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# Revisiting the Role of Health Literacy in Predicting Knowlesi Malaria Prevention Behaviour: Evidence from At-Risk Communities in Peninsular Malaysia

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## ABSTRACT

Health literacy has been widely recognised as a key determinant of health behaviour; however, there's insufficient evidence for its role in shaping prevention behaviours in zoonotic disease contexts. The current study attempts to revisit the role of health literacy in predicting behavioural intention towards Knowlesi malaria prevention behaviours among at-risk communities in Peninsular Malaysia. The Integrated Behaviour Model (IBM) is used to examine how attitudes, perceived norms, personal agency, and health literacy influence the intention to perform four Knowlesi malaria prevention behaviours: wearing long-sleeved clothing during outdoor activities, using mosquito repellents, using bed nets, and using mosquito coils. Data were collected through a cross-sectional survey among 440 respondents from four malaria-endemic districts and were analysed using IBM SPSS version 27 software. The hierarchical regression analysis indicates that IBM constructs, attitudes, perceived norms, and personal agency showed strong and significant associations with behavioural intention across all prevention behaviours. But, health literacy showed limited and inconsistent predictive power, with no significant effect observed for certain behaviours and a negative association in others. These findings challenge the common assumptions regarding the role of health literacy in promoting health behaviours. The results suggest that while health literacy enhances an individual's capacity to process information, it does not necessarily translate into behavioural intention without the support of motivational or social determinants. This study contributes to health communication scholarship and helps policy-makers by highlighting the need to integrate cognitive, social, and contextual factors when designing effective malaria intervention strategies, especially for at-risk populations.

**Keywords:** *Knowlesi malaria prevention behaviours, integrated behaviour model, health literacy, at-risk communities, Peninsular Malaysia.*

## INTRODUCTION

Plasmodium knowlesi Malaria (Knowlesi malaria) has become a notable public health concern in Southeast Asia, with Malaysia reporting a steady increase in cases. The country has reported 18,965 confirmed Knowlesi malaria cases between 2018 and 2024, and contributes to approximately 87.4% of total Knowlesi malaria cases worldwide in 2023 with 14 indigenous Knowlesi malaria-related death (Theivindran et al., 2025; World Health Organization, 2024).

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This has been a continuous challenge for the Malaysian government despite various steps taken to eradicate human-only malaria species (Fornace et al., 2023). Unlike the usual malaria, Knowlesi malaria poses unique challenges due to its multi-layered transmission cycle involving human, vector, the anopheles mosquitoes and the long-tailed and pig-tailed monkeys' reservoirs. Besides that, environmental changes such as deforestation, agricultural expansions, and increased human interaction with this new forest ecosystem have contributed to a continuous transmission of Knowlesi malaria among the at-risk communities. Hence, the necessity to look at this issue beyond the public health lens. In this context, Knowlesi malaria prevention behaviours among at-risk communities play a critical role in reducing exposure and transmission risk.

From the health communication perspective, reducing the transmission of Knowlesi malaria through prevention behaviours solely depends on individuals' readiness to practice the prevention measures. While health communication campaigns mainly increase awareness and disseminate Knowlesi malaria prevention-related information, it must be understood that behaviour change does not occur by just acquiring information. Individuals will only be able to have sustainable behaviour change when they understand the health message and evaluate the prevention behaviours according to perceived risk and convenience (Sahin et al., 2019).

Not only that, but researchers have also recognised that disease prevention is not entirely dependent on medical interventions. This has led to increasing interest in health literacy as a key determinant of health behaviour. Health literacy is broadly defined as the capacity to access, comprehend, appraise, and apply health-related information in making informed decisions (Sørensen et al., 2012). Existing research has established that higher levels of health literacy are generally associated with improved health outcomes and improved prevention practices across both non-communicable and infectious diseases (Paakkari & Okan, 2020).

But growing evidence suggests that the relationship between health literacy and behaviour is not always direct. While individuals may possess enough knowledge of health risks and prevention measures, this does not necessarily translate into actual behavioural adoption. For example, in the context of COVID-19, studies show that uptake of preventive measures varied significantly across populations. It was also found to be influenced by factors such as perceived risk, social norms, and the reliability of information sources (Uchibori et al., 2022). This suggests that health literacy alone may be insufficient to drive behavioural change without broader social and psychological support mechanisms.

Prior studies have investigated malaria prevention practices through various determinants such as malaria knowledge, perceived risk, perception, cultural beliefs, and occupational exposure (Grigg et al., 2017; Manin et al., 2016; Naserrudin et al., 2023). Another study also highlighted the behavioural factors, such as sleeping outside, engaging in forest- related activities, such as plantation works or hunting, contribute to mosquito bites that increase the risk of increased Knowlesi malaria infections (Grigg et al., 2017). Although these studies establish a foundation for understanding the behavioural risk factors, the studies mostly focus on individual behaviours rather than the communication process that contributes to behavioural intentions using established behavioural theories (Naserrudin et al., 2022).

Within health communication scholarship, behavioural theories such as the Integrated Behavioural Model (IBM) provide a valuable framework for understanding how intentions toward health behaviours are created. The IBM posits that behavioural intention is primarily formed by attitudes, perceived norms, and personal agency (Kasprzyk & Montano, 2012). While the IBM has been widely utilised in various health contexts, its application to zoonotic disease remains limited. Besides that, studies that integrate health literacy and the IBM framework have received little empirical attention, particularly in understanding whether cognitive capacity improves or merely complements motivational determinants of behaviour.

In the context of Knowlesi malaria, existing studies have mostly focused on epidemiological, clinical, and environmental aspects, with limited attention given to behavioural and communication-related determinants. This presents a critical gap, as prevention behaviours such as using mosquito repellents, bed nets, and long-sleeved clothing are essential for reducing exposure among high-risk populations. Therefore, this study revisits the role of health literacy in predicting malaria prevention behaviour intention within a communication-based behavioural framework. Based on the IBM constructs, this study examines how attitudes, perceived norms, personal agency, and health literacy influence intention to perform prevention behaviours against *Knowlesi* malaria among at-risk communities in Peninsular Malaysia. With this, the study aims to critically evaluate if health literacy functions as a direct predictor of behaviour or only as a context-dependent factor within a broader scheme of behavioural determinants.

## MATERIALS AND METHODS

### *Health Literacy and Health Behaviour*

Health literacy has been widely acknowledged as a driving factor of health behaviour, especially in the context of health communication and disease prevention. It is defined as an individual's ability to access, understand, appraise, and apply health-related information in making informed decisions (Sørensen et al., 2012). Current studies have shown that higher levels of health literacy are closely linked with better prevention behaviours, improved risk perception and better engagement with health services (Paakkari & Okan, 2020; Sentell et al., 2017).

In addition, in the infectious diseases' context, health literacy plays a crucial role in determining behavioural responses. For example, during the COVID-19 pandemic, individuals who reported high health literacy were more likely to observe prevention measures such as wearing a face mask, receiving a vaccine, and practising good hygiene (El Islami et al., 2023; Hange et al., 2022; Paakkari & Okan, 2020). Likewise, recent research on vector-borne diseases suggests that knowledge and awareness facilitate uptake of prevention strategies, including the use of mosquito nets, long-sleeved clothing, and environmental management practices (Kalitsilo et al., 2025; Wang, 2024).

But emerging evidence continues to underscore the limitations on the predictive power of health literacy alone. A number of studies highlight the consistent disparities between knowledge and behaviour, stating that individuals may possess sufficient awareness but can still fail to adopt prevention behaviours resulting due to attitudinal, social, and contextual influences (Alves, 2023; Kirby & Lindly, 2024). This suggests that health literacy alone is insufficient to drive behavioural change, particularly in complex socio-cultural contexts. Especially among the rural or at-risk populations, lifestyle, cultural beliefs,

and challenges in accessing the tools for prevention behaviours may further hinder the translation of knowledge into practice. This necessitates examining health literacy together with other behavioural determinants.

*Behavioural Determinants and the Integrated Behaviour Model*

To further understand health behaviour, researchers continuously adopt theory-driven frameworks that incorporate cognitive, sociocultural, and motivational factors. The Integrated Behavioural Model (IBM) is a theory that offers an integrated approach, positing that behavioural intention is the most immediate predictor of behaviour and is shaped by attitudes, perceived norms, and personal agency (Kasprzyk & Montano, 2012; Rhodes et al., 2007).

Recent studies continue to validate the relevance of these constructs in predicting health-related behaviours. Attitudes have been shown to influence preventive practices such as vaccination uptake and other protective health behaviours (Akmatova et al., 2024; Malik et al., 2023). Perceived norms, particularly social expectations and peer influence, have been identified as strong predictors of compliance with preventive behaviours during health crises and disease outbreaks (Akfırat et al., 2023; Geber, 2023). Personal agency, including self-efficacy and perceived behavioural control, has also been consistently associated with individuals' ability to adopt and sustain preventive health behaviours within communication-based intervention contexts (Liu et al., 2022).

In the context of malaria prevention, behavioural determinants such as perceived risk, social influence, and confidence in prevention measures have been found to significantly affect practices such as bed net usage and vector avoidance behaviours (Monroe et al., 2021). Despite this, limited studies have applied the IBM comprehensively within zoonotic disease contexts, particularly in Southeast Asia. Furthermore, the interaction between health literacy and IBM constructs remains underexplored. While health literacy enhances individuals' cognitive capacity, behavioural theories suggest that motivation and social influence are equally important in shaping behavioural intention. This gap further highlights the need for comprehensive approaches that combine cognitive and behavioural perspectives.

*Health Communication and Malaria Preventive Behaviour*

In behavioural change, health communication is the key instrument that translates knowledge. Current strategies, especially Social and Behaviour Change Communication (SBCC), highlight participatory approaches, audience segmentations and culturally tailored message designs to influence health behaviours (Birhanu et al., 2025). Recent research shows that communication strategies can notably enhance malaria prevention practices. For example, a community-based malaria intervention that integrated interpersonal communication, community enablers, and an audience participatory approach has shown successful uptake of insecticide-treated nets and other preventive measures (Kebede et al., 2020). At the same time, another study also confirms that a multi-channel communication strategy integrating traditional and digital media increased awareness and behavioural adherence in both infectious and vector-borne disease contexts (Awasthi et al., 2024).

But present communication interventions mostly emphasise information dissemination over behavioural motivation. Many intervention programmes concentrate on improving knowledge without properly addressing attitudes, perceived norms, and self-

efficacy, which are crucial drivers of behaviour. This constraint is especially evident in the context of zoonotic malaria because behavioural judgements are shaped by complex occupational, sociocultural and environmental factors (Naserrudin et al., 2022).

For example, in the context of Knowlesi malaria, at-risk communities in Malaysia living in forest-fringe and rural areas face unique exposure risks due to occupational activities, closeness to vector habitats, and varying access to health information (Azlan et al., 2023). These challenges further highlight the need for communication strategies that go beyond awareness to comprehensively address behavioural determinants.

*Integrating Health Literacy with the Integrated Behaviour Model (IBM)*

It is evident that the IBM has shown sturdy predictive ability in many health behaviours; at the same time, it also stresses the importance of individuals possessing adequate knowledge and skills to perform the intended health behaviour (Kasprzyk & Montano, 2012). This shows that individuals can still fail to adopt specific prevention behaviours regardless of possessing a positive attitude about the prevention behaviour, having social support or even having the confidence to perform the prevention behaviour if they are not able to obtain, comprehend, or evaluate the relevant health information.

The role of health literacy becomes an important addition to IBM in this context. From the health communication perspective, health literacy reflects individuals' ability to receive, process and translate health information into informed behavioural decisions. A recent study also emphasised that health literacy works in parallel with behavioural determinants by improving self-efficacy and motivation to make informed decisions to strengthen health-promotion (Liang et al., 2024). So, in the current study, integrating IBM and health literacy may provide an inclusive framework for determining the at-risk communities' intention to perform Knowlesi malaria prevention behaviour, where it relies heavily on individuals' interpretation and application of health messages. Besides that, there is no known evidence of studies that have combined health literacy with IBM to study intention to perform Knowlesi malaria prevention behaviour among the at-risk community in Peninsular Malaysia. Addressing this gap will be useful for future evidence-based behavioural communication interventions for zoonotic malaria transmission among at-risk communities.

## METHODOLOGY

*Research Design and Study Setting*

This study employed a quantitative cross-sectional survey design to examine the determinants of malaria preventive behavioural intention among at-risk communities in Peninsular Malaysia. Cross-sectional designs are widely used in public health and social science research to assess relationships between variables at a single point in time and to identify patterns within a defined population (Wang & Cheng, 2020). This design is particularly appropriate for investigating behavioural intentions and perceptions in real-world settings where longitudinal data collection may be constrained.

Data were collected from four malaria-endemic districts in Peninsular Malaysia Kampar (Perak), Kuala Lipis (Pahang), Gua Musang (Kelantan), and Kota Tinggi (Johor). These locations were selected based on epidemiological evidence indicating a higher incidence of *Plasmodium knowlesi* malaria in 2019 and the presence of at-risk populations residing in forest-fringe environments.

*Participants and Sampling*

The study targeted adults residing in high-risk communities, particularly those with potential exposure to zoonotic malaria due to environmental and occupational factors. A purposive sampling approach was employed to ensure that respondents were suitable for the research objectives and represented populations most vulnerable to Knowlesi malaria transmission. This sampling method allows for intentional selection of participants who meet predefined inclusion criteria and are considered to be the most suitable method for studying a particular environment (Etikan et al., 2016). Participants for the study were recruited through the respective District Health Offices in the study locations to ensure eligibility. Only participants who reside in the selected districts for more than a year and agree to participate were included in the study. Each participant was informed of the purpose of the study, and a written informed consent form was signed by all participants. A total of 440 respondents participated in the study. This sample size is considered adequate for regression-based analysis and allows for robust estimation of relationships between variables.

*Data Collection and Instrumentation*

Data were collected using a structured, interviewer-administered questionnaire after considering participants' varying literacy levels. Local health district officers from each study location were trained as enumerators to ensure question clarity, minimise missing data, and to enhance response reliability.

The questionnaire consisted of five sections measuring key constructs of IBM, which are attitudes, perceived norms, and personal agency. Questions on health literacy were adapted from a validated instrument, HLS-M-Q18, which assesses individuals' ability to access, understand, and use health information (Mirza et al., 2020). Behavioural intention was measured across four malaria prevention behaviours, which are wearing long-sleeved clothing, using mosquito repellents, using bed nets, and using mosquito coils.

All items were measured using a five-point Likert scale ranging from strongly disagree to strongly agree. Likert-scale measurement method was used as it is widely used in quantitative research to capture perceptions, attitudes, and behavioural tendencies in a structured manner (Joshi et al., 2015). Before conducting the main survey, health communication experts reviewed the questionnaire to ensure clarity and appropriateness and minor revisions were made according to their suggestions.

A pilot test involving 30 participants was also conducted to ensure the questionnaire's reliability, and contextual relevance prior to the main data collection (Damanhuri et al., 2025). A Cronbach's alpha evaluation was done to determine the internal consistency. All constructs showed acceptable reliability values surpassing the recommended threshold of 0.70 (Hair et al., 2019; Taber, 2018). This indicates that the research instrument was suitable for the main study. Internal consistency was evaluated using Cronbach's alpha, with all constructs demonstrating acceptable reliability values exceeding the recommended threshold of 0.70 (Hair et al., 2022; Taber, 2018). These findings indicated that the instrument was suitable for administration in the main study.

*Data Analysis*

IBM SPSS version 27 software was used to analyse the data. Descriptive statistics were used to summarise respondent characteristics. It was used to summarise the patterns and variations of the study variables. Then, to examine the relationships between variables,

hierarchical multiple regression analysis was employed. All the IBM constructs, which are attitude, perceived norms and personal agency, were computed in the first block and health literacy was computed as an additional variable in the second block. This was done to assess the incremental contribution of predictor variables entered in blocks, making it particularly suitable for theory-driven research (Hair et al., 2014). The change in the coefficient of determination ($\Delta R^2$) between the first and second blocks was examined to assess whether the inclusion of health literacy significantly improves the predictive ability of the model. Various assessments were conducted to ensure the robustness of the analysis, including assessment of multicollinearity using the Variance Inflation Factor (VIF) and tolerance values, and evaluation of model fit using $R^2$ and ANOVA.

## RESULTS AND DISCUSSION

### *Overview of Respondents*

A total of 440 respondents from four malaria-endemic districts in Peninsular Malaysia, Kampar (Perak), Kuala Lipis (Pahang), Gua Musang (Kelantan), and Kota Tinggi (Johor) participated in this study. The sample consisted of individuals living in high-risk surroundings, including rural areas and forest fringes.

Table 1: Sociodemographic characteristics of respondents (N = 440)

| Characteristics | Frequency | % | Mean (SD) |
|---|---|---|---|
| **Gender** | | | |
| Male | 251 | 57.0 | |
| Female | 189 | 43.0 | |
| **Age** | | | 40.1 (14.7) |
| Ethnicity | | | |
| Malay | 250 | 56.8 | |
| Orang Asli | 134 | 30.4 | |
| India | 2 | 0.5 | |
| Chinese | 9 | 2.0 | |
| Pakistan | 2 | 0.5 | |
| Indonesian | 25 | 5.7 | |
| Dusun | 1 | 0.2 | |
| Myanmar | 4 | 0.9 | |
| Thailand | 4 | 0.9 | |
| Bangladesh | 9 | 2.0 | |
| **Nationality** | | | |
| Malaysians | 395 | 89.8 | |
| Non-Malaysians | 45 | 11.2 | |
| **Category of cases** | | | |
| Actual case | 88 | 20.0 | |
| Close contact | 352 | 80.0 | |

Table 1 shows the mean age of respondents, approximately 40 years, with males being higher than females. The majority were Malaysians, consisting mostly of Malays and Orang Asli.

*Descriptive Findings of Key Variables*

Table 2: Descriptive statistics of IBM constructs, health literacy, and preventive behaviour intentions

| Variable | Mean | SD |
|---|---|---|
| **Attitudes** | | |
| Wearing long-sleeved clothing | 3.06 | 0.55 |
| Mosquito repellents | 2.74 | 0.52 |
| Bed nets | 3.05 | 0.73 |
| Mosquito coils | 2.86 | 0.55 |
| **Personal Agency** | | |
| Wearing long-sleeved clothing | 3.09 | 0.42 |
| Mosquito repellents | 2.77 | 0.46 |
| Bed nets | 2.85 | 0.47 |
| Mosquito coils | 3.05 | 0.42 |
| **Perceived Norms** | | |
| Wearing long-sleeved clothing | 3.11 | 0.71 |
| Mosquito repellents | 2.77 | 0.46 |
| Bed nets | 3.05 | 0.74 |
| Mosquito coils | 3.03 | 0.68 |
| Health Literacy | 2.89 | 0.49 |
| **Behavioural Intention** | | |
| Wearing long-sleeved clothing | 3.12 | 0.57 |
| Mosquito repellents | 2.72 | 0.74 |
| Bed nets | 2.79 | 0.71 |
| Mosquito coils | 2.91 | 0.73 |

As shown in Table 2, respondents demonstrated higher mean scores for wearing long-sleeved clothing and for using bed net prevention behaviours than for using mosquito repellents and mosquito coils prevention behaviours. A similar pattern was observed across the IBM constructs, attitudes, perceived norms, and personal agency. This indicates that some prevention behaviours are more positively perceived and socially accepted within the community. Health literacy levels among respondents were moderate, suggesting that while respondents possess some understanding of Knowlesi malaria prevention behaviours, gaps still exist in translating knowledge into actionable behaviour.

*Hierarchical Regression Analysis*

The hierarchical regression analysis was conducted to examine the influence of IBM constructs (attitudes, perceived norms, personal agency) and health literacy on respondents' intentions to perform the four Knowlesi malaria prevention behaviours.

Table 3: Hierarchical Regression Analysis Predicting Preventive Behaviour Intentions

| Predictor | Long Sleeve (β) | Repellent (β) | Bed Net (β) | Coil (β) |
|---|---|---|---|---|
| Attitude | 0.346*** | 0.430*** | 0.369*** | 0.531*** |
| Perceived Norms | -0.180** | 0.277*** | 0.339*** | 0.250*** |
| Personal Agency | 0.168** | 0.205*** | 0.213*** | 0.138*** |
| Health Literacy | 0.012 (ns) | -0.113*** | -0.124*** | -0.125*** |
| $R^2$ | 0.142 | 0.582 | 0.683 | 0.643 |
| $\Delta R^2$ (HL added) | 0.000 | 0.011 | 0.010 | 0.013 |

Table 3 presents the results of the hierarchical regression analysis for each Knowlesi malaria-prevention behaviour.

*Wearing Long-Sleeved Clothing*

The regression model for wearing long-sleeved clothing explained approximately 14.2% of the variance in behavioural intention, demonstrating a moderate predictive size. As for the IBM constructs, attitude and personal agency emerged as significant positive predictors. This suggests that individuals are more inclined to wear long-sleeved clothing when they perceive the behaviour as practical and personally performable. These findings strengthen the importance of perceived usefulness and self-efficacy in forming prevention intentions. This is evident in behaviours that require daily adoption and adjustment to comfort. Another factor could be due to the fact that the majority of the study population are Muslims, where wearing long-sleeved clothing is in line with their religious requirement for females.

However, perceived norms show a substantial negative relationship with behavioural intention. This could be due to the community's usual lifestyle, where wearing long-sleeved clothing during outdoor activities may not always align with their behavioural norms, clothing preferences, or occupational routines. In plantation-based locations, which are mostly hot and humid, individuals may experience social and practical challenges towards sustained use of long-sleeved clothing despite its benefits as a Knowlesi malaria prevention measure.

Interestingly, including health literacy in the second block did not significantly improve the model. This again indicates that knowledge alone is insufficient to predict the intention to engage in this behaviour. This finding suggests that behavioural intention towards wearing long-sleeved clothing is influenced more strongly by motivational and contextual factors than by knowledge alone.

*Use of Mosquito Repellents*

The regression model for mosquito repellent shows strong explanatory power, accounting for 58% of the variance in the behavioural intention. As for the IBM constructs, attitudes, perceived norms, and personal agency, results show them as significant positive predictors. This indicates that respondents were inclined to use mosquito repellent when they had a positive perception of the behaviour. They may also intend to adopt the behaviour when others around them support the behaviour, and when they feel confident in their ability to perform it consistently.

Compared to wearing long-sleeved clothing, using mosquito repellent may be perceived as more convenient and socially acceptable prevention behaviours. This could explain the model's stronger predictive power. The findings also suggest that social influence and cultural norms play a crucial role in the adaptation of prevention behaviour that is easily integrated into daily routines. The inclusion of health literacy in the second block contributed to a small but statistically significant increase in explanatory power. Still, its negative relationship with prevention behaviour intention suggests a more complicated, indirect relationship between health literacy and prevention behaviour. It can be interpreted that individuals with higher health literacy may critically evaluate the effectiveness, cost, practicality or the perceived necessity of using mosquito repellent. This may potentially result in inconsistent adoption despite having the knowledge of Knowlesi malaria risk.

*Use of Bed Nets*

As for using bed nets, the regression model explained approximately 68% of the variance in behavioural intention, indicating a strong predictive power and suggesting that IBM

constructs are highly relevant to understanding this preventive behaviour. Attitudes, perceived norms, and personal agency all emerged as significant positive predictors. This underscores the influence of personal appraisal, social expectation and perceived behavioural control, which together encourage bed net usage.

The strong influence of perceived norms also reflects the possibilities of collective and domestic bed net practices, where household decisions are largely influenced by family routines, community expectations and shared sleeping arrangements. At the same time, personal agency may also play a role in deciding whether an individual feels confident of using a bed net consistently despite inconveniences such as heat, cost, maintenance or accessibility.

Although the inclusion of health literacy in the second block contributed only marginally to model improvement, it showed a significant negative association with behavioural intention. This result further confirms the argument that awareness alone does not guarantee adoption of prevention behaviour. And in some cases, an individual with higher health literacy may think bed nets are inconvenient or unnecessary in their local context, especially if they use other prevention methods.

*Use of Mosquito Coils*

Lastly, the regression model for mosquito coil Knowlesi malaria prevention behaviour explained approximately 64% of the variance in behavioural intention, indicating significant explanatory power. All IBM core constructs remained significant positive predictors, with attitude signifying the strongest effect. This posits a positive evaluation towards mosquito coil prevention behaviour. Individuals' perceptions of convenience, accessibility, cost, or effectiveness when using mosquito coils may have strongly influenced their intention to perform this Knowlesi malaria-prevention behaviour.

Specifically, perceived norms and personal agency contributed positively, which indicates that behavioural intention was strengthened by social expectations and confidence in one's ability to consistently use mosquito coils. The findings suggest that Knowlesi malaria prevention behaviours that require less comfort or behavioural adjustment may be more strongly influenced by positive attitudes compared to prevention behaviours that require greater lifestyle changes.

Here, too, health literacy showed a significant negative relationship with behavioural intention, despite contributing only slightly to the overall variance explained. This can be inferred as individuals with more knowledge may engage in more critical evaluation of possible health risks associated with smoke emissions or the effectiveness of using mosquito coils as a Knowlesi malaria prevention, which may lead to more selective behavioural intention.

*Summary of Findings*

Across all four preventive behaviours, attitudes, perceived norms, and personal agency consistently emerged as strong predictors of behavioural intention. This reinforces the significance of the Integrated Behavioural Model (IBM) in understanding Knowlesi malaria prevention behaviours within the at-risk community context. The findings propose that prevention behaviour intention is mainly shaped by motivational, social, and self-regulatory factors rather than by knowledge alone.

In contrast to the above, health literacy demonstrated a limited and unpredictable pattern of influence and shows no significant effect for some prevention behaviours and a negative association on others. These findings aligned with recent findings that the relationship between health literacy and prevention behaviour is indirect and context-dependent. While it may improve individuals' capacity to access and understand health information, prevention behaviour adoptions are still influenced by sociocultural norms, perceived practicality, environmental constraints and personal preferences.

Overall, these results emphasise the significance of communication strategies that go beyond just information dissemination. An effective Knowlesi malaria prevention intervention may require culturally grounded, behaviour-focused strategies that reinforce positive attitudes and improve individuals' ability to adopt prevention behaviours as part of their routine lifestyle.

## DISCUSSION

This study examined the role of health literacy in predicting four Knowlesi malaria prevention behavioural intentions among the four malaria-endemic at-risk communities in Peninsular Malaysia. Drawing on the (IBM), the findings provide important insights into how cognitive, social, and motivational factors interrelate in determining health behaviour in a zoonotic disease context.

### *Dominance of Behavioural Determinants over Cognitive Factors*

A key finding of this study is that the consistent and strong influence of IBM constructs, attitudes, perceived norms, and personal agency is across all preventive behaviours. This reinforces recent evidence that behavioural intention is largely shaped by motivational and social determinants rather than knowledge alone (Hammer et al., 2024)

Attitudes emerged as a strong predictor, indicating that individuals are more likely to engage in preventive behaviours when they perceive them as beneficial and personally relevant. Recent studies in health behaviour research continue to demonstrate that positive evaluations of preventive actions significantly enhance behavioural intention and increase the likelihood of behavioural adoption (Ghorbanzadeh et al., 2023; Phipps et al., 2024). Similarly, perceived norms highlight the importance of social influence, particularly in close-knit or rural communities where collective practices shape individual decision-making. Personal agency further supports this pattern, as individuals who feel capable of performing preventive behaviours are more likely to intend and sustain such practices. Recent empirical evidence continues to demonstrate that self-efficacy and perceived behavioural control remain critical determinants of preventive behaviour across infectious disease and health communication contexts (Fang et al., 2025; Kusol & Kaewpawong, 2023). Collectively, these findings suggest that behavioural intention in malaria prevention is primarily driven by social and motivational mechanisms, rather than purely cognitive understanding.

### *Revisiting the Role of Health Literacy*

Contrary to conventional expectations, health literacy in this study demonstrated limited and inconsistent influence, with no significant effect for some behaviours and negative associations for others. This result aligns with current research, which suggests that the relationship between health literacy and behaviour is indirect, context-dependent, and shaped by sociocultural and environmental factors rather than knowledge alone (Palmer et

al., 2024; Soydan et al., 2026). Recent studies further underscore that health literacy may improve individuals' ability to appraise health information, but it does not guarantee the adoption of prevention behaviour without supportive social, environmental, and structural conditions (Mcguinness et al., 2024; Wu et al., 2025). Again, this echoes the increasing recognition of a knowledge-action gap, in which awareness alone is insufficient to drive sustained behaviour change.

The findings of this study also reiterate the stand that prevention behavioural intention is influenced not only by cognition, but also by how individuals appraise the feasibility and social adequacy of adopting prevention behaviour in their everyday routines. In the current context of rural and forest-fringe populations, prevention behaviour decisions are often challenged by occupational routines, self-doubt, and accessibility of resources. As such, even though individuals possess adequate knowledge about Knowlesi malaria prevention methods, they may still demonstrate inconsistent behavioural adoption due to limitations that are beyond their immediate control.

The negative association observed in this study suggests that individuals with higher health literacy may engage in more critical evaluation of prevention behaviours, leading to selective or inconsistent adoption. They may critically assess the perceived health risks associated with prevention behaviours, assess their effectiveness, or assess their affordability before deciding to adopt prevention behaviours consistently. These findings show that health literacy functions more as an enabling or contextual factor rather than a direct behavioural influencer (Eriksson et al., 2025).

*Implications for Health Communication and Social and Behaviour Change Communication (SBCC)*

In the health communication context, while knowledge remains an important foundation, recent research emphasises that effective behaviour change requires addressing emotional, social, and contextual dimensions (Awasthi et al., 2024). Hence, health communication strategies that solely emphasise information dissemination or increasing awareness can be considered ineffective if they fail to incorporate contextual and tailored communication which takes into account the target population's societal norms and conditions.

Besides that, Social and Behaviour Change Communication (SBCC) strategies provide a more holistic approach by integrating behavioural theory and audience participation. Studies suggest that SBCC interventions that incorporate community enablers, culturally grounded message design and multi-channel communication are more effective in sustained behavioural change (Abdissa et al., 2024; Kebede et al., 2020). These types of strategies are especially important in combating Knowlesi malaria in this context, where behaviours are strongly influenced by collective social norms, customs, and environmental exposures.

The current result also supports this strategy, in which attitudes, perceived norms and personal agency consistently emerged as the primary forces driving behavioural intention across all prevention behaviours. While the positive attitudes towards prevention behaviours increased the possibilities of behavioural uptake, social norms and perceived community support reinforced behavioural intention. Likewise, individuals who were confident in their ability to perform prevention behaviours were more inclined to display a stronger intention to adopt and continue the behaviours. Again, these results underscore the importance of communication strategies that go beyond information dissemination and

awareness campaigns. Interventions that increase positive attitudes, leverage community norms, and enhance self-efficacy are the way forward for sustained behaviour change.

Furthermore, tailored communication materials that reflect local language or dialect, sociocultural norms, and everyday routines are more likely to enhance message relevance, resonate better with the audience, promote engagement, and ultimately lead to sustainable behavioural change. Recent studies suggest that context-dependent and audience-centred communication design significantly improve the effectiveness of health interventions, particularly in high-risk areas with limited resources (Awasthi et al., 2024).

Overall, these findings highlight the need for future Knowlesi malaria interventions to employ participatory, behaviour-focused approaches that involve community members in the design to achieve effective and sustained outcomes. Future Knowlesi malaria interventions must also ensure they are fully customised to the target population and avoid the common one-size-fits-all approaches.

*Contribution to Knowledge*

This study contributes to the body of knowledge of health communication in various ways. Firstly, it expands the application of Integrated Behaviour Model (IBM) to Knowlesi malaria, a zoonotic disease which explains its continuous relevance in explaining prevention behaviours. Secondly, this study provides evidence challenging the presumed relationship between health literacy and behaviour. Thirdly, this study adopts a behaviour-based analytical approach, showing that determinants of intention differ across different prevention behaviours, thus evolving to more multifaceted and targeted intervention strategies. Thirdly, the study adopts a behaviour-specific analytical approach, demonstrating that determinants of intention vary across different preventive behaviours, thereby advancing more nuanced and targeted intervention strategies. Lastly, by highlighting the influence of contextual, environmental, and social norm factors on prevention behaviour intentions, the study provides valuable suggestions for creating a more effective community-based communication intervention that targets at advancing sustainable Knowlesi malaria prevention behaviours.

## CONCLUSION

This study revisited the role of health literacy in predicting Knowlesi malaria prevention behaviours using a communication and behavioural framework in the context of at-risk communities in Peninsular Malaysia. Based on the core components of the Integrated Behaviour Model, attitude, perceived norms and personal agency, the result shows that behavioural intention is more strongly influenced by these components than health literacy alone. While respondents showed a moderate level of health literacy, it showed limited and inconsistent predictive power, which challenges the conventional notion that knowledge and information appraising ability directly translates into prevention behaviour uptake.

From a theoretical perspective, this study contributes to the growing body of knowledge that calls for a more multifaceted and integrative understanding of health behaviour by combining cognitive and behavioural frameworks. Basically, the study focuses on the need for context-specific community-based communication strategies, particularly those that draw on Social and Behaviour Change Communication (SBCC) approaches. Interventions should prioritise shaping positive attitudes, strengthening social norms, and

enhancing individuals' confidence in performing preventive behaviours, rather than relying solely on imparting knowledge or increasing awareness.

In conclusion, it is important that Knowlesi malaria interventions move from knowledge-based approaches to more holistic, community-based, and behaviourally informed strategies to truly reflect the lived experience of at-risk populations. Tailored communication designs that align with the sociocultural and behavioural contexts of the communities are also important considerations for enhancing message relevance and acceptance. This will ensure long-term behavioural adoption. This approach is especially important in the context of Knowlesi malaria among at-risk communities, where the risk of being exposed to the disease is closely tied to the communities' lifestyle and environment. Future research should further explore how tailored communication interventions can close the gap between knowledge and prevention behaviour adoption to ensure sustained health communication outcomes.

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