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THE ROLE OF KNOWLEDGE IN PREVENTING MALARIA INCIDENCE AMONG PADDY FARMERS IN NORTHERN MALAYSIA

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Abstract:

The agriculture sector is notoriously associated with hazardous activities and high occupational accident rates, with most studies focusing on physical and chemical hazards. Biological hazards including zoonoses have been less studied due to scarce information and diverse perplexing factors that hinder the development of risk assessment activities by safety professionals. Zoonotic malaria, a communicable disease, has recorded upsurge in the infection rates in Malaysia. Malaria, a mosquito-borne infectious disease, poses significant risks to individuals working in agricultural settings, particular paddy farmers. Paddy farmers are highly vulnerable to these diseases due to their exposure to working environments such as stagnant water in the paddy field. This study aims to explores the relationship between the role of knowledge about malaria in preventing the incidence of malaria, highlighting the specific occupational challenges encounter by paddy farmers in Northern region of Malaysia. We propose the hypothesis that enhanced knowledge and awareness among paddy farmers about malaria and its prevention can contribute to notable reduction in the incidence of malaria. To test this hypothesis, we will conduct a questionnaire survey which will be distributed to collect data from selected paddy farming communities. The survey will evaluate the current level of knowledges associated with malaria prevention. The result of this study will provide valuable insight into the role of education and knowledge dissemination in alleviating biological hazards, with a main focus on malaria

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among the paddy farmers. Moreover, this research could contribute to the refinement of policy and practical interventions focusing in improving occupational health and safety of agricultural communities, ultimately boosting health outcomes and declining occupational accident rates.

Keywords:

Agriculture, Biological Hazards, Disease Prevention, Malaria, Paddy

Introduction

Malaysia has entered the phase of eliminating indigenous malaria transmission caused by *Plasmodium falciparum* and *Plasmodium vivax*, however, zoonotic *Plasmodium knowlesi* which thought to infect only animals has now been reported to cause infections in human with over 15,000 cases reported and approximately 50 deaths since 2008. Although Malaysia have been officially declared a nation free of the human-only malaria transmission, in 2017 alone, there were 3,600 reported infections caused by zoonotic *Plasmodium knowlesi* (Chin et al., 2020). Figure 1 depicted malaria trends from 2013 to 2022 showing a fluctuating pattern in the total number of malaria cases. While cases gradually declined from 2013 to 2016, a significant increase was observed in 2017 and 2018, followed by a decline after 2019. Concurrently, *Plasmodium knowlesi* cases consistently contributed to the malaria burden, peaking in 2018 and 2021. According to The Star dated 2 October 2023 (Vethasalam, 2023), Sabah has reported 840 cases followed by Kelantan at 215 cases and Terengganu with 26 cases. Kelantan showed a spike in the numbers of cases at 98 cases compared to last year with 53 infections were from human and 162 cases involved zoonotic transmission. As for Sabah, 816 cases involved zoonotic malaria while 14 were imported human cases and 10 were human-introduced infections. The worrying statistics raise concern as Malaysia is now faces a new threat in the spike of malaria cases due to zoonotic transmission after having declared zero human malaria infections from 2018 to 2021.

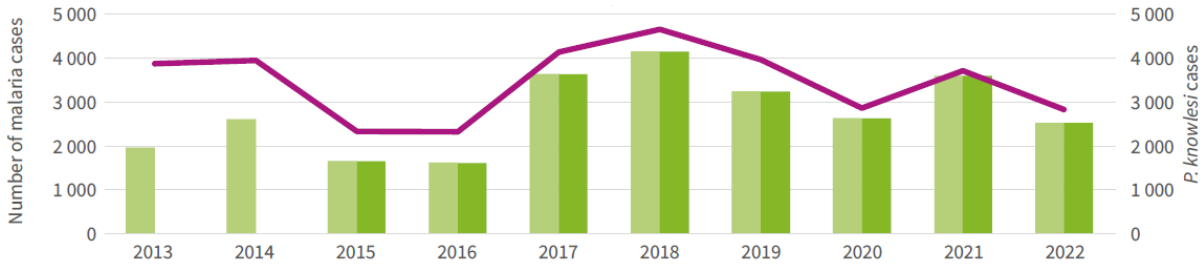

Figure 1: Number Of Total *Plasmodium Knowlesi*, Indigenous *Plasmodium Knowlesi* And Total Malaria Cases In Malaysia, 2013–2022

Source: NMP Data

Malaria among agricultural workers in Malaysia has slowly gain attention from public health authorities as several malaria cases has been reported among those that works in forestry, plantation, paddy farming or agricultural work (Myzabella et al., 2019, Fornace et al., 2019, Hussin et al., 2020; Naserrudin et al., 2023). Based on the observation, clearing of forest for opening of new rubber estates and other form of land-use changes for agricultural purposes may influence the mosquito vector populations and increase the chances of malaria transmission among agricultural workers (Hussin et al., 2020; Bryne et al., 2021). These land-use changes have been associated with the increased incidence of human cases of zoonotic

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transmission *Plasmodium knowlesi* in Sabah, Malaysia (Bryne et al., 2021). While it is acknowledged that performing agricultural work increases the risk of contracting malaria based on previous findings which reported agricultural workers as a high-risk group (Hussin et al., 2020; Bryne et al., 2021;Naserrudin et al., 2023), there is still a lack of precise data to support this hypothesis. Moreover, previous study by Ali and colleagues which reported lack of current information on malaria vectors in Malaysia also suggested the need for more extensive research and the systematic compilation of entomological data (Ali et al., 2023). Previous study has reported the prevalence of malaria in Sabah, Malaysia which associated with certain socio-demographic factors including types of occupations, however, there is still limitations as it is not possible to obtain information such as knowledge, attitudes and practices on malaria (Ramdzan et al., 2020). As such, this study will investigate the role of knowledge in preventing the incidence of malaria among paddy farmers and determine which aspects of the knowledge are crucial for reducing malaria cases. Subsequently, the educational interventions could be tailored accordingly, thereby addressing hazards that are less studied as compared to the steadily researched impacts of physical and chemical hazards to paddy farmers.

Research Questions:

Based on the identified research problem, the following research question guides this study:

1. What is the relationship between the role of knowledge about malaria in preventing the incidence of malaria among paddy farmers in Northern region of Malaysia.

Research Objectives:

Based on the identified research questions, the following research objective guides this study:

1. To explore the relationship between the role of knowledge about malaria in preventing the incidence of malaria among paddy farmers in Northern region of Malaysia.

Scope of the Study

This study examines the role of knowledge in preventing malaria incidence among paddy farmers in the Northern region of Malaysia. It specifically targets paddy farmers within the Muda Agricultural Development Authority (MADA) area, a region particularly vulnerable to malaria risks due to its agricultural practices and environmental conditions. Using a quantitative approach and probability cluster sampling, data is collected through a structured questionnaire. The questionnaire assesses knowledge about malaria, including its causes, symptoms, transmission modes, and preventive measures, in relation to the incidence of the disease. Statistical analyses, including correlation and regression, are used to explore the relationship between farmers' knowledge levels and malaria incidence. By focusing on the role of knowledge in malaria prevention, this study addresses a crucial yet underexplored dimension of occupational health while contributing to broader efforts to combat communicable diseases in Malaysia.

Literature Review

Agriculture has been reported as one of the most perilous occupations globally which poses diverse health and safety challenges to its workers (Irani et al., 2021). According to the website of National Institute for Occupational Safety and Health (NIOSH), agricultural workers have high likelihood to be exposed to lethal and nonlethal injuries, which also reported to affect the worker's family members that used to share the similar working activities and resides on the same living premises (NIOSH, 2023). In Malaysia, Department of Occupational Safety and Health (DOSH) has reported concerning trends related to occupational accidents in agriculture, forestry and fishery sector with a total of 1,064 accidents occurred from January to October

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2023, although it was expected that the accidents may exceeded more due to underreporting (DOSH, 2023). Von Essen and McCrudy (1998) have categorized agricultural health risk into ten distinct categories, including traumatic injuries, hearing loss, respiratory disease, cancer, chemical poisoning, dermatoses, zoonoses, heat and cold stress, musculoskeletal disorders (MSD), and green tabacco sickness (GTS).

Farming in paddy fields exposes workers to a myriad of biological agents, contributing to the risk of diseases and illness. Biological agents which denoted as occupational hazards were categorized into two groups including allergenic and/or toxic agents forming bioaerosols and agents causing zoonoses and other infectious diseases (Dutkiewicz et al., 2011). In general, bioaerosols are biological particles of organic dust and/or droplets suspended in the air which could be heavily polluted with viruses, bacteria, endotoxin, fungi, β-glucans, secondary metabolites of fungi, plant particles, particles of faeces and the bodies of mites and insects, particles of feather, faeces, hair and urine of birds and mammals. These particles are often causing occupational diseases of the respiratory tract, conjunctiva and skin (Dutkiewicz et al., 2000; Nimmermark et al., 2009). As for the agents causing zoonoses and other infectious diseases, they are mainly spread by tick or insect vectors by the alimentary route, airborne route or immediate contact with skin (Buczek et al., 2009). Vectors such as mosquitoes are living hosts that transmit disease through virus and bacteria between humans and animals via biting activity (Center for Disease Control and Prevention, 2018). Previous study by Gupta and Joshi has highlighted the suitability of water-rice fields for the growth of bacteria, viruses, fungi, mosquitoes, and parasites, leading to diseases such as malaria, hookworm and skin diseases (Gupta and Joshi, 2002).

Zoonotic malaria is transmitted through the bite of an infected female Anopheles mosquitoes. The transmission of malaria involves complex life cycle that includes both humans and mosquitoes. When mosquitoes infected with Plasmodium knowlesi bites a person, it will inject the malaria parasites into the bloodstream. These parasites will then travel to the liver where it will mature and multiplies before entering the bloodstream again to infect the blood cells. The cycle continues when the mosquitoes subsequently bite an infected person, ingest the parasites and then transmit the malaria parasites by biting another person causing new transmission (Singh and Daneshvar, 2013). Due to these modes of transmission, malaria has been considered as a communicable disease. Communicable disease is known as infectious or contagious diseases that is caused by infectious agents including bacteria, viruses, parasites or fungi that can be transmitted from one person, animal or vector to another. The Sustainable Development Goal 3 (SDG3) recognizes malaria as one of the major concerns, warranting attention and research to fight against the communicable diseases along with epidemics of AIDS, tuberculosis and neglected tropical diseases and combat hepatitis as well as water-borne diseases (Global Goals, 2023). Moreover, malaria also rises concern due to its high dependency in antimalarial drug for treatment instead of effective malaria vaccine which is till date is still undergoing clinical trials.

Occupational safety and health (OSH) management approach is vital in ensuring the well-being of the paddy farmer against exposure to malaria diseases. The use of personal protective measures such as long-sleeved clothing could aid in reducing the risk of mosquito bite and transmission of malaria (DOSH, 2002). Previous study reported strong awareness on the importance of wearing protective clothing such as long shirts and pants to avoid mosquito bite, although it had limitations as mosquito can bite areas that is not covered by clothing such as hands, fingers, head and neck (Naserrudin et al., 2023). Larvicide approach also demonstrated

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its feasibility in controlling malaria vectors. According to various literature reviews, larvicide showed wide acceptance by the community, safe to be used as it only targeted malaria vector and low in costs as compared to other vector control measures (Derua et al., 2019). Paddy field workers should also be protected through provision of systematic health surveillance and monitoring services as well as uses of mosquito nets to curb the malaria transmission (Babamale et al., 2020; Zou et al., 2023). Predominantly, Knowledge dissemination plays a critical role in lowering malaria incidence by increasing awareness among agricultural workers about risks, transmission, and prevention measures (Matowo et al., 2022).

To provide a structured summary of the key studies reviewed, Table 1 categorizes the literature into three main themes: Biological Hazards, Knowledge Dissemination, and Malaria Prevention Strategies. These themes encapsulate the critical findings and implications from the reviewed works, offering a clear overview of the role of knowledge in addressing malaria risks among paddy farmers. The table highlights both the practical applications and the research gaps identified in the literature, serving as a foundation for further exploration within this study.

Table 1: Summary of Past Findings

Reference	Category	Key Findings	Implications and Research Gaps
Cooper et al. (2020)	Biological Hazards	• Over 98% of malaria cases caused by *Plasmodium knowlesi*. • Highest risk in men involved in agricultural work. • Standard prevention methods like bed nets are not effective.	• Need for targeted interventions specific to agricultural workers.
Dutkiewicz et al. (2011)	Biological Hazards	• Bioaerosols and zoonotic diseases are major occupational hazards. • Highlights the role of mosquito-borne diseases like malaria in occupational health hazards.	• Educational programs can reduce exposure to biological hazards. • Lack of comprehensive studies linking farmer education with bioaerosol-related disease reduction.
Gupta & Joshi (2002)	Biological Hazards	• Paddy fields promote malaria and other vector-borne diseases. • Paddy fields are breeding grounds for malaria vectors, increasing the risk for workers.	• Water management education can significantly reduce vector-borne diseases. • Limited research on how knowledge of water management impacts malaria prevention.

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Addis & Wondmeneh (2023)	Knowledge Dissemination	• 64.2% had good knowledge of malaria prevention. • Knowledge directly linked to prevention practices. • Young adults showed poor healthcare seeking behaviors.	• Need for targeted education programs for agricultural workers.
Irani et al. (2021)	Knowledge Dissemination	• Agriculture is a high-risk sector requiring enhanced knowledge for safety. • Highlights the occupational health risks faced by agricultural workers, including exposure to malaria vectors.	• Knowledge dissemination can improve safety practices among agricultural workers. • Limited studies on the role of knowledge in specific agricultural hazards, such as malaria.
Global Goals (2023)	Knowledge Dissemination	• Emphasizes the need for health education under SDG3 to combat malaria. • Recognizes malaria as a critical health issue requiring global and localized interventions.	• Aligning education initiatives with SDG3 can ensure long-term health sustainability. • Gaps in localized SDG-aligned malaria prevention strategies for paddy farmers.
Matowo et al. (2022)	Knowledge Dissemination	• Farmers struggle to identify malaria vectors and manage pesticide resistance. • Farmers' limited knowledge of malaria vectors hinders effective vector control strategies.	• Education on vector identification and pesticide resistance can improve vector control. • Need for studies exploring the link between pesticide education and resistance management.
Rahim et al. (2024)	Knowledge Dissemination	• Heterogeneity in knowledge levels among populations. • Asymptomatic cases present in communities. • Need for improved surveillance.	• Limited understanding of knowledge variations among specific occupational groups.

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Naserrudin et al. (2023)	Malaria Prevention Strategies	• Farmers are aware of protective clothing but face challenges with full coverage. • Farmers' incomplete use of protective measures exposes them to malaria risks.	• Knowledge-driven strategies can improve personal protective measures among agricultural workers. • Need for tailored education to address incomplete or incorrect protective practices.
Derua et al. (2019)	Malaria Prevention Strategies	• Larvicides are cost-effective and widely accepted for malaria vector control. • Larvicides can effectively control malaria vectors in agricultural settings.	• Larvicide education can enhance vector control acceptance and effectiveness. • Gaps in understanding farmer attitudes toward larvicides and their long-term use.
Naserrudin et al. (2023)	Malaria Prevention Strategies	• Strong awareness of protective clothing importance. • Limitations in protection for exposed body parts. • Need for comprehensive protection strategies.	• Need for improved personal protection methods.
Zou et al. (2023)	Malaria Prevention Strategies	• Highlights the need for worker education on effective malaria prevention. • Knowledge dissemination can empower agricultural workers to adopt effective malaria prevention measures.	• Preventive education can improve malaria control among high-risk groups. • Limited focus on the scalability of knowledge-driven prevention strategies.

Definition of Malaria Knowledge

According to Failoc-Rojas and colleague, knowledge was denoted as an accurate perception of risk. It encompasses the aspects of knowledge regarding the malaria vectors, route of transmission, symptoms of the disease and preventive controls executed by the paddy farmers (Failoc-Rojas et al., 2023).

Definition of Malaria Disease

Malaria disease refers to disease with a febrile-like symptom caused by protozoan parasites of the genus Plasmodium knowlesi which is prevalent causes of malaria in humans, particularly in Southeast Asia. These parasites are notable for its rapid replication and potentially severe

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disease course which is transmitted by the bites of infected Anopheles mosquitoes (Sato, 2021). Malaria disease will generally exhibit symptoms such as headache, chills, vomiting, dizziness, fever and cough (Van Eijk et al., 2020).

Relationship Between Malaria Knowledge and Malaria Disease

Health-related knowledge is of paramount importance supported by evident link between individual health knowledge, health actions, and health effects (Friis et al., 2016). Studies shown that individuals that exhibited inadequate level of health knowledge are more than twice as likely to encounter adverse health effects (Australian Commission on Safety and Quality in Health Care, 2013). Previous studies have demonstrated level of malaria knowledge between rural and urban communities. Rural communities which mainly reside in malaria prone areas commonly exhibited enhanced levels of knowledge in malaria and correct knowledge regarding the symptoms and control measures due to first-hand experience and direct exposure to the zoonotic disease (Gupta et al., 2016). In contrast, urban communities which have better access and broad exposure to information, health education talks and campaigns, and easy access to healthcare facilities exhibited better understanding on the mode of disease transmission and activities that prone to malaria infection. This may be due to various exposure of public health reports, health talks, and educational information to urban communities thus highlighted the importance of evading mosquito bites, using bed nets, and implementing preventive controls.

Health education interventions aimed at improving knowledge or altering attitudes and behaviours have been proven to impact the incidence of malaria. The WHO reported that possessing a comprehensive understanding of the causes, infection symptoms, signs, transmission modes, and preventive control of malaria leads to the adoption of malaria prevention policies and enhances health-seeking behaviours (Sixpence et al., 2020). For example, in Peru and Ecuador, health education significantly increased knowledge about the malaria vector and uses of bed nets, resulting in a decline in malaria cases (Simsek et al., 2005).

Theoretical Underpinning

This study draws upon two key theories to establish its conceptual foundation: the Occupational Health Behavioural Theory and the Knowledge-Attitude-Practice (KAP) Model. The Occupational Health Behavioural Theory emphasizes how individual behaviors influence occupational health outcomes, particularly in high-risk work environments like agriculture (Moradhaseli et al., 2020). It suggests that workers' behaviors, such as adherence to protective measures and safety guidelines, are shaped by their awareness of workplace hazards and their ability to mitigate these risks . The nature of agricultural work, as described in the agricultural occupational health behavioural model by Moradhaseli et al. (2020), serves as a contextual condition influencing the prevalence of occupational diseases. Workers' psychological and physical insecurities contribute to unsafe work activities, increasing the likelihood of human errors that result in work injuries or diseases. Such non-compliance with occupational health behavior is a critical factor in escalating workplace hazards (Geer et al., 2006).

However, the prevalence of occupational diseases in agriculture can be moderated by effective occupational safety and health (OSH) management, which includes educational programs, safety requirements for equipment and inputs, and other supporting factors (Moradhaseli et al., 2020). Increasing awareness, organizing regular educational programs, and providing ongoing training for agricultural workers are vital strategies to improve health outcomes in the agricultural sector. Furthermore, government involvement plays a pivotal role in health

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promotion. Awareness of governmental support motivates workers to exhibit better occupational health behaviors, thereby reducing the prevalence of workplace injuries and diseases (Moradhaseli et al., 2020). This theory is highly relevant to paddy farmers, whose actions such as wearing protective clothing, using mosquito nets, and adopting larvicide measures can directly impact their exposure to malaria vectors.

Additionally, the Knowledge-Attitude-Practice (KAP) Model complements this by focusing on the progression from knowledge acquisition to behavioral change (Tairou et al., 2022). The model postulates that individuals who acquire knowledge about a health issue, such as malaria, are more likely to develop positive attitudes and adopt preventive practices. This is particularly relevant to paddy farmers, as knowledge about malaria transmission, symptoms, and prevention can empower them to adopt proactive behaviors that reduce the incidence of malaria (Kala et al., 2021). Together, these theories provide a robust framework for understanding the role of knowledge in influencing behaviors and outcomes. They support the hypothesis that enhancing farmers' knowledge about malaria will lead to the adoption of preventive practices, thereby reducing the incidence of the disease.

Theoretical Framework

The theoretical framework for this study is designed to explore the relationship between malaria knowledge, as the independent variable, and malaria incidence, as the dependent variable. Malaria knowledge refers to the level of awareness and understanding among paddy farmers regarding malaria transmission, symptoms, and prevention methods. This includes knowledge of effective preventive measures, such as eliminating mosquito breeding sites, using protective clothing, and applying larvicides. Malaria incidence represents the occurrence of malaria cases within the farming population. The framework posits that increased knowledge about malaria empowers farmers to adopt preventive behaviors, which in turn reduces the risk of infection. Figure 2 visually represents this framework by illustrating the direct relationship between malaria knowledge and malaria incidence. The independent variable (malaria knowledge) directly influences the dependent variable (malaria incidence), highlighting the critical role of education and awareness in reducing disease occurrence among paddy farmers. This simple conceptual model underscores the study's focus on the importance of malaria knowledge in mitigating the disease.

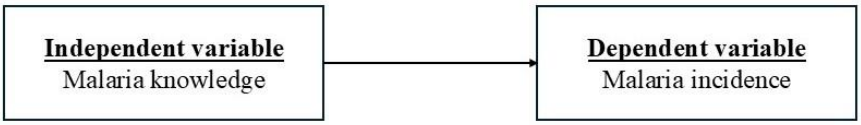

Figure 2: Theoretical Framework

Methodology

This conceptual study aims to explore the role of knowledge in preventing malaria incidence among paddy farmers in Kedah Darul Aman, located in the Northern region of Malaysia. Using a quantitative approach, this research will rely on a structured survey questionnaire to gather data on malaria knowledge and its relationship to malaria incidence. The theoretical foundation of this study, which integrates the Occupational Health Behavioural Theory and the Knowledge-Attitude-Practice (KAP) Model, underpins the research objectives by providing a conceptual framework to explore how knowledge influences malaria prevention behaviours and reduces disease incidence among paddy farmers. The research process is structured to systematically achieve the study objectives through a series of key stages, as illustrated in the

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research flow diagram (Figure 3). The diagram outlines the sequential steps, starting with identifying the study area and population, followed by sampling, development and validation of the survey instrument, data collection, and finally, statistical analysis using SPSS. This structured approach ensures that the study comprehensively addresses the research questions while maintaining methodological rigor.

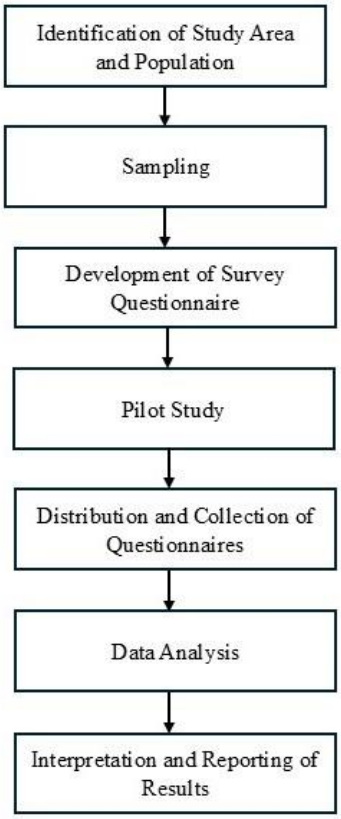

Figure 3: Flow Chart of Research Process

Study Design

A cross-sectional survey design will be employed, focusing on the Muda Agricultural Development Authority (MADA) area. The study targets paddy farmers as they are at high risk of exposure to malaria due to their agricultural practices and environmental factors. Probability cluster sampling will be used to select a representative sample.

Survey Instrument

The primary data collection tool for this study is a structured survey questionnaire, which is designed to capture comprehensive information related to malaria knowledge and its relationship to malaria incidence. The questionnaire is divided into two main sections. The first section gathers socio-demographic data, including respondents' age, gender, education level, and farming practices. The second section assesses respondents' knowledge about malaria, focusing on transmission, symptoms, and preventive measures (Table 2). This section employs a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree) to measure the degree of agreement or understanding. The questionnaire has been adapted from Fang et al. (2021) to ensure relevance and reliability. A pilot study will also be conducted to validate the tool and confirm its internal consistency using Cronbach's alpha.

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Table 2: Knowledge Items For Malaria Disease

Knowledge	Items
Malaria infection	1) Through mosquito bites
	2) Through food/water
	3) Through contact with another workers
	4) Through the air particles
Sign of infection	1) Fever, shivering, sweating
	2) Flu and rashes
	3) Prolonged cough and constipation
Preventive measures	1) Consume antimalarial drug or applying mosquito repellent during farming activities
	2) Wearing protective clothing
	3) Sleeping under insecticide-treated nets
	4) Spraying insecticide on the wall surface

Data Collection and Analysis

Data collection will involve distributing the adapted survey questionnaires to paddy farmers in the Muda Agricultural Development Authority (MADA) area. Probability cluster sampling will be used to ensure that the sample adequately represents the population. The process may face challenges, including difficulty accessing farmers due to their demanding farming activities and communication barriers during the data collection period. To address these challenges, the research team will engage local intermediaries to facilitate communication and participation, and flexible scheduling will be implemented to accommodate farmers' availability.

Upon collection, the data will be managed systematically to ensure integrity and confidentiality. Responses will be checked for accuracy, and any inconsistencies will be addressed before analysis. Statistical analysis will be conducted using SPSS software. Descriptive statistics will summarize the socio-demographic and malaria knowledge data, while inferential techniques such as correlation and regression analysis will examine the relationship between malaria knowledge and malaria incidence. The results will provide insights into how knowledge influences preventive practices and health outcomes among paddy farmers.

Discussion

Finding of this research will provide fundamental knowledge on the relationship between the role of knowledge about malaria in preventing the incidence of the disease. It is expected that this research will demonstrate inverse relationships suggesting that increasing farmers' knowledge and awareness will empower them to adopt more effective malaria prevention strategies, thereby reducing the incidence of the disease. With regression analysis, higher scores on accurate knowledge, for example understanding that malaria is transmitted through mosquito bites should be correlated with lower incidence of malaria. In contrast, incorrect knowledge items such as thinking malaria is transmitted through air particles will demonstrate no significant correlation or even positive correlation of the respondents reflect misconceptions. The output of this research could be shared with the Department of Safety and Health (DOSH) and Disease Control Division, Ministry of Health (MOH) to give the general overview on the risk of paddy farmers to be contacting malaria. The data of malaria cases associated with paddy farming could serves as a guideline for future awareness program for

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Disease Control Division, MOH and DOSH for the improvement of current guidelines on occupational safety and health in agriculture focusing on malaria vectors, its transmission, and preventive ways.

This effort aligns with the effort of Ministry of Health (MOH) to eradicate or reduce the number of malaria cases caused by zoonotic infection in humans and Sustainable Development Goal (SDG) 3, which recognizes the importance of combating diseases such as malaria. The SDG3 policy emphasizes the need for research, attention, and strategic measures to address communicable diseases and epidemics, including malaria. In addition, enhanced knowledge in malaria disease, its transmission mode and prevention could also help to create safe and secure working environments as denoted by SDG8.

Conclusion

While Malaysia's progress toward human malaria elimination is commendable, zoonotic malaria remains a significant challenge, particularly among agricultural communities such as paddy farmers. As this is a conceptual study, achieving the stated objectives involves laying a theoretical foundation for future empirical research. The framework and insights presented here aim to guide future investigations into the role of knowledge in malaria prevention. The primary contribution of this study lies in its potential to inform future educational and policy interventions aimed at mitigating malaria risks among paddy farmers. By emphasizing the importance of knowledge dissemination, this study aligns with broader public health goals, including Sustainable Development Goal 3 (SDG 3), which focuses on combating communicable diseases such as malaria, and Sustainable Development Goal 8 (SDG 8), which promotes decent work and economic growth. Enhancing farmers' knowledge and reducing malaria incidence directly contribute to improving agricultural productivity and creating safer working conditions, which are integral to SDG 8. Future studies should empirically validate the proposed framework by collecting and analysing data from paddy farmers. These studies could explore additional factors, such as cultural beliefs, environmental influences, and economic barriers, that may affect malaria prevention efforts. Furthermore, expanding research to other agricultural communities beyond paddy farmers could enhance the generalizability of findings.

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