteria.

Results and Discussion: From 19 PD identified, only seven related to Malaria in MMPs (p-value <α 0.05) in preventing Malaria: cleaning the environment (p=0.032), burning garbage (p=0.005), burning dry leaves (p=0.013), using the eucalyptus oil (0.001), consuming herbal medicine (p=0.013), "Baupu"/" Baukuf" (p=0.028) and utilizing hot steam from a "Kettle" (p=0.043). The logistic regression analysis showed that eucalyptus oil was the variable most related to Malaria prevention in MMPs (p=0.027;95% CI for EXP(B): 1.227 – 30.799).

Conclusions and suggestions: Identification of PD and applying them in everyday life is essential in preventing Malaria in MMPs. Utilizing the potential of eucalyptus oil as a natural way to prevent Malaria in the era of elimination is an innovative and promising specific local-based approach, considering that Buru Island is a eucalyptus granary area in Maluku, Indonesia.

Keywords: Eucalyptus Oil, Mobile and Migrant Populations, Positive Deviance, Malaria Elimination

1. Introduction

Malaria is an infectious disease still a public health problem in the world and Indonesia, which the Covid-19 pandemic has exacerbated. In 2020 there were 241 million Malaria cases in 85 Malaria-endemic countries originating from countries in the African region. Malaria deaths in 2020 increased by 12% compared to 2019, often associated with the failure of health services during the Covid-19 pandemic[1]. The World Malaria Report 2021 shows that Malaria in Sub-Sahara Africa accounts for 93% of the total deaths from Malaria. There was a decrease in the use of insecticide-treated nets (LLIN-ITN) until the end of 2020 due to the impact of the Covid-19 pandemic[1].

Annually, Parasite Incidence (API) figures per 1000 population in Indonesia for the last four years have shown a fluctuating trend. In 2017-2020, the API per 1000 population was 0.99/1000, 0.84/1000, 0.93/1000, and 0.87/1000, respectively. The highest API in 2020 in Indonesia is still in the eastern region of Indonesia: Papua 63.12/1000 population, West Papua 10.15/1000 population and NTT 2.76/1000 population.

According to the Maluku Health Profile document, API in Maluku has declined since 2016. In 2016 – 2020, the API per 1000 population was 4.64/1000, 2.30/per 1000, 1.16/per 1000, 0.72 per 100, and 0.42 per 1000, respectively. Even though API has decreased in the last four years, it does not mean Malaria is no longer a public health problem in Maluku Province [2].

The API rate per 1000 population in Buru island for the last five years has significantly declined. From 2017 to 2021, the API per 1000 population was 0.19/1000, 0.14/1000, 0.1/1000, 0.1/1000, and 0.04/1000, respectively [3]. In the last

five years, the number of examinations for Malaria blood preparations (ABER) in the Buru district has fluctuated. In 2017 and 2018, ABER 6.9% decreased to 6.1%. In 2019 and 2020, ABER increased to 7.9% and 9.5%, respectively. In 2021 ABER will drop to 5%. In the last five years, the slide Positivity Rate (SPR) of Malaria in the Buru district has significantly decreased. In 2017 the 0.28% Malaria SPR decreased to 0.23%, 0.13%, 0.1% and 0.08% in 2018, 2019, 2020 and 2021. Imported Malaria cases on Buru Island from 2016 to 2022 were 72 cases and six indigenous cases in 2019. Imported Malaria cases came from outside the Buru Island area, while indigenous cases came from the MMPs group in Buru district [3].

Buru Island is one of the Maluku province districts targeted to achieve Malaria elimination by the end of 2022 or early 2023. Still, it faces a big challenge with increasing population movement with an increasing Mobile and Migrant Population (MMPs)[4,5]. This population is often referred to as the "hard-to-reach population" [6] being a vulnerable group to both suffer from and transmit Malaria [7]. Control of Malaria in MMPs in the era of elimination is a big challenge. Therefore, a unique surveillance system is needed [8].
Control of Malaria in the MMPs group requires an innovative and sustainable method and approach in a society that can be done using the positive deviation (PD) approach [9]. The PD approach is unique because the solutions come from the affected population and not from outside experts [10]. Learning from the success stories in Vietnam on preventing childhood malnutrition, the PD approach can end the spread of Neglected Tropical Diseases (NTDs) and all health problems by entirely using locally available solutions [11].
By knowing the various PD of Malaria in the local or special populations in the Buru island district, appropriate interventions can be made to prevent Malaria in these unique or specific populations. The PD approach used in the Malaria prevention and control program for MMPs in the Buru district is an innovative strategy. It has never been implemented in a Malaria control program in this region. This approach is a new method or strategy to accelerate the elimination or maintain the status of Malaria elimination in the Buru island district.

2. Material and Methods

It is an analytic observational study with a cross-sectional approach to see the relationship between PD and Malaria in MMPs. The research was conducted on Buru Island, Indonesia, as a Malaria-elimination preparation area. The study population was MMPs on Buru Island. Those included as samples were groups of MMPs who worked as eucalyptus oil farmers, illegal gold miners, employees of logging companies, and district border cross-border drivers who lived on The Buru island for less than one year according to WHO criteria. The sample was selected purposively and calculated using sample size 2.0 software according to the sample size Determination in Health Studies [12] and found a total sample of 72 respondents.

Quality control of research data is carried out through the standardization of enumerators, standardization of methods, and measuring instruments through field trials and instrument trials. Instrument validity and reliability tests were also carried out as part of the resulting data quality control. Data analysis was performed univariately, bivariate (chi-square), and multivariate with logistic regression analysis. It was performed to determine which positive deviation was most associated with Malaria in the MMPs group. Primary data was collected through interviews with structured questionnaires and observation of 72 selected respondents.

3. Result and Discussion

a. Result

This research is a rapid survey conducted on special populations in the Malaria control program on Buru Island, especially in the era of acceleration and maintenance of Malaria elimination. The characteristics of the respondents involved in this study can be seen as follows:

Table 1: Characteristics of Respondents in MMPs Rapid Survey for the Acceleration and Maintenance of Malaria in Buru Island, 2022

Characteristics	N	%
Age		
Productive	69	95,8
Not Yet/Not productive	3	4,2
Sex		
Male	47	65,3
Female	25	34,7
Marital status		
Married	57	79,2
Not Married	15	20,8
Last Education		
No school	2	2,8
Elementary School and equivalent	27	37,5
Junior High School and equivalent	13	18,1
Senior High School and equivalent	28	38,9
Undergraduate or Post Graduate	2	2,8
Occupation		
Employee	16	22,2
Gold miners	20	27,8
Eucalyptus oil farmer	27	37,5
Cross border driver	9	12,5

Source: primary data, 2022

Based on table 1, it is known that the majority of respondents are in the productive age group, with 69 respondents (95.8%). Respondents were also dominantly male, as many as 47 (65.3%) and married as many as 57 (79.2%). Many respondents who had completed their last education at the high school education level or equivalent were 28 people (38.9%) and worked as eucalyptus oil farmers as many as 27 people (37.5%)

Some critical things and additional information related to the respondent's knowledge about Malaria can be seen in the following table:

Table 2. Distribution of MMPs Knowledge About Malaria, 2022

	Yes		No / Never		Total	
Issue	n	%	n	%	n	%
Ever heard of Malaria	52	72,7	20	27,8	72	100
Know the cause of Malaria	18	25,0	54	75,0	72	100
Know the symptoms of Malaria	21	29,2	51	70,8	72	100
Know the dangers of Malaria	13	18,1	59	81,9	72	100
Know Malaria prevention	14	19,4	58	80,6	72	100
Know how to treat Malaria	10	13,9	62	86,1	72	100

Source: primary data, 2022

For more details, see the following image:

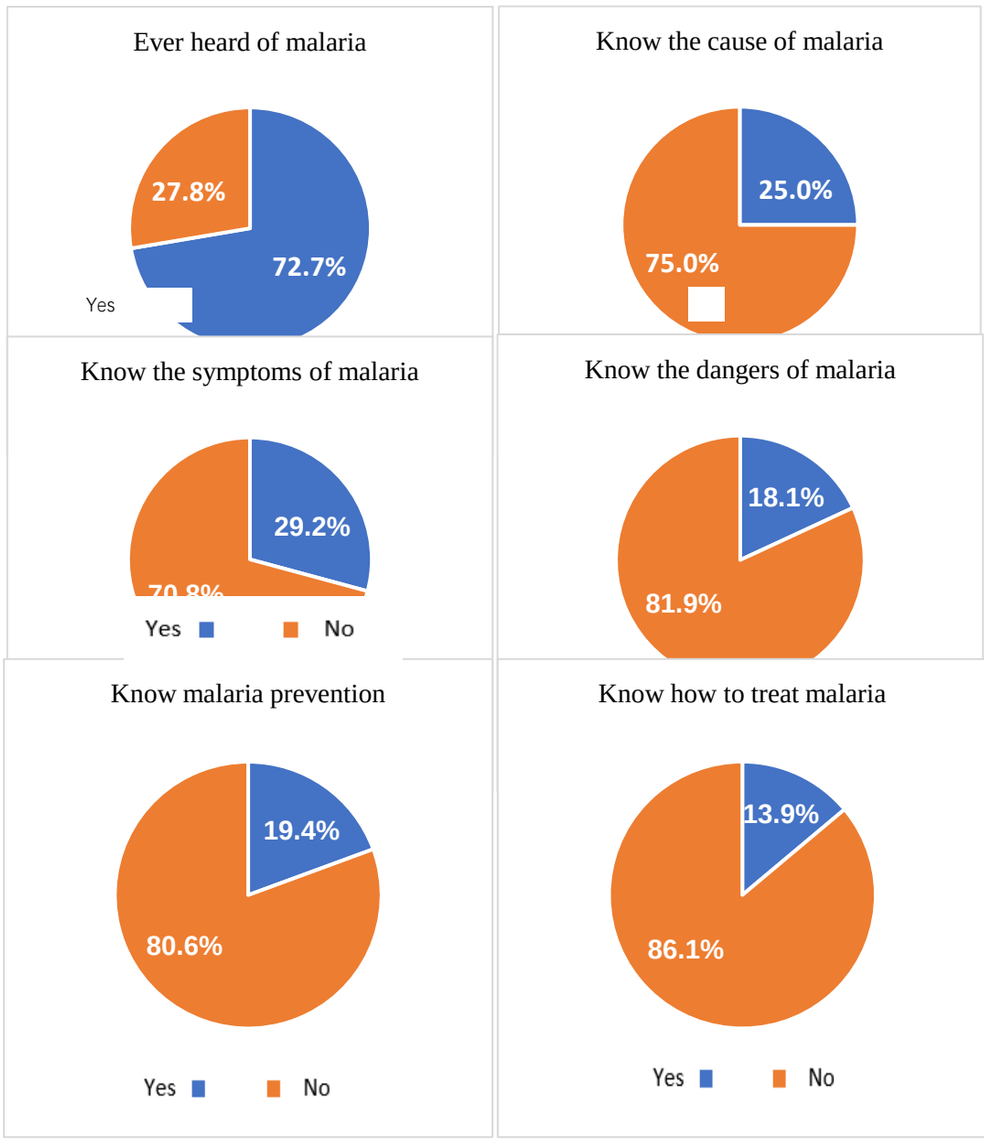

Figure 1. Graph of Respondents' Knowledge of Malaria

Table 2 and figure 1 show that the knowledge of the MMPs about Malaria involved in the rapid survey was still deficient. Although 72.7% of respondents had heard of Malaria before, 75% did not know its causes., 70.8% did not know the symptoms of Malaria, and 81.9% did not know the dangers of Malaria. 80.6% of respondents also did not know how to prevent Malaria, and 86.1% did not know how to treat Malaria. It can be concluded that knowledge about Malaria in MMPs in The Buru island district is still deficient.

Analysis of PD behaviour and the incidence of Malaria in the MMPs can be seen in the following table:

Table 3: Distribution of Respondents Based on PD and Malaria Incidence in MMPs to Accelerate and Maintain Malaria Elimination in Buru Island, 2022

Positive Deviance	Malaria				Total		p-value	Description
	Yes		No					
	n	%	N	%	n	%		
Using mosquito coils							1,000*	p-value >α
Yes	8	17,4	38	82,6	46	100		
No	5	19,2	21	80,8	26	100		
Using mosquito repellent spray							1,000*	p-value >α
Yes	2	18,2	9	81,8	11	100		
No	11	18,0	50	82,0	61	100		
Using mosquito repellent lotion							1,000*	p-value >α
Yes	1	14,3	6	85,7	7	100		
No	12	18,5	53	81,5	65	100		
Use mosquito netting							1,000*	p-value >α
Yes	1	16,7	5	83,3	6	100		
No	12	18,2	54	81,8	66	100		
Using ITN							0,825**	p-value >α
Yes	7	20,6	27	79,4	34	100		
No	6	15,8	32	84,2	38	100		
Wear long sleeves							0,112*	p-value >α
Yes	2	7,4	25	92,6	27	100		
No	11	24,4	34	75,6	45	100		
Burn the egg rack							0,723*	p-value >α
Yes	2	13,3	13	86,7	15	100		
No	11	19,3	46	80,7	57	100		
Burn egg shells							0,439*	p-value >α
Yes	1	7,7	12	92,3	13	100		
No	12	20,3	47	79,7	59	100		
Clean up the environment							0,032*	p-value <α
Yes	7	12,5	49	87,5	56	100		
No	6	37,5	10	62,5	16	100		
Burning garbage							0,005*	p-value <α
Yes	5	9,6	47	90,4	52	100		
No	8	40,0	12	60,0	20	100		
Burning dry leaves							0,013*	p-value <α
Yes	4	8,9	41	91,1	45	100		
No	9	33,3	18	66,7	27	100		
Use eucalyptus oil							0,001*	p-value <α
Yes	3	6,5	43	93,5	46	100		
No	10	38,5	16	61,5	26	100		
Burning coconut skin/belt							0,681*	p-value >α
Yes	1	8,3	11	91,7	12	100		
No	12	20,0	48	80,0	60	100		
Plant lemongrass							1,000*	p-value >α
Yes	2	15,4	11	84,6	13	100		
No	11	18,6	48	81,4	59	100		
Plant other herbal medicines							1,000*	p-value >α
Yes	1	16,7	5	83,3	6	100		
No	12	18,2	54	81,8	66	100		
Consuming herbal medicines							0,013**	p-value <α
Yes	3	10,0	27	90,0	30	100		
Tidak	10	23,8	22	52,3	42	100		
Baupu / Baukuf							0,028**	p-value <α
Yes	4	9,3	39	90,7	43	100		
No	9	31,0	20	69,0	29	100		
Utilizing hot steam from a kettle							0,043**	p-value <α
Yes	2	6,3	30	93,8	32	100		
No	11	27,5	29	72,5	40	100		
Maintain larvae-eating fish							0,558*	p-value >α
Yes	1	25,0	3	75,0	4	100		
No	12	17,6	56	82,4	68	100		

Source: primary data, 2022

Table 3 shows that based on the identification of various PD in the MMPs in Buru island related to Malaria prevention and control, 19 PD were found. After analyzing the 19 PD identified, 7 PD were found, which had a relationship with the incidence of Malaria in the MMPs.

PD associated with the incidence of Malaria in the MMPs in the Buru island district includes cleaning the living environment regularly at least once a week (p-value =0,032<α 0.05), burning garbage (p-value = 0.005 <α 0.05), burning dry leaves (p-value = 0.013 <α 0.05), using the eucalyptus oil (p-value = 0.001 <α 0.05), consuming herbal medicine (p-value = 0.013 <α 0.05), Baupu/baukuf (p-value = 0.028 < α 0.05) and utilizing hot steam from a kettle or eucalyptus oil distillery as a medium to warm the body (p-value = 0.043 α 0.05). PD in the MMPs in The Buru island district, especially in the prevention and control of Malaria, was identified through in-depth interviews and FGD.

Chi-square analysis showed that only 7 PD behaviours correlated with Malaria incidence.

PD in the MMPs is not related to Malaria incidence because the analysis results show that the p-value is greater than the alpha α value of 0.05. This PD include the use of mosquito coils and sprays, use of mosquito repellent lotions, use of mosquito repellent gauze/net, use of mosquito nets, use of long-sleeved clothes when outside the house at night, burning egg racks, burning egg shells, burning coconut skin/belts, planting lemongrass, planting other herbal medicines and raising larvae-eating fish. The p-value for each PD can be seen in detail and more clearly in table 6.

Various PD carried out by a particular group, MMPs in Buru Regency, related to the prevention and control of Malaria, as previously mentioned and explained earlier, are habits that are often carried out whether they realize it or not have a relation to the incidence of Malaria. The activities carried out aim not only to increase endurance and quality of health personally and socially but also to directly aim to prevent Malaria. These efforts have been statistically proven to have a relationship with the incidence of Malaria.

The analytical test is used to see the interaction of various independent variables related to the dependent variable. The appropriate analytical test is a logistic regression test (Amirullah, 2013) (Bebchuk & Wittes, 2012). The variables included in the logistic regression test have a p-value of less than 0.05. The results of the multivariate analysis of the PD variable that has a relationship with the incidence of Malaria in the MMPs in the Buru island district can be seen in the following table:

Table 4: Multivariate Analysis of PD and Malaria Incidence in MMPs for the Acceleration and Maintenance of Malaria Elimination in Buru Island, 2022

Variable (Positive Deviance)	**B**	**S.E**	**Wald**	**df**	**Sig.**	**Exp(B)**	**95% CI for EXP(B)**	
							Lower	Upper
Cleaning up the environment	.110	.838	.017	1	.895	1.117	.216	5.773
Burning garbage	-1.224	1.001	1.496	1	.221	.294	.041	2.091
Burning dry leaves	-.110	1.049	.011	1	.917	.896	.115	7.009
Using eucalyptus oil	**1.816**	**.822**	**4.880**	**1**	**.027**	**6.148**	**1.227**	**30.799**
Consuming herbal medicines	-1.374	.824	2.780	1	.095	.253	.050	1.273
Baupu/Baukuf	.345	.842	.168	1	.682	1.412	.271	7.348
Utilization of hot steam from a kettle	.712	1.005	.502	1	.479	2.038	.284	14.622
Constant	4,215	2,004	4,422	1	,035	67,674		

Source: primary data, 2022

Table 4 shows that after multivariate analysis, with a logistic regression test, it can be seen that from 7 independent variables (positive deviations), only one independent variable has the strongest or dominant relationship. The use of eucalyptus oil with B value = 1.816 and significance (sig) 0.027 (95% CI: 1.227 – 30.799). The PD logistic regression equation model for the MMPs group in The Buru island, related to Malaria prevention and control, is 4.215 + 0.110 (cleaning up the environment) – 1.224 (burning garbage) – 0.110 (burning dry leaves) + 1.816 (using eucalyptus oil) – 1.374 (consuming herbal medicine) + 0.345 (Baupu/Baukuf) + 0.712 (hot kettle steam). From table 4, it can be concluded that statistically, the use of eucalyptus oil in MMPs has the most substantial relationship to the incidence of Malaria, especially in the prevention and control of Malaria.

b. Discussion

Characteristics of Respondents

Respondents were involved in a rapid survey in the MMPs, to accelerate and maintain Malaria elimination on Buru island, 72 people. The survey results showed that most respondents were in the productive age group, 15-64 years (95.8%). The large number of respondents who are of productive age and are involved as respondents in this study indicates that MMPs, in addition to showing high mobility due to work being done, also inform us that this particular population is also productive. Special populations with high mobility and are in the productive age group can be a potential condition in increasing the risk of Malaria transmission.

The survey showed 47 male respondents (65.3%), more than female respondents. It shows that the mobility of the population due to job demands is primarily male, which epidemiologically also has potential and is related to the

incidence of Malaria. Research conducted by Alemu et al. in 2014 showed that males with high mobility who travel and return to their place of origin have a strong relationship with the incidence of Malaria (Alemu et al., 2014).

The results of the rapid survey showed that many of the respondents involved were married, as many as 57 people (79.2%). Many of the respondents who had completed their last education at the high school education level, or the equivalent, were 28 people (38.9%). The respondents' marital characteristics and education level provide information to us directly that the MMPs in Buru island at the time the research was conducted and selected as the sample were those who were adults, were married, and had a high school education background.

Respondents' occupations based on the results of the rapid survey showed that the majority of respondents worked as seasonal eucalyptus oil farmers, with 27 people (37.5%). Illegal gold miners in the rapid survey totalled 20 people or 27.8%. Apart from eucalyptus oil farmers and illegal gold miners, the rapid survey respondents also work as employees of a logging company in one of the logging companies in the Buru island district. District border cross-border drivers who were involved as respondents in the rapid survey totalled nine people, or 12.5%. If viewed from the respondent's occupation, the MMPs involved in the PD rapid survey on MMPs to accelerate and maintain Malaria elimination work as eucalyptus oil farmers, illegal gold miners, employees of logging companies, and drivers across district boundaries.

Other important information outlined based on the results of a rapid survey about the basic knowledge of respondents about Malaria shows that their knowledge about Malaria is still low. From the survey results, it is known that although many have heard of Malaria, not a few also do not know about the causes, symptoms, and ways to prevent, dangers, and treat Malaria. More than fifty per cent of respondents said they did not know about this basic Malaria information.

The insufficient basic knowledge of the MMPs group about Malaria is a potential situation and will even be a risk factor for Malaria in this particular population. Research conducted by Nyunt et al. in 2015 showed that communication of changes in Malaria prevention behaviour is closely related to the level of knowledge in the population studied. Insufficient knowledge of Malaria will hinder communication in Malaria prevention behaviour, impacting Malaria incidence [13].

Research conducted by Win et al.in 2017 shows that the pattern of seeking Malaria treatment in MMPs is always associated with a lack of knowledge about treating Malaria. This particular population tends to seek private or illegal treatment because it is cheaper, easier to obtain, and less complicated to obtain when compared to official government treatment [14,15]. Saha et al., in 2019, showed that although the knowledge of respondents (migrant population) in general was good, there were still specific things, such as their work which would also increase the risk of suffering from Malaria [16].

The efforts to accelerate Malaria elimination face a significant threat in the presence of MMPs. The low level of basic knowledge about Malaria in this particular group is an obstacle in efforts to accelerate Malaria elimination. Win et al., in a study conducted in 2017, stated that knowledge of seeking treatment in this particular population is a threat in the era of achieving Malaria elimination [14,17]. A cross-sectional study conducted in Cambodia in 2019 showed that MMPs are a specific group that requires a specific intervention in the country's Malaria control program. Their common knowledge, especially in the prevention and transmission of Malaria, is a separate threat in efforts to accelerate the achievement of Malaria elimination in this country [18].

Positive Deviance analysis

The rapid survey conducted on 72 respondents from the MMPs in the Buru island district aims to obtain general information about Malaria and to identify various PD in this population that is related to the incidence of Malaria, especially in the prevention and control of Malaria, in the context of acceleration and maintenance of elimination. The PD most related to the incidence of Malaria was identified in the multivariate analysis performed. The instrument's questions were formulated based on the results of previous qualitative research. The various PD identified in the in-depth interviews and FGD were re-examined to assess their relationship with the incidence of Malaria, especially in preventing Malaria in specific populations.

Based on qualitative research through in-depth interviews and FGD that have been conducted previously, it is known that PD in MMPs in preventing and controlling Malaria are as follows: use of mosquito coils, mosquito spray, anti-mosquito lotion, anti-mosquito gauze, use of mosquito nets, long-sleeved clothing, burning egg racks, egg shells, cleaning the environment, burning garbage, burning dry leaves, using eucalyptus oil, burning coconut belts, planting lemongrass, growing other herbal medicines, consuming herbal medicines, baupu/baukuf, hot kettle steam and raising/maintain larva-eating fish.

The results of the rapid survey study showed that from the 19 PD above in respondents in controlling and preventing Malaria, there were 7 PD in MMPs associated with the incidence of Malaria in this population. These PD behaviours include cleaning the environment, burning garbage, burning dry leaves, using eucalyptus oil, taking herbal medicines, baupu/baukuf, and utilizing hot steam from the kettle where eucalyptus oil is distilled. Even though it was identified as a PD in controlling Malaria in MMPs, the results of a rapid survey showed that 12 PD were not related to the incidence of Malaria.

Cleaning the environment is a conventional effort that is still effective in Malaria prevention and control programs in various parts of the world. Dhiman and Valecha, in research conducted in 2019 in India, stated that environmental management efforts through increasing awareness by cleaning the residential environment had a good impact on reducing the incidence of Malaria in India [19]. Inah et al.2017 in their research in Nigeria, stated that clean environmental sanitation conditions had a relationship with a decrease in the incidence of Malaria [20].

Based on the results of interviews and direct field observations, it was found that the respondents stated that cleaning the environment had become a habit that was often carried out with different frequencies. One way to clean up the environment, both the residential area (house, mess, camp, barracks) and the surrounding environment, is by burning dry garbage and dry leaves. They believe the smoke from burning garbage and dry leaves can repel mosquitoes and insects. The habit of burning garbage and dry leaves is an activity that is routinely carried out before the evening or the change of day and night in the community. Burning trash and dry leaves is a tradition passed down by their ancestors, who are believed to help ward off mystical things.

Research conducted by Roy and Sadiwala in India in 2021 concluded that burning smoke could expel vectors that cause dengue fever and Malaria [21]. Research conducted by Arsunan et al.in the Selayar district of Indonesia states that burning trash and coconut belts is a PD for the people of Selayar Island, which is done to repel mosquitoes and can reduce the incidence of Malaria [22].

The use of eucalyptus oil is a PD in the MMPs in preventing Malaria. The results of the analysis prove that the use of eucalyptus oil is associated with the incidence of Malaria. 93.5% of respondents who had never had Malaria admitted that they often used eucalyptus oil daily. From the results of interviews and observations, it is known that respondents admitted to using eucalyptus oil as a habit that is often done. They use eucalyptus oil when they finish eating, after bathing or even use eucalyptus oil to reduce the fishy smell after eating or repel insects and mosquitoes.

A systematic review study conducted by Asadollahi et al.in 2019 showed that administering essential oils containing eucalyptus extract could increase protection against mosquito bites. Almer et al.in Asadollahi 2019 showed that narrow-leaved Eucalyptus, lemon-scented Eucalyptus, and broad-leaved Eucalyptus could protect against Anstephensi for 8 hours, while the total protection time of the Eucalyptus globulus is reported to be 5.5 hours [23].

The habits of the people on the island of The Buru, both the local population and the MMPs, have many benefits for their health. One of the habits people is consuming herbal medicine to maintain health and increase endurance. The Covid-19 pandemic has also taught everyone many lessons to maintain their immune systems so that they don't get sick and get infected easily.

A rapid survey study showed that people's habits of consuming herbal or traditional medicines were related to the incidence of Malaria. 90% of respondents who have never had Malaria admit that they often take herbal medicines. The interviews show that the respondents consumed herbal medicines to increase their immune system, especially during the Covid-19 pandemic era. From the results of in-depth interviews and FGD, it was found that various herbal medicines consumed included pariah leaves, papaya leaves, Beluntas leaves, turmeric stew, laka/henna leaves, bark decoction, Cinta-Cinta leaves, Katuk leaves, forest basil leaves and tok-tok leaves. Respondents explained that they felt the benefits when they finished taking the herbal medicine, and their bodies felt healthier and fresher.

Various studies concluded that the use of various herbal medicines derived from anti-Malarial medicinal plants that people around the world have widely used. Research conducted by Mukungu et al.showed that the Luthya people in Kenya have widely used various anti-Malarial plants, both the leaves, roots and stems of these plants [24]. The same research was conducted by Stangeland, Ngarivhume, Oliveira and Asnake, showing that the community also uses traditional medicinal plants as anti-Malarial drugs [25,26,27,28,29].

Although the community has widely used herbal or traditional medicines as anti-Malarial drugs, several things are of concern, including the dosage, method of administration, toxicity, and therapeutic potential of these herbal medicines. A systematic review study was conducted by Alebie et al.in 2017 on 200 types of anti-Malarial herbal plants. Seventy-one families showed that using anti-Malarial herbal plants people believe can cure Malaria requires in-depth research and investigation regarding aspects of dosage, toxicity, chemical effects, and therapeutic potential. Communities must be innovative and have sufficient information about consuming herbal medicines [29,27]. The use of medicinal plants as an alternative treatment for Malaria must be carried out carefully by paying attention to the dosage and method of using these medicinal plants.

The use of eucalyptus oil in local communities and special populations on Buru Island has become a habit carried out in everyday life. Other community habits directly related to eucalyptus oil use are Baupu/Baukuf and utilizing hot steam from a kettle (where eucalyptus oil is refined). The survey research results show that baupu/baukuf and utilizing hot steam from the kettle is a PD in MMPs, especially in preventing Malaria.

Baupu or baukuf is a habit carried out by the people on the island of Buru to warm the body and create a feeling of freshness in the body by using the smoke that comes from the boiled water of various medicinal plants, which is still boiling and hot. The principle of Baupu/Baukuf is almost the same as that of a sauna. Then boiled water from various medicinal plants is usually placed in a container or bucket. Then the person doing the Baupu stands over the container or bucket and then covers it with a cloth or sarong so that the person doing the Baupu with the bucket containing the

boiled medicinal plants together is inside the cloth/sarong. This ritual lasts a few minutes until the cooking water is not too hot. The purpose of this ritual is to sweat so that the person doing Baupu feels fresher and lighter.

Leaf concoctions commonly used for Baupu include eucalyptus oil leaves, banana leaves, and yellow papaya leaves, boiled until boiling, and then the hot smoke is used to warm the body. Historically, Baupu was a ritual used by the people of Buru Island for postpartum care. Most postpartum mothers on Buru Island will perform this ritual to help warm the body and accelerate postpartum healing. In its development, the Baupu ritual was then carried out by the community as a way that was considered effective in helping to increase endurance and help recovery after illness.

From the interviews, it is known that respondents did Baupu as one of the ways to help increase their immune system during the Covid-19 pandemic to prevent transmission of various infectious diseases. Another reason put forward was that apart from being easy to do, the raw material in the form of eucalyptus leaves is also widely available on Buru Island. The Baupu ritual on the island of Buru is also carried out in other parts of Indonesia and the world. The people in Jailolo, Halmahera, perform the "Bakera" ritual as a method used for postpartum care and to increase body immunity to prevent transmission of infectious diseases [30].

"Baupu" or "Baukuf" has the basic principle of utilizing hot steam/smoke from boiling water containing various aromatic plants that can be used to warm the body, improve blood circulation and increase endurance. Warming the body near the eucalyptus oil refinery has more or less the same benefits as the working principle of the Baupu ritual. The difference is that the hot steam from the kettle or place where eucalyptus oil is distilled comes from the burning process of eucalyptus oil stoves.

From interviews and observations, it is known that respondents who work as eucalyptus oil farmers spend most of their time in the kettle to produce eucalyptus oil so that they are directly exposed to hot steam coming from the kettle. They believe there are no mosquitoes around the kettle due to the hot steam and smoke from the eucalyptus oil distillation process. By being around a kettle, the hot steam will repel Malaria mosquitoes and reduce their risk of being bitten by Malaria mosquitoes.

Prevention and treatment of Malaria in traditional ways by utilizing leaves from the forest and using the aroma produced from the boiling process has been widely practised. Elliot et al.2020 stated that some medicinal leaves are used effectively against Malaria [31]. Oratai, 2012 collected various plants from mangrove forests in Thailand to test their effectiveness in reducing various symptoms of fever, including fever caused by Malaria. The results of his research showed that 18.52% of the plants collected were effective in curing fever [32].

The habits of Buru Island people, which are carried out to increase their immune system and maintain their health, become a PD behaviour in preventing various diseases, including Malaria. It has also become a habit carried out by special groups on the island of Buru to maintain health. The results of the rapid survey conducted have proven that various PD behaviours have been carried out and identified in the MMPs related to Malaria prevention and control.

Use of Eucalyptus Oil as Positive Deviance in MMPs

The multivariate analysis aims to determine the independent variable (positive deviance) most dominant or related to the dependent variable under study [33]. After conducting a multivariate analysis, it is known that the use of eucalyptus oil in the MMPs in Malaria prevention and control on Buru Island has the strongest PD with the incidence of Malaria in this particular population.

The interaction of the various PD associated with the incidence of Malaria in this particular population resulted in the 7 PD associated, only 1 PD showing the most vital relationship. In comparison, the other 6 PD are not statistically significant. As previously explained, from the results of interviews and observations, respondents admitted to using eucalyptus oil as a habit that was often done almost daily. They use eucalyptus oil when they finish eating, after bathing or even use eucalyptus oil to reduce the fishy smell after eating or repel insects and mosquitoes. Eucalyptus oil is often believed to reduce symptoms of colds and can increase endurance. The very distinctive aroma of eucalyptus oil is believed to help make you feel more relaxed and can reduce stress symptoms.

A systematic review study conducted by Asadollahi et al.in 2019 showed that administering essential oils containing eucalyptus extract could increase protection against mosquito bites [23]. Almer et al.in Asadollahi 2019 showed that narrow-leaved Eucalyptus, lemon-scented Eucalyptus, and broad-leaved Eucalyptus could protect against mosquito bites An. Stephensi for 8 hours, while the full protection time of Eucalyptus globulus is reported to be 5.5 hours [23]. Auysawasdi et al.used E. globulus essential oil at concentrations of 5%, 10%, 15%, 20% and 25% for An. Dirus [34].

All concentrations of E. globulus provide complete repellency ranging from 1.7 to 3.4 hours, depending on the concentration applied [34]. Eucalyptus globulus with a dose of 0.1 ml in a study conducted by Sritabutra & Soonwera in 2013 could repel An. dirus bites for 1.58 hours [35]. In addition, 100 µl of Eucalyptus citriodora repelled Anopheles minimum for 0.5 hours [36]. From various studies that have been conducted, it is known that the use of eucalyptus oil (eucalyptus oil) is known that gives eucalyptus extract to essential oils and can protect against the bites of Anopheles mosquitoes.

The use of eucalyptus oil has been widely found in people in Maluku, especially on the island of Buru. The most significant potential for eucalyptus oil in Maluku is in Buru Regency, followed by West Seram Regency, West

Southeast Maluku Regency and Central Maluku Regency (H. Smith & Idrus, 2018). In Maluku, the potential for Eucalyptus is quite significant, as seen from small eucalyptus oil refining industries spread across several districts. It is in line with the potential for eucalyptus forests in Maluku, namely Buru Regency ± 120,000 Ha, West Seram Regency ± 50,000 Ha, West Southeast Maluku Regency ± 20,000 Ha and Central Maluku Regency ± 60.00 Ha [37].

Eucalyptus oil is an essential oil widely developed and used in Indonesia. In general, this oil is used in the pharmaceutical and food fields. In the pharmaceutical sector, the need for eucalyptus oil in Indonesia is quite promising, reaching 1,500 tons per year, whereas currently, Indonesia's eucalyptus oil production is only 500 tons. Indonesia's largest eucalyptus oil production centres are in Maluku, especially Buru Island [38].

Essential oils have long been used by people, especially in rural areas in Indonesia, to cure illnesses. Essential oils have the characteristic odour of the original plant and are volatile. Likewise, eucalyptus oil is one of the essential oils with the trade name "Cajuput oil", which comes from a plant with the species Melaleuca leucadendron, which is often used in the pharmaceutical industry as a medicinal plant.

Eucalyptus leaves are known to have various benefits and properties for health. One of the active compounds contained in eucalyptus leaf extract is 1,8-cineol. These compounds are known to have antimicrobial, antioxidant, and anti-inflammatory activities. Apart from 1,8-cineol, eucalyptus leaves contain α-terpineol, α-pinene, and ß-pinene compounds. These compounds also have antibacterial activity by damaging cell membranes, inhibiting the action of enzymes, and destroying the genetic material present in bacteria, so they are thought to inhibit bacterial growth [39].

The 1,8-cineol compound found in eucalyptus leaf extract in various studies has shown the potential to repel Anopheles mosquitoes that cause Malaria and Aedes aegypti that cause dengue fever. Research conducted by Kim et al.in 2012 in Auysawasdi 2016 showed that the combination of Eucalyptus globulus essential oil with vanillin could affect the mechanism of the mosquito's olfactory system both in the periphery and the central nervous system, which controls behaviour driven by smell by mosquitoes. It was stated that the 1,8-cineol compound has a vital role in the olfactory mechanism of both Anopheles and Aedes mosquitoes. Mosquitoes do not like this smell because it is toxic to mosquitoes and has a chemical effect on the olfactory mechanism [34].

Research by Kaihena & Ukratalo, 2021 concluded that ethanol extract with eucalyptus leaves has a toxic effect on Aedes mosquito larvae. The results of the research by Cheng et al.2008 and by Kaihena & Ukratalo, 2021 showed that the essential oils of Eucalyptus camaldulensis and E. Urophyilla were larvicidal towards A. Aegypti with LC50 values of 31 and 96 µg/mL, respectively [40].

Flavonoid compounds contained in eucalyptus leaf extract are thought to be respiratory poisons, causing the larvae to be unable to breathe due to damage to the respiratory system and eventually causing the death of the larvae. Flavonoid compounds are also planted defence compounds that can inhibit insect eating and are also toxic. These saponins and flavonoids work as stomach poisoning, which can cause disruption of the digestive system of Aedes aegypti larvae so that the larvae fail to grow and eventually die (Haditomo, 2010 in Kaihena & Ukratalo, 2021). The larvicidal potency of eucalyptus leaf extract, based on research results conducted on Aedes mosquito larvae, is a sign that eucalyptus leaf extract can also be applied as a larvicide for the larvae of the anopheles mosquito that causes Malaria [40,34].

So far, efforts to control Malaria-causing vectors in Indonesia have focused more on efforts to kill adult mosquitoes and larvae with chemicals that are not environmentally friendly. The use of insecticide-treated nets (ITN) and house spraying (IRS), although they are felt to be effective, can have long-term effects [41]. The use of eucalyptus oil as a natural repellent can be an alternative in vector control efforts in Indonesia. Besides being able to repel mosquitoes, eucalyptus leaf extract can also be used as a natural larvicide in eradicating the larvae of Aedes and Anopheles mosquitoes.

PD of MMPs and residents of the Buru island district, preventing Malaria by using eucalyptus oil regularly, become a good habit that must be maintained and preserved. In the era of elimination and maintenance of Malaria elimination in Buru island, genuine efforts that are more environmentally friendly in controlling Malaria must continue to be carried out. Control of Malaria vectors using eucalyptus oil is a unique strategy and a solution to solving problems with a specific local approach. Buru Island is an area of eucalyptus oil where eucalyptus tree leaves thrive and are the primary raw material for making eucalyptus oil. Therefore, using eucalyptus oil to control Malaria in this region is a promising solution.

4. Conclusion and Suggestion

PD in MMPs is a unique approach to solving the problem of Malaria on Buru Island. In the era of elimination and maintenance of Malaria elimination, the existence of the MMPs group is a challenge in controlling Malaria. Identifying the PD of Malaria prevention in this population is essential to find a more appropriate solution in the intervention plan. A positive deviation approach is unique because problem-solving efforts come from the community itself, which will be more enduring in the behaviour patterns and habits of the community. The use of eucalyptus oil as a PD for MMPs in preventing Malaria is a promising strategy in Malaria control programs because inexpensive, easy to implement, and sustainable. Therefore, it is vital to carry out further research on laboratory tests on the effectiveness of eucalyptus oil and eucalyptus oil extraction in killing Anopheles larvae and killing adult Anopheles mosquitoes.

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