

Local Community Wisdom in Environmental Management Efforts to Control Malaria: A Literature Review

Yulius Sarungu Paiting^{1,3*}, Anwar Daud², A. Arsunan Arsin⁴, Hasanuddin Ishak²,
Gurendro Putro⁵, Suriah Suriah⁶, Fathu Rahman⁷, Erniwati Ibrahim²,
and Anwar Mallongi²

¹*Faculty of Public Health, Hasanuddin University, Makassar, Indonesia*

²*Department of Environmental Health, Faculty of Public Health, Hasanuddin University,
Makassar, Indonesia*

³*Department of Environmental Health, Faculty of Public Health,
Cenderawasih University, Jayapura, Indonesia*

⁴*Department of Epidemiology, Faculty of Public Health, Hasanuddin University,
Makassar, Indonesia*

⁵*Research Center for Public Health and Nutrition, National Research, and Innovation Agency
(BRIN), Republic of Indonesia, Indonesia*

⁶*Department of Health Education and Behavioral Sciences, Faculty of Public Health,
Hasanuddin University, Makassar, Indonesia*

⁷*Department of English Literature, Faculty of Cultural Sciences, Hasanuddin University,
Makassar, Indonesia*

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ABSTRACT This research aimed to obtain a deeper understanding of local community wisdom in environmental management efforts for malaria control to provide sustainable solutions and strengthen community responses to malaria control efforts. This study is a literature review by selecting and analyzing eight relevant studies published between 2013 and 2023 from three databases, including *Science Direct*, *PubMed*, and *Google Scholar*. Six papers report on cultural practices based on positive local wisdom, and two papers report negative or harmful practices towards Malaria control efforts. These findings help health promotion strategies consider the community's cultural values or combine them with scientific knowledge to provide the best results. Environmental management practices based on local knowledge can align with and may also conflict with scientific knowledge, leading to malaria control failure risk. Therefore, positive cultural values must be supported, and negative values must be engineered by increasing good health literacy.

INTRODUCTION

Malaria is still one of the primary infectious diseases in the world (WHO 2021). Various efforts to control malaria continue to be carried out, but the results are not optimal, especially in areas with high levels of endemicity (Noor et al. 2017). Although globally, the number of malaria cases decreased between 2000 and 2015, since 2016, malaria cases have increased again. The most significant increase occurred between 2019 and 2020, reaching 13 million cases. In 2021, it is estimated that there will be 247 million cases of malaria in 84

endemic countries. This number increased by 2 million cases compared to 2020, with 600,000 deaths yearly (WHO 2021).

Control is the primary basis for efforts to eliminate malaria (Lukubwe et al. 2023). Before 1940, vector control was based on a thorough understanding of vector ecology and epidemiology and the application of environmental management tailored to the ecology and behavior of local vector species (Wilson et al. 2020). However, since *Dichlorodiphenyltrichloroethane* (DDT) or *Pestisida dicophane* and other organochlorine compounds were introduced in the 1940s, malaria vector control efforts have shifted to relying on insecticides (Van den Berg et al. 2012). The use of insecticides was so efficient in vector control efforts that most vector control efforts at that time did not have other alternative methods (Baitharu et al. 2020).

*Address for correspondence

Yulius Sarungu Paiting
Jl. Perintis Kemerdekaan Km. 10 Tamalanrea,
Makassar, South Sulawesi, Indonesia
E-mail: ysarungu@gmail.com
Phone: +6281228471234

Control of Malaria vectors with insecticides has the advantage of reducing transmission quickly (Ranson and Lissenden 2016). However, the height pressure on population vectors causes increased mosquito resistance (WHO 2015). Resistance to four classes of insecticides available for indoor residual spraying has been documented in Sub-Saharan Africa (Dondorp et al. 2011; Tusting et al. 2013). In addition, long-term use of insecticides harms the environment and human health (Van den Berg et al. 2012).

Increasing the challenge of insecticide resistance in adult mosquitoes has led to a shift in vector control strategies aimed at preventing the development of adult mosquitoes and encouraging ecosystem changes to help reduce the spread of disease vectors. One of these strategies is environmental management, which can reduce the abundance of mosquito vector species, not only reducing the number of mosquitoes entering the house but also reducing the number of mosquito bites outside the house. In this case, the intervention/strategy is an additional and sustainable method to complement existing methods (Tusting et al. 2017).

Malaria is a complex disease, and most sufferers live in geographical areas that are difficult to reach and require a particular social and cultural approach (Indonesian Ministry of Health, 2013). The persistence of malaria may be caused by a failure to recognize sociocultural factors that aid in malaria prevention efforts. The preventive methods prioritize modern medical attitudes and practices and are considered the best methods to eliminate malaria. This method does not consider the sociocultural factors that exist in society. Therefore, it is necessary to implement diverse prevention strategies and combine traditional and modern methods (Uushona et al. 2022).

Over the years, communities living in malaria-endemic areas have developed approaches to malaria treatment and prevention based on traditional ideas about health and disease and observations about the relationship between environmental conditions, vectors, and malaria. As well as adaptive responses to these conditions. Therefore, adaptation to malaria endemicity must be based on local knowledge and the adaptive capacity of affected communities (Dirontsho et al. 2022).

The potential of local community wisdom enables better prevention efforts (Arsunan et al. 2020). Local wisdom is the overall knowledge,

skills and technology possessed by a particular community based on practical experience and capable of being preserved and utilized by a community for present and future generations (Mapiira and Mazambara 2013; Dirontsho et al. 2022). In conventional health systems, local wisdom has given individuals the ability to overcome past and present vulnerabilities and has become the basis for decision-making at the local level in many rural communities (Macherera et al. 2017). Integrating local wisdom into programs can lead to the development of sustainable, practical, cost-effective, and participatory adaptation strategies (Uushona et al. 2022). This research aims to gain a deeper understanding of local community wisdom in environmental management for malaria control to provide solutions to increase community response to malaria control efforts.

Theoretical Framework

Malaria is a vector-borne disease caused by protozoan parasites of the genus *Plasmodium* in tropical and subtropical regions worldwide (Fikadu and Ashenafi 2023). The malaria parasite is transmitted through mosquito bites *Anopheles* females. Mosquitoes breed well if the environment is suitable for the conditions needed by mosquitoes. Environmental factors influence malaria distribution, prevalence, and incidence in a particular area, including the physical, biological, chemical, social, economic, and cultural environments (Arsin 2012).

The physical environment is closely related to vector survival and influences the emergence of sources of malaria transmission. The biological environment has a beneficial or detrimental impact on mosquito survival. The social, economic, and cultural environment is the environment that arises because of interactions between humans, including behavior, customs, culture, customs, and traditions of the population (Achmadi 2014). This factor sometimes has a more significant influence compared to other factors because it creates favorable environmental conditions for mosquitoes, as well as habits that cause more critical opportunities for contact between mosquito vectors and humans (Arsin 2012; Achmadi 2014). Therefore, approaches to preventing the risk of mosquito bites and managing malaria need to consider environmental, social, and cultural factors.

Environmental management theoretically has a relationship with the occurrence of diseases caused by mosquitoes (Sarungu Paiting et al. 2012). Therefore, environmental management can help reduce the global malaria burden, which can be applied to complement other malaria control methods (Tusting et al. 2017). Environmental management has been proven to be sustainable in the long term, has no or little negative impact on the environment, and has the potential to make better use of local resources and knowledge, thereby increasing community independence in malaria control efforts (Dirontsho et al. 2022).

Over the years, communities have understood various aspects of the environment through experience and knowledge passed down from generation to generation, forming the basis of local expertise for making decisions. This helps local communities adapt to environmental changes and reduces vulnerability to disease transmission (Dirontsho et al. 2022). Therefore, understanding local practices is essential to assess how local communities utilize local knowledge and resources to reduce and adapt to environmental risks (Grey et al. 2020).

Local knowledge is generally context-specific, and its form varies depending on place and time (Klenk et al. 2017). In practice, this condition can align with and may conflict with scientific knowledge, thereby causing the risk of malaria control failure. Therefore, knowing sociocultural and local knowledge is very important to support malaria elimination strategies in a particular area, as well as combining local practices with scientific knowledge can lead to the development of effective, cost-effective, participatory, sustainable mitigation and adaptation strategies (Uushona et al. 2022).

METHODOLOGY

The researchers researched to gain a deeper understanding of local community wisdom regarding environmental management for malaria control. The review was done in *Science Direct*, *PubMed*, and *Google Scholar*. The search was based on articles published in English and non-English journals between 2013 and 2023. The search used the Boolean operations “AND” and “OR” with the following keywords: local wisdom, citizen knowledge, customary knowledge systems, culture, environmental management, and

malaria. Additional literature was also obtained through *snowballing* the use of bibliographies of previously published articles.

The search criteria in this review are: 1) presenting original (primary) data that includes environmental management behavior related to malaria control based on local wisdom; 2) research with sample populations from malaria endemic areas; 4) published in English and non-English between January 2012 and July 2023; 5) published as a complete article. Methodological quality was assessed using a quality assessment checklist by *Joanna Briggs Institute*. Critical appraisal tools The *Joanna Briggs Institute* is widely known and used to study variations in research designs (Ma et al. 2020). Articles with high and medium assessment scores were included in the study.

Articles retrieved from each database were imported into *Mendeley Library*. After the first search, duplicates are removed. The remaining articles were screened based on title and abstract. The text was read thoroughly in the final stage, and studies that met the inclusion/exclusion criteria were retained. All data extraction and assessment of retrieved studies were assessed independently. A summary of selected studies was noted, including author, title, year of publication, country of research, methods, and findings.

RESULTS

The initial literature search produced 792 articles from 2013 to 2023. After reviewing them based on the inclusion criteria, eight articles met the inclusion criteria in this review (Fig. 1). Selected studies were conducted at the community level in several countries, including Panama, Zimbabwe, Indonesia, Botswana, India, and Malaysia.

Cultural Practices and Local Wisdom for Malaria Control

Six papers report positive cultural practices and local wisdom regarding malaria control efforts. Most of these traditional practices are popular among the community to avoid mosquito bites because they are sustainable, low-cost, and easy to obtain (Das et al. 2013; Arsunan et al. 2020; Naserrudin et al. 2023). Indigenous knowledge systems for malaria management and prevention through the ability to predict weather conditions

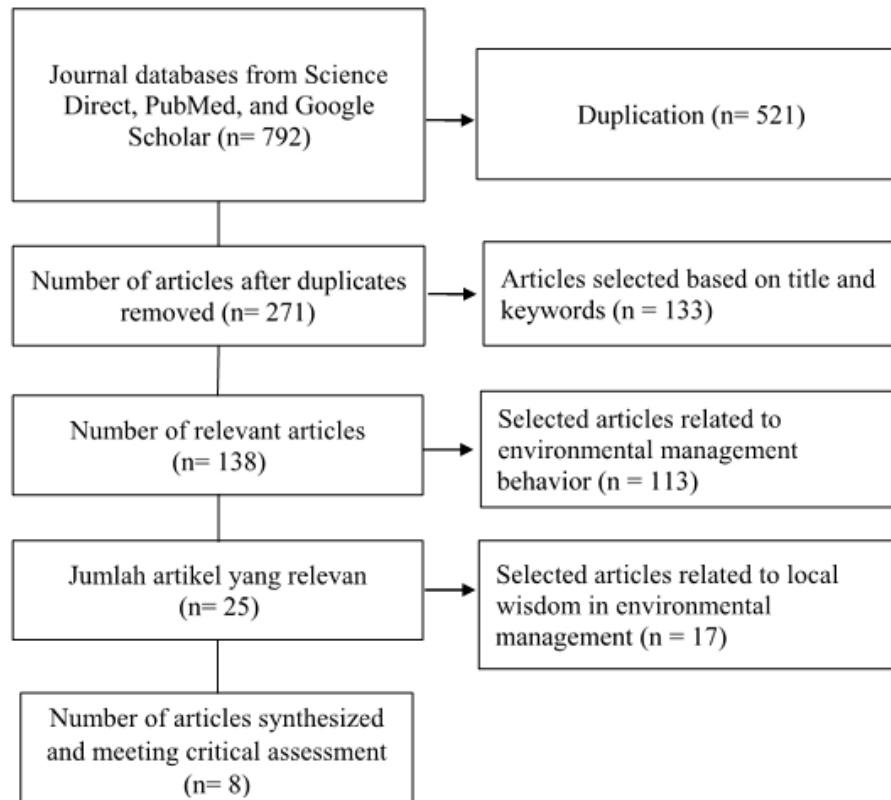


Fig. 1. Prisma Flow Chart of study selection

(Macherera et al. 2017). Culturally based coping strategies is helpful in malaria control include timing activities and limiting movement to certain times of the day (Dirontsho et al. 2022).

Table 1 reported two papers that reported negative cultural practices and local wisdom for Malaria control efforts. In some community groups, malaria is the result of the integration of

Table 1: Cultural practices and local wisdom that are positive for malaria control efforts

Author, Year	Positive practices
(Macherera et al. 2017)	Indigenous knowledge systems regarding environmental indicators related to climate information (temperature and rainfall) and the behavior shown by animals can be utilized in a malaria early warning system.
(Isnani et al. 2021)	Tradition <i>mountain fall</i> , <i>self-esteem</i> , <i>shame</i> , and <i>slira</i> useful in efforts to maintain environmental cleanliness to control malaria, and the values of <i>pakewuh</i> and obeying superiors/community leaders can also be utilized in outreach activities for malaria control.
(Arsunan et al. 2020; Naserrudin et al. 2023; Das et al. 2013)	Avoid mosquito bites by wearing long sleeves when working and when going out at night and burning rubbish, husks, twigs, and coconut husks, and using natural mosquito repellent oil.
(Dirontsho et al. 2022)	Cultural practices (taboos) that limit movement at certain times can help reduce the risk of malaria transmission.

socio-supernatural and biological factors. Therefore, special rituals are needed to restore humans' connection with spirits.

Table 2 shows that some cultural practices have negative effects on malaria control. For example, constructed in the Guna cultural style, it features palm leaf roofs, vertically placed tree trunk walls, no windows, and dirt floors, which facilitate mosquito entry. Malaria is believed to be caused by spirits, leading to protective rituals such as "smokes from the pipe" and "cocoa burning".

Table 3 describes those studies on malaria perceptions and control practices across diverse regions. Key findings include the influence of sociocultural beliefs, traditional practices, and environmental indicators on malaria prevention. For instance, in Panama and Indonesia, local customs and cultural values shape control practices, while Zimbabwean communities use environmental signs to predict malaria. Adaptive strategies in Botswana involve modifying home structures and activity schedules, and Malaysian communities address zoonotic malaria through local knowledge. Overall, the studies highlight that malaria control efforts are deeply connected to local cultural, environmental, and social contexts.

DISCUSSION

Malaria remains a significant public health challenge, particularly in sub-Saharan Africa, Southeast Asia, and parts of South America. Despite substantial advancements in treatment and prevention, malaria control efforts often encounter obstacles due to local ecological and social factors. Recently, there has been a growing recognition of the value of integrating local community wisdom into environmental management strategies for malaria control (Chandy et al. 2023; Fathima et al. 2023).

Malaria is estimated to cause 58 percent of deaths and affects 20 percent of the world's poorest population and most of the sufferers live in difficult-to-reach geographic locations (Tartour et al. 2024). Households with low socioeconomic levels are more vulnerable to malaria due to a lack of access to malaria prevention and treatment efforts (Guin et al. 2023). This encourages most people to choose traditional methods of preventing and treating malaria, which were developed over many years through experience and knowledge interacting with the environment and passed down from generation to generation (Macherera et al. 2017). The use of traditional methods was chosen because it is sustainable, cheap, and easy to obtain (Das et al. 2013; Arsunan et al. 2020; Naserrudin et al. 2023) compared to non-traditional methods which require expensive costs (Naserrudin et al. 2023).

Environmental conditions are important in malaria transmission (Villena et al. 2024). Therefore, managing this condition can help reduce the burden of malaria (Yamba et al. 2023). The climate is an environmental risk factor that cannot be modified and plays an important role in changes in the distribution and prevalence of malaria, influencing the survival and development levels of parasites and mosquito vectors (Villena et al. 2024; Yamba 2023). Local wisdom systems about climate change modify the behavior of local communities to develop mitigation and adaptation strategies to reduce their vulnerability to malaria outbreaks (Macherera et al. 2017; McIntyre-Mills et al. 2023). This has a positive impact on malaria control efforts.

Malaria control faces inhibiting factors when the concept of disease occurrence is still associated with magical things and there is a misunderstanding about the incidence of malaria which has been passed down from generation to gener-

Table 2: Cultural practices and local wisdom that are negative for Malaria control efforts

Author, Year	Negative practices
(Griffith et al. 2015)	All the respondents' houses were built according to the Guna cultural model: plant roofs made of palm leaves, walls made of small tree trunks placed vertically, no windows and dirt floors making it easier for mosquitoes to enter the house; The cause of malaria is attributed to spirits and thus requires a ritual of protection against the disease known as "smokes from the pipe" and "cocoa burning".
(Cáceres et al. 2017)	Vector control is carried out through rituals. <i>It's Ued</i> , or 'Pipe Smoking' to appease the anger of outer spirits.

Table 3: Reviewed articles

<i>Author, Year</i>	<i>Title</i>	<i>Region/ Country</i>	<i>Study design</i>	<i>Results</i>
(Das et al. 2013)	<i>Community perceptions on malaria and care-seeking practices in endemic Indian settings: policy implications for the malaria control programme</i>	India	Qualitative	The main determinants of health care seeking are sociocultural beliefs, age, gender, and trust in health care providers
(Griffith et al. 2015)	<i>Knowledge, attitudes, and practices about malaria in the Guna indigenous population of the Madungandí region, Panama, 2012</i>	Panama	Cross sectional	Individual practices in malaria control mostly use traditional cultural practices Use
(Cáceres et al. 2017)	<i>Social representations of malaria in the Guna indigenous population of Guna province of Madungandi, Panama</i>	Panama	Qualitative, descriptive, and exploratory	Malaria in culture Use in line with some cultural elements, such as magic, religion, belief, myth, and nature.
(Macherera et al. 2017)	<i>Indigenous environmental indicators for malaria: A district study in Zimbabwe</i>	Zimbabwe	Qualitative	Communities can use environmental indicators to predict malaria incidence
(Isnani et al. 2021)	<i>Javanese Cultural Values in Malaria Control to Achieve Malaria Elimination in the Menoreh Hill Area</i>	Indonesia	Qualitative and observational condition environment and behavior in control malaria	Efforts to control malaria are faced with cultural values <i>mountain fall, self-esteem, shame, ewuh pakepu, tepa slira</i> and obey public figure.
(Arsunan et al. 2020)	<i>Identification and strengthening of positive deviance: An effort to reduce the incidence of malaria in Selayar islands</i>	Indonesia	Mix method	The most influential factor in the incidence of malaria is <i>positive deviance</i>
(Dirontsho et al. 2022)	<i>Local Knowledge of Adaptive Strategies Against Malaria Endemicity in The Okavango Delta, Botswana</i>	Botswana	Retrospective Cohort	Adaptation strategies applied to malaria transmission include increasing knowledge capacity; home structure modifications; setting activity schedules and limiting movement at certain times of the day
(Naserrudin et al. 2023)	<i>Seeing malaria through the eyes of affected communities: using photovoice to document local knowledge on zoonotic malaria causation and prevention practices among rural communities exposed to Plasmodium malaria in Northern Borneo Island</i>	Malaysia	Community-based participatory research (CBPR)	Rural communities in Sabah, Malaysia have local knowledge related to non-human primate malaria and natural factors related to the presence of mosquitoes

ation. Sa's study conducted in Panama associates the incidence of malaria with several cultural factors, such as magic, religion, belief, myth, and nature (Cáceres et al. 2017; Tunon et al. 2024) and the incidence of malaria in India is associated with food and drink (Das et al. 2013; Vennu et al. 2024). This occurs due to the low level of public education (Abbas et al. 2023). Increasing education will reduce the risk of malaria incidence. The availability of information through appropriate community channels is very necessary to avoid misunderstandings that can hinder proper responses to malaria (Abbas et al. 2023). The research results in Malawi found that direct community involvement in mosquito habitat management efforts resulted in increased capacity for recognizing mosquito larvae and increasing understanding of malaria risk (Gowelo et al. 2023).

An approach that focuses on the behavior of local communities (*positive deviance*) can be an effective tool in the context of controlling and eliminating malaria in an area, based on the belief that everyone has certain habits and behaviors or uniqueness that allow them to find the best way to prevent a disease (Arsunan et al. 2020). Local wisdom is a dynamic knowledge resource that is owned, developed, and disseminated by certain population groups and integrated into their understanding of the surrounding nature and culture (Sakti et al. 2024).

Local wisdom is a health promotion method that can be applied to various populations. This will encourage program sustainability. The lack of respect for local knowledge, Indigenous culture, and lack of cultural sensitivity has an impact on the sustainability of the implementation of community empowerment programs and hinders program sustainability and positive behavior change (Hikmawati et al. 2021).

Local wisdom which originates from the beliefs held by the community creates agreed social norms and becomes a shared commitment that can be a determining factor in environmental management efforts (Sulaiman et al. 2023; Nirzalin et al. 2023), including environmental management for malaria control (Isnani et al. 2021). Practice Cultural taboos that limit movement at certain times can help reduce the risk of malaria transmission (Delta et al. 2022). This strategy is effective in avoiding mosquito bites, especially at dawn, dusk, or night. Environmental cleaning activities

or community service with the term *mountain fall*, namely cleaning cemeteries and roads is one of the positive local wisdom (Isnani et al. 2021). This activity regularly will indirectly eliminate the habitat and breeding ground for *Anopheles* mosquitoes so that they can become solutions and cost-effective. A similar model has also been applied in control efforts for *Dengue Hemorrhagic Fever* in the form of flick patrols adapted from *siskamlng* patrols (Azam et al. 2016). However, this approach is only temporary and therefore needs to be carried out continuously.

Empowerment of traditional leaders and community leaders as part of local wisdom in efforts to control malaria is very necessary. The involvement of traditional leaders in Tribal communities resulted in a high percentage of people willing to participate in community action against malaria (Naseruddin et al. 2023). Apart from that, in Tetel Village, Pengadegan District, Purbalingga Regency, the culture of obeying leaders is a driving factor in efforts to control malaria. Community participation will be effective and sustainable if the health service delivery system originates from the local context of the community (De Vries and Pool 2017; Naseruddin et al. 2023) and refers to the social norms and values that exist in society. This makes it easier for communities and individuals to believe health messages and adopt new practices.

CONCLUSION

Local communities' wisdom provides the ability to overcome past vulnerabilities. Therefore, malaria control efforts must be integrated into the health system by paying attention to local cultural values and local wisdom. Direct participation of local communities in the program will be beneficial in increasing capacity regarding control efforts and avoiding misunderstandings about malaria. Positive cultural values must be supported, and negative values engineered to be beneficial for malaria control efforts.

RECOMMENDATIONS

Efforts need to be made to increase public health literacy through information channels that are acceptable to the public. Massive health literacy has the potential to help understand specific

risks better, reduce exposure, and lead to better health outcomes for individuals and communities. Without adequate health literacy, community efforts to eradicate malaria based only on local wisdom alone are not enough to control malaria.

DECLARATIONS

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

CONSENT FOR PUBLICATION

Not applicable.

COMPETING INTERESTS

The authors declare no competing interests.

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AUTHORS' CONTRIBUTIONS

YSP, AD, AAA, and HI developed the initial concept and idea. YSP, AD, GP, and DAM conducted literature searches and prepared the initial manuscript. YSP and AM made critical revisions and prepared the final submitted manuscript. YSP, AD, AAA, HI, GP, SU, FR, EI, and AM reviewed the work and provided further revisions. All contributing authors have approved the final draft.

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