ORIGINAL ARTICLE

Understanding mobile health literacy among the working-age population: A cross-sectional study in Thailand

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ABSTRACT

Mobile health (mHealth) literacy refers to the ability of individuals to seek, find, understand, and evaluate health information accessed via mobile devices. In Thailand, an assessment of mobile health literacy among the working-age population (25-59 years old) across the country is still needed to gain a better understanding of the current landscape of this concept as well as to create strategies for improvement. As a result, this study aimed 1) to assess mHealth literacy among the Thai working-age population, 2) to investigate differences in mHealth literacy among the Thai working-age population classified by demographic variables, and 3) to identify the predictive factors affecting mHealth literacy among the Thai working-age population. Cross-sectional survey research was conducted in this study with samples consisting of 600 working-age individuals derived from six regions across the country. Respondents were randomly selected using a multi-stage sampling method. Data were collected by a self-administered questionnaire. Mean, SD, *t*-test, One-Way ANOVA, and multiple regression analysis [MRA] were used for data analysis at a .05 level of significance. The results found that 1) the samples showed a high level of mHealth literacy (Mean = 4.32, SD = 0.58) 2), differences in mHealth literacy level were classified by gender, age, income, education, and region, and 3) perceived behavioral control, attitudes, and subjective norms were factors significantly affecting mHealth literacy. These findings can be used to plan and develop strategies for improving mHealth literacy among the Thai working-age population more effectively.

Key words:
mobile health literacy; working-age population; Thailand

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INTRODUCTION

Mobile health (mHealth) literacy refers to the ability of individuals to use mobile devices to seek, find, understand, and evaluate health information to address or solve health problems.[1] Nowadays, smart phones have become necessary tools for accessing health-related information[2] and services. As such, mHealth literacy plays an important role in empowering individuals to make decisions about their health[2]. Mobile health literacy shows the skills necessary to navigate the health-related apps, websites, and online resources available on mobile platforms. This includes the ability to search for reliable health information and understand the relevance and implications of the information found.[3-4] With health apps offering various features from symptom tracking to medication reminders, individuals must possess mobile health literacy skills to assess their quality and suitability for their needs. Moreover, mHealth literacy extends to encompass comprehension and critical evaluation.[2] Users need to understand complex health concepts presented in digital platforms. Moreover, they must evaluate the reliability, accuracy, and potential biases of the information they encounter.[5] Developing these skills will help individuals to make decisions about their health, engage in productive discussions with healthcare providers, and actively participate in managing their health.[1,3] Besides, mHealth literacy is essential for promoting health equity as well as reducing disparities in access to healthcare information and services. With the increasing reliance on mobile devices for health-related activities, individuals must have these literacy skills to leverage these technologies effectively.

Thailand has seen significant growth in mobile phone penetration over the past decade, with a large portion of the population owning smartphones.[6-7] This widespread adoption of mobile technology has created opportunities for leveraging mHealth solutions to improve healthcare access and outcomes. Despite the increasing availability of mobile devices, there are challenges related to mHealth literacy in Thailand.[8-9] While mobile phone penetration in Thailand is high, there remains a digital divide between urban and rural areas.[9-10] Urban areas typically have better access to high-speed internet and newer smart phone models, while rural areas may have limited connectivity and access to older devices.[8-10] Additionally, marginalized populations, such as low-income individuals and ethnic minorities, may face barriers to accessing mobile technology.[9-11] Addressing these disparities is essential for ensuring equitable access to mHealth resources.[12-15]As a result, the Thai government has recognized the potential of mHealth to improve healthcare access and has implemented various initiatives to support its development. For example, the Ministry of Public Health and other governmental health organizations have launched mobile health apps to provide information on preventive care, disease management, and emergency services, such as MOR PROM, MOR CHANA, H4U, YaAndYou, Mental Health Check Up, and even Air4Thai. However, conducting a comprehensive study to understand the concept and the current landscape of mHealth literacy among the Thai population is still needed to address and resolve these challenges. Information about the level of mHealth literacy, differences across various demographic groups and regions, and predictive factors affecting mHealth literacy among the Thai working-age population are limited in Thailand. Consequently, this study aimed 1) to assess mHealth literacy levels among the Thai working-age population, 2) to investigate differences in mHealth literacy among the Thai working-age population classified by demographic variables, and 3) to establish the predictive factors affecting mHealth

literacy among the Thai working-age population. Regarding the identification of predictive factors, the researcher used a group of variables based on the Theory of Planned Behavior [TPB][16] as a theoretical framework. Based on a comprehensive review from previous studies[17-22], three variables in this theory, including attitude, subjective norms, and perceived behavioral control, were found to be factors affecting various health behaviors. The investigation of these three research questions would enable the outcomes to be used to plan and develop strategies for improving mHealth literacy among the Thai working-age population more effectively.

METHODS

Study design, population, and sample

Cross-sectional survey research was employed in this study using self-reporting questionnaires. The population comprised Thai working people aged between 25 and 59 years old. Multistage sampling was used to select 600 samples in 6regions throughout Thailand: North, South, North East, Central, West, and East. The size of the samples in this study was initially calculated by using Yamane's formula[23] with a 95% confidence level, an acceptable margin of error of 5%, and a significance level of .05, yielding a sample of 400 participants. However, the researcher added 50% to the estimated sample size to account for potential losses.[24-26]Ultimately, the samples comprised 600 participants. In the sampling procedure, multistage random sampling was employed. First, stratified sampling was employed at the area level to cover 6 regions in Thailand: North, South, North East, Central, West, and East. Second, simple random sampling [SRS] was used at the provincial level by randomly drawing two provinces per region. After this process, twelve provinces from six regions across the country were randomly drawn, including Nan, Phitsanulok, Songkla, Phuket, Nakhon Phanom, Udon Thani, Ayutthaya, Pathum Thani, Phetchaburi, Tak, Chonburi, and Chachoengsao. Subsequently, quota sampling (50 participants per province) was used in this stage by approaching Thai working people aged 25-59 years old around parks, shopping malls, and convenience stores in each selected province to collect data in the prior stage. The researcher selected multi-stage random sampling because this sampling method has been recommended by numerous scholars due to its appropriateness in sampling a large population.[24-26]

Data collection process

All respondents in each area received an explanation of the necessary details of the study, including the name of the researcher, research objectives, data collection process, participants' data protection rights, and then were invited to participate. They were asked to complete the questionnaire after they were informed that their participation was voluntary and that their responses would be anonymous and confidential. The results would be reported only in a group format. All participants signed informed consent forms that were then separated from their questionnaires to maintain confidentiality.

Research Instrument

The research instrument for this study was a questionnaire, divided into five parts as follows: 1) Demographic Variables - Questions about gender, age, income, education level, and region measured using multiple choices;2) Mobile health (mHealth) literacy - Questions about the respondents' ability to seek, find, understand, and evaluate health information accessed via mobile phone as adapted from a previous study[1] with eight items covering both health information

seeking (seek and find) and health information appraisal (understand and evaluate);3) Attitude towards the behavior - Questions related to a person's feelings about using a mobile phone to seek, find, understand, and evaluate health information, which also comprised eight items;4) Subjective norms - Questions to assess a person's opinions of their reference groups (friends, relatives, medical personnel, and celebrities) about what the person should do regarding mHealth literacy and the importance of those opinions to the person's conduct, which comprised 20 items in this part; 5) Perceived behavioral control, often called self-efficacy - Questions about a person's belief in their ability to carry out mHealth literacy, which was derived from both current abilities and prior experiences. Perceived behavioral control in this study was the person's perceived ease or difficulty in performing mHealth literacy. It comprised six items. From parts 2 to 5, a 5-point rating scale in the pattern of the Likert Scale was used for measurement, ranging from "strongly disagree" (1), "disagree" (2), "neutral" (3), "agree" (4) and "strongly agree" (5).

A pretest to check the quality of the research instrument with a reliability analysis was conducted with 30 working-age people in Bangkok. Cronbach's alpha was used to evaluate the internal consistency of the summed scale for analyzing the reliability of several variables (mHealth literacy, attitude, subjective norms, and perceived behavioral control). The results showed that the values of Cronbach's Alpha Coefficient ranged from 0.930 to 0.952. Scores within this range (more than 0.70) are considered an adequate indication of internal consistency.[24-26]

Statistical analysis

For statistical analyses, mean, standard deviation, *t*-test, One-Way ANOVA, and multiple regression analysis [MRA] were used in this research at a .05 level of significance. Mean and SD were used to analyze as well as describe the demographics and all studied variables. Besides, *t*-test and One-Way ANOVA were used to test differences in mHealth literacy classified by demographic variables (gender, age, income, education level, and region). Lastly, multiple regression analysis was used to analyze the predictive factors affecting mHealth literacy consecutively.

Ethical considerations

Ethical consideration for this research project was approved by the Kasetsart University Research Ethics Committee (KUREC) under Certificate No. COE66/089, Study Code KUREC-SSR66/104, dated 25 August 2023.

RESULTS

Characteristics of the study sample

The samples were 600 working-aged people, aged 25-59 years old. Most samples were female (51.5%) and had bachelor's degree level education (55%). The average age was 34.07 years old, (SD = 8.69) and the average monthly income was 27,598.93 THB (SD = 13,376.08).

Descriptions of the studied variables

Mean and standard deviation (SD) were used for analyzing this section to describe the studied variables. The overall mean of 8-item mobile health (mHealth) literacy among samples was 4.32 (SD = 0.58). The details of each item are shown in Table 2. The mean of attitude was 4.33 (SD = 0.57). The mean of the subjective norms from reference groups (friends, relatives, medical personnel, and celebrities) was 3.80 (SD = 0.67). Lastly, the mean of perceived behavioral control was 4.34 (SD = 0.61), as shown in Table 1.

Table 1. Means and SD of mobile health (mHealth) literacy and other studied variables

Mobile health (mHealth) literacy	Mean*	SD
1. I know how to find helpful health resources on a mobile phone.	4.59	0.54
2. I know how to use a mobile phone to answer my questions about health.	4.44	0.62
3. I know what health resources are available on a mobile phone.	4.42	0.68
4. I know where to find helpful health resources on a mobile phone.	4.34	0.72
5. I know how to use the health information I find on a mobile phone to help me.	4.34	0.71
6. I have the skills I need to evaluate the health resources I find on a mobile phone.	4.18	0.80
7. I can tell high-quality health resources from low-quality health resources on a mobile phone.	4.09	0.79
8. I feel confident in using information from a mobile phone to make health decisions.	4.14	0.73
Overall	**4.32**	**0.58**
Attitude	4.33	0.57
Subjective Norms	3.80	0.67
Perceived Behavioral Control	4.34	0.61

** 5-point rating scale*

Differences in mHealth literacy classified by demographic variables

Gender

After a *t*-test was conducted to check for differences in mHealth literacy between two groups classified by gender (male and female), the results found that the difference in gender led to different levels of mHealth literacy. The findings showed that female respondents exhibited significantly higher mHealth literacy levels compared to male respondents, as detailed in Table 2.

Age

To examine differences in mHealth literacy classified by age in three groups (25-29 years old, 30-39 years old, and 40-59 years old), one-way ANOVA was conducted. The findings showed that respondents aged 40-59 years old exhibited significantly lower mHealth literacy levels compared to respondents from other age groups, as detailed in Table 2. This result showed that age differences led to different levels of mHealth literacy

Income

To examine differences in mHealth literacy classified by income in four groups, as detailed in Table 2, one-way ANOVA was conducted. The findings showed that respondents who had incomes over 35,000 THB per month exhibited significantly lower mHealth literacy levels compared to respondents from other groups. This result showed that the difference in income contributed to different levels of mHealth literacy.

Education

In this part, one-way ANOVA was performed to check for differences in

mHealth literacy classified by education level in three groups. The findings showed that respondents who had graduated from high school exhibited significantly lower mHealth literacy levels compared to respondents from other education groups, as detailed in Table 2. This result demonstrated that the difference in education led to different levels of mHealth literacy.

Region

Lastly, one-way ANOVA was also conducted to check for differences in mHealth literacy classified by region in six areas (North, South, North East, Central, West, and East). This result showed that the difference in regions led to different levels of mHealth literacy. The findings indicated that respondents who lived in the western region exhibited significantly lower mHealth literacy levels compared to respondents from other region groups, as detailed in Table 2.

Table 2. Comparison of mHealth literacy mean scores according to various socio-demographic variables

Variables	Mean	SD	*t*-test/F-test	*P*
Gender				
Male	4.26	0.61	-2.245	.025*
Female	4.37	0.54		
Age				
25-29 years old	4.39	0.56	14.123	<.001**
30-39 years old	4.40	0.84		
40-59 years old	4.11	0.97		
Income (baht)				
Under 15,000	4.30	0.60	3.571	.014*
15,000 - 25,000	4.36	0.59		
25,001 - 35,000	4.40	0.55		
Over35,000	4.19	0.56		
Education level				
High School	4.00	0.81	11.895	<.001**
Bachelor's Degree	4.37	0.52		
Master's Degree/PhD	4.33	0.54		
Region				
North	4.14	0.72	4.193	<.001**
South	4.29	0.58		
North East	4.42	0.57		
Central	4.36	0.51		
West	4.08	0.52		
East	4.15	0.70		

**Significant at 0.05 level*
***Significant at 0.01 level*

Predictive factors affecting mHealth literacy among Thai working-age population.

In this part, multiple regression analysis (MRA) was performed to examine the factors affecting mHealth literacy among the Thai working-age population. The predictive factors in this study are composed of three variables based on the Theory of Planned Behavior [TPB] (attitude, subjective norms, and perceived behavioral control).[16]Standardized regression coefficients (β) and *t*-statistics were used for this analysis. Before conducting the analysis, the problem of multicollinearity was addressed by considering all correlations among independent variables. The results found that all correlations in this study were less than 0.60. This range of correlation coefficients was considered an acceptable level, indicating the absence of multicollinearity issues.[24-26] After multiple regression analysis was performed, the results showed that all three independent variables affected mHealth literacy significantly, as shown in Table 3. Perceived behavioral control showed the highest effect (β =.481)on mHealth literacy, followed by attitude (β =.411)**,** and subjective norms (β = .395), respectively. Besides, all three independent variables could significantly co-predict mHealth literacy among the Thai working-age population at 67.2 percent (Adjusted R^2 = 0.672).

Table 3. Multiple regression analysis (MRA) of mHealth literacy

Predictive Factors	**β**	***t***	***P***
1. attitude	.411	11.558	<.001**
2. subjective norm	.395	10.415	<.001**
3. perceived behavioral control	.481	14.253	<.001**
Adjusted R^2= 0.672,F= 409.321,Sig.=<.001**			

***Significant at .01 level*

DISCUSSION

From the findings of mHealth literacy, the author found that the overall mean of 8-item mobile health literacy among samples was4.32 (SD = 0.58). This value can be considered a high level (Mean = 3.51 – 4.50).[24-26]It shows that the Thai working-age population (25-59 years old) still has the ability to seek, find, understand, and evaluate health information accessed via mobile phones. However, when considering into details in each item, the author found that question no.7 had the lowest value (Mean = 4.09). Consequently, improving mHealth literacy in item no.7, which involved the ability to determine the quality of health resources on mobile phones, should be addressed further. This item was included in the dimension of health information appraisal. As a result, efforts to improve mHealth literacy in this dimension should be prioritized. This finding was related to previous studies[1,27-29] that encourage improving mHealth literacy in the dimension of health information appraisal, which covers the ability to understand and evaluate health information on mobile devices. Improving health information appraisal is crucial for ensuring that individuals have access to accurate and reliable information so they can make informed decisions about their health.[30-31]Besides, the results of studying the differences in mHealth literacy classified by demographic variables enabled the author to reveal that mobile health literacy varies across different demographic

variables within the working-age population, including gender, age, income, education level, and region. In other words, the difference in demographic variables led to different levels of mHealth literacy. The results were related to other studies[3,30-35] to support the notion that demographic variables play an important role in mHealth literacy. Consequently, understanding the importance of demographic variables in improving health literacy is essential for developing effective health interventions and policies. Demographic data on health literacy can inform policy decisions aimed at improving healthcare delivery and health outcomes. Moreover, identifying which demographic groups are most at risk of low health literacy can guide the allocation of resources as well as the development of policies to promote health literacy education and awareness. As a result, analyzing differences using *t*-test and one-way ANOVA indicated that males exhibited lower mobile health literacy than females. The population group aged 40-59 years old demonstrated lower mobile health literacy compared to other age groups. Additionally, the population with an income exceeding 35,000 THB showed lower mobile health literacy than other income groups. Similarly, the population with only a high school education background showed lower mobile health literacy compared to those with a higher education background. Lastly, the population residing in the Western region displayed lower mobile health literacy compared to those in other regions. Hence, the working-age population within these demographic groups should be addressed further to improve mHealth literacy in Thailand.

From the results of analyzing the predictive factors affecting mHealth literacy among the Thai working-age population by multiple regression analysis [MRA], the findings indicated that three variables based on the Theory of Planned Behavior [TPB][16] could be used as predictive factors to determine the level of mHealth literacy. These results are related to previous studies[21-22,36-38] that also used all three variables from the Theory of Planned Behavior [TPB] to predict health behaviors, health-risk behaviors, or even other social behaviors. From Table 8, the findings indicated that the beta value or the standardized regression coefficient (β) of perceived behavioral control was the highest (β = .481), followed by attitude (β = .411), and subjective norm (β = .395), respectively. These results can be used to prioritize planning to increase mHealth literacy among the working-age population in Thailand more effectively. Consequently, the Theory of Planned Behavior [TPB] can be a valuable framework for improving mHealth literacy as well as guiding other behavior changes in various fields such as health promotion, health education, or even environmental conservation behaviors.[39]However, this study had some limitations that must be acknowledged. First, it relied on a self-reporting questionnaire to assess mHealth literacy and other variables. This limitation may lead respondents to exaggerate their behavior, which may be due to feelings of shame or guilt. Second, respondents in this study were limited only to the working-age population (25-59 years old). Thus, any generalization of the results to other age groups may be limited. Despite these limitations, the strength of this study lies in its ability to create more understanding and unveil the current landscapes of knowledge about mHealth literacy in Thailand, especially among the working-age population.

RECOMMENDATIONS

The results of this study would be significantly beneficial for improving mHealth literacy among the working-age population in Thailand. Thus, recommendations are made for national or

local health organizations and academics in the related field of public health.

First, improving mHealth literacy among the working-age population in Thailand should emphasize the aspect of promoting health information appraisal (the dimension of understanding and evaluating health information). Promoting health information appraisal involves helping individuals develop the skills they need to understand and critically evaluate the credibility, reliability, and relevance of the health information they encounter. Promotion strategies can include1) workshops to teach individuals how to critically appraise health information in covering topics such as evaluating the source, checking for bias, and assessing the validity of research studies, 2) provision of access to reliable sources, 3) suggestion of tools and checklists that individuals can use to evaluate health information by themselves.

Second, demographic variables play a critical role in shaping health literacy levels across different population groups. Recognizing and addressing these demographic determinants of health literacy is essential for designing effective interventions that can effectively improve mHealth literacy. From the research results, males exhibited lower mobile health literacy than females. The population aged 40-59 years old demonstrated lower mobile health literacy compared to other age groups. Additionally, the population with an income exceeding 35,000 THB showed lower mobile health literacy than other income groups. Similarly, the population with only a high school education background showed lower mobile health literacy than those with a higher education background. Lastly, the population residing in the Western region displayed lower mobile health literacy compared to those in other regions. Hence, these demographic groups should be addressed further and prioritized to improve mHealth literacy throughout Thailand.

Third, perceived behavioral control, attitude, and subjective norms in improving mHealth literacy should be addressed further and promoted as significant predictive factors. If these factors are enhanced, mHealth literacy among the working-age population in Thailand tends to increase as well. To increase perceived behavioral control in mobile health literacy, the following three strategies could be **useful: 1) Enhancing skills and knowledge** by providing comprehensive tutorials, educational content, and FAQs within the mobile health app to build users' confidence in using the app effectively;2) Designing the app with a user-friendly interface to make it easy for users to navigate and find information, and reducing complexity and increasing self-efficacy;3) Offering **training and workshops** for different demographic groups to address specific challenges and reduce barriers to using mobile health applications. To increase positive attitudes towards mHealth literacy, it is important to focus on the benefits, usability, and relevance of mobile health tools, with three strategies recommended: 1) Focusing on the benefits of having mHealth literacy such as immediate access to medical information and personal health tracking;2) Ensuring that mHealth applications are user-friendly, aesthetically pleasing, and easy to navigate, which can lead to more positive user experiences;3) Providing personalized health information through the app, which can make users feel that the service is specially designed for them. Lastly, three strategies are recommended to increase subjective norm or use reference groups: 1) Showcasing testimonials and stories of successful users who have managed to improve their health using the app, which can foster belief in one’s ability to achieve similar outcomes;2) Utilizing

social proof by sharing expert endorsements, information from medical personnel or celebrities, and influencers' reviews to create a positive word-of-mouth effect;3) Using **peer education** by implementing peer-led education programs where individuals from within the community are trained to use mHealth tools and then teach others.

For further research directions, the author proposed three possible paths. First, conducting longitudinal studies to track changes in mobile health literacy over time and exploring the factors influencing these changes will help provide valuable insights into the dynamics of health literacy development and its impact on health outcomes. Second, using qualitative research methods such as interviews and focus groups will help the researcher gain a deeper understanding of individuals' experiences, attitudes, and perceptions about mobile health literacy. Third, studies to develop, design, and implement interventions aimed at improving mobile health literacy among the working-age population in Thailand should be conducted. By pursuing these research directions, scholars can contribute to the advancement of knowledge in mobile health literacy to improve health outcomes among the working-age population in Thailand more effectively.

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CONFLICTS OF INTEREST

The author has no conflicts of interest to declare. The author certifies that the submission is original work and not under review by any other publication.

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