Original Article

m-Health views and perception among Malaysian: findings from a survey among individuals living in Selangor

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Background: Information and communication technology can be a useful tool to improve population health especially in low-middle income countries. However, the full potential of m-health may be limited by the users' health and technology literacy. This study aims to explore the m-health and technology literacy among Malaysians, and factors that may promote the use of m-health.

Methods: A cross-sectional study was performed among residents residing around Klang and Petaling district in Selangor, Malaysia from November 2015 to January 2017. Multivariable logistic regression models were used to assess the predictors of mobile device and health apps usage and examine the association between apps use and intention to change behavior with sociodemographic predictors.

Results: A total of 4,504 respondents participated in our survey. Most respondents reported that they owned a mobile or smartphone, which was commonly used to make calls and deliver text messages. However, only one-fifth (20.4%) of respondents were familiar with the term m-health or had used a health related application, with millennial (individuals aged ≤39 years) generally more aware of the term m-health and were more likely to use m-health as a tool for health management. The most commonly used application were for promoting adherence as well as self-efficacy (e.g., lifestyle advice). Other factors associated with higher levels of m-health use were individuals with higher level of education and individuals taking multiple medications.

Conclusions: While most Malaysian were not familiar with m-health, they reported to have a positive attitude towards m-health. Malaysians were willing to use m-health to manage their health conditions but expressed that they required further education and training. As m-health is still at its infancy in Malaysia, there is potential to further develop m-health as an innovative solution to manage the population health.

Keywords: m-health; cross sectional survey; technology literacy; telehealth; health literacy

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Introduction

Health literacy is defined as the cognitive and social skills which determines the motivation and ability of individuals to gain access, understand and use information needed to promote, maintain and improve health (1,2). Research have shown that individuals with low health literacy have poorer engagement with health care services as well as lower knowledge of chronic disease process leading to higher hospitalization rates (2-4). A low level of health literacy was also commonly found in many low income countries as well as ethnic minorities; and is thought to explain some of the inequities in the uptake and use of health care services in many parts of the world (5).

Information and communication technologies (ICTs) are now increasingly being used in various aspects of healthcare, including management of patients with chronic diseases such as diabetes and hypertension; during routine interactions with healthcare systems such as making appointments; as well as medication refills. ICT is also used by healthcare professionals to distribute information or expertise necessary to geographically separated individuals such as patients or other consulting physicians (6-10), and has been advocated as a cost-effective solution for patients, healthcare professionals, healthcare providers, as well as health authorities in helping to address contemporary global health problems (11).

This innovation in healthcare can reduce health disparities, as it can lower health literacy demand through the use audio graphics and multiple languages to expand the capacity and reach of healthcare system. It is however unclear what are the utilization rates and role of the internet and in particular mobile health (m-health) apps in supporting the health among the general public here in Malaysia. Similarly, there is very little information on the usage of internet or m-health to perform any health related task online among individuals with limited health literacy. In this study, we explored the users' technology literacy and internet usage among individuals, in order to have a better understanding of issues related to m-health in different segments of the population.

Methods

Respondents

This was a nested study (12,13) using convenience sampling where respondents were randomly recruited from public areas (e.g., shopping malls, parks, government hospitals, primary care clinics as well as public and private universities) in the Klang and Petaling district in the state of Selangor from November 2015 to January 2017. Inclusion criteria of respondents were: aged 18 years and older; able to speak and read English, Mandarin or Malay language and were able to provide informed consent. To ensure we are able to recruit a representative demographic profile of respondents, we approached individuals of all ages and gender.

Ethical approval

No compensation was provided for study participation. The study protocol was reviewed and approved by the Medical Research and Ethics Committee, Malaysia (NMRR-14–1453-22963) and Monash University Human Research Ethics Committee (CF14/1977–201456345463). All respondents provided written informed consent. All methods were performed in accordance with the relevant national and international guidelines and regulations.

Survey instrument

Respondents were asked to complete a battery of self-administered questionnaire. The questionnaire was developed and adopted from reviewing existing literature and previous studies that have examined on the use of m-health and mobile health devices for health literacy (14-19). The questionnaire comprised of three sections: (I) respondent demographics such as age, gender, ethnicity, employment and marital relationship and education; (II) baseline health status including self-reported diseases (e.g., diabetes, cardiovascular diseases, cancer) as well as health behaviors (smoking and alcohol consumption frequency) and; (III) use of ICTs to seek for health related information to assessing cellphone/smartphone ownership, access and usage of internet, and internet/apps to obtain health information. In the latter component of the questionnaire, respondents were asked to rate on a 5-point Likert scale about their preference regarding their ability to understand health information, attitudes towards heath, and access to healthcare information.

The questionnaire was subsequently piloted among a convenience sampling of 50 individuals, and was found to have an acceptable validity and reliability (data presented separately). The questionnaire was also translated into Bahasa Malaysia (the local language) and Mandarin to suit respondents whom the English language was not their first language using forward and backward translation by

three independent reviewers whose Bahasa Malaysia and Mandarin were their first language. The final translated instrument was used in this study.

Use of mobile health devices and m-health apps

To determine the acceptance of m-health among individuals, we use the following question: "Have you used any mobile health devices or m-health for managing your health?" Specifically, participants were provided with examples of a mobile health device such as diabetes telemonitoring device, as well as teleconsultation devices. Examples of m-health apps include health monitoring app to encourage exercise, weight loss or track personal health information. Respondents were coded as willing to accept if they reported agree or strongly agree while respondents who disagree or strongly disagree were coded as not willing. We also examined factors which may affect health information seeking behavior, as previous studies have suggested that mobile device ownership are related to the availability of Internet access.

Statistical analysis

All categorical variables were described with frequencies and percentages. All continuous variables were summarized using mean and standard deviations (SD) for normally distributed data or median and interquartile range if data were skewed. To investigate the factors affecting respondent's ICT use and acceptance of m-health, chi-square tests and Pearson's correlation was used.

We conducted several logistic regression analyses to determine the relationship between use of m-health and ICT with respondent demographics. Firstly, we hypothesized that there were generational differences in ICT use between millennial (aged 39 and below) and baby boomers (aged 50 and above). We calculated the relationship using multiple logistic regression analysis using a hierarchical model. All multivariate model included the use of m-health and ICT use as the dependent variables, while respondent demographics, socioeconomic status, and baseline health measures were independent models. In secondary analyses we tested for differences in the association between ICT use by age, gender, education, or existing chronic disease by adding interaction terms into separate regression models. Significance level for all statistical analysis was $P<0.05$. All analyses were performed using Statistical Package for Social Sciences (SPSS) software version 22 (Armonk, NY, IBM Corp.).

Results

Socio-demographic characteristics of respondents

A total of 4,504 respondents responded to our study during this period, with an almost equal number of males and females (ratio 1:1.17). Most of the respondents were married (74.2%), with a median age between 41–50 years, and had had some form of formal education (92.3%). The respondents were ethnically diverse, which included Malays (42.2%), Chinese (24.7%), Indian (27.4%) and other ethnic groups (5.7%) and usually lived with their family members (*Table 1*). The demographics of participants are generally representative of the population in Malaysia, although a higher number of Indians were recruited in this study.

Electronic device ownership

All respondents reported that they owned at least one electronic device (63.6%), the most common being either a mobile or smartphone. The device was mostly used to make telephone calls and deliver text messages. However, up to 44% of respondents reported that they required some assistance from friends and family to use the device. The most common issues respondents needed help with were: connecting their device to a wireless network (49.9%), searching for information on the Internet (48.6%), and checking emails (46.9%; *Table 2*).

Ability for self-care

Most respondents reported that they were positive with their current and future health state. However, nearly half of respondents (48.2%) surveyed expressed concern about their health and were frustrated by their health problems. Most respondents reported that they were able to follow a healthy diet (70.1%), take their medications independently (65.0%) as well as perform routine exercise (57.2%, *Table 3*).

Respondents reported that they did not feel they had received adequate support from their friends and family in various aspects of their health such as maintaining a healthy diet, taking their medication, exercising regularly, attending routine medical check-ups, or handling their emotional needs in relation to their illness. A large proportion of respondents also reported poor compliance to following

Table 1 Socio-demographic characteristic of respondents

Variables	All respondents, n=4,504 (%)	Used internet to find information on health, n=2,021 (%)	Malaysian population, n=32.4 million, %
Gender			
Male	2,075 (46.1)	952 (47.1)	51.7
Female	2,429 (53.9)	1,069 (52.9)	48.3
Age (years)			
21–30	1,086 (24.1)	835 (41.3)	69.9[†]
31–40	546 (12.1)	357 (17.7)	
41–50	675 (15.0)	270 (13.4)	
51–60	1,090 (24.2)	378 (18.7)	
>60	1,107 (24.6)	181 (9.0)	6.5
Ethnic group			
Chinese	1,113 (24.7)	582 (28.8)	23.0
Malay	1,899 (42.2)	813 (40.2)	50.9
Indian	1,235 (27.4)	499 (24.7)	6.9
Others	257 (5.7)	127 (6.3)	1.0
Marital status			
Single	866 (19.2)	636 (31.5)	NA
Married	3,340 (74.2)	1,297 (64.2)	
Divorced	76 (1.7)	32 (1.6)	
Widow	222 (4.9)	56 (2.8)	
Living			
Alone	476 (10.6)	306 (15.1)	NA
Status			
Caregiver	15 (0.3)	11 (0.5)	
Family member(s)	3,759 (83.5)	1,540 (76.2)	
Friend(s)	237 (5.3)	159 (7.9)	
Nursing home	17 (0.4)	5 (0.2)	
Education level			
None	329 (7.3)	59 (2.9)	NA
Primary – secondary	2,522 (56.0)	804 (39.8)	
Diploma or equivalent	1,111 (24.7)	745 (36.9)	
Bachelor or higher	542 (12.0)	413 (20.4)	
Income level (RM/month)			
No income	2,626 (58.3)	909 (45.0)	NA
<1,000	130 (2.9)	66 (3.3)	
≥1,001-5,000	1,076 (23.9)	612 (30.3)	
≥5,001–10,000	212 (4.7)	132 (6.5)	
>10,001	33 (0.7)	22 (1.1)	
Prefer not to say	427 (9.5)	280 (13.9)	

Table 1 (*continued*)

Table 1 (*continued*)

Variables	All respondents, n=4,504 (%)	Used internet to find information on health, n=2,021 (%)	Malaysian population, n=32.4 million, %
Presence of multi-morbidities			
Hypertension	1,951 (43.3)	545 (27.0)	NA
Type 2 diabetes	1,837 (40.8)	452 (22.4)	
Hyperlipidemia	1,514 (33.6)	361 (17.9)	
Arthritis	179 (4.0)	45 (2.2)	
Asthma	171 (3.8)	61 (3.0)	
Others	229 (5.1)	61 (3.0)	
Electronic device ownership			
Mobile phones	2,309 (51.3)	722 (35.7)	NA
Smartphones	2,347 (52.1)	1,376 (68.1)	
IPad/tablet devices	816 (18.1)	602 (29.8)	
Computers	953 (21.2)	684 (33.9)	

†, data presented are for individuals aged between 20–64 years old. NA, not available.

instructions of their healthcare providers, with 30.3% of respondents reported stopping their medication when they feel better while 24.5% respondents stopped their medication when it made them feel worse.

Perception of m-health

Only one in every five respondents in the survey reported that they had used some health related application/ mobile health device. The most commonly used device were adherence aids, or an application that was pre-installed with their glucose meters for self-efficacy (e.g., receiving information, lifestyle advice). Most respondents also reported that they had limited knowledge regarding m-health or mobile health devices but were willing to use these devices if it were provided at no cost to respondents (42.7%). Interestingly, there was very little benefits of making the device more user friendly as respondents reported that it will not increase their willingness to utilize the device.

Nearly one in every two respondents also reported they were comfortable to share their health information with their healthcare professional or family members. Although respondents were optimistic about the benefits of mobile technology (e.g., receiving doctor's instructions and consultations), some expressed concerns on the accuracy of the data as well as their own personal privacy (*Table 2*).

Generational differences in healthcare preference

We stratified our analysis to determine if there were generational differences in healthcare preference between millennial and baby boomers. We found that most millennial owned two or more devices compared to baby boomers (61.1% *vs.* 9.4%, P<0.01). Baby boomers were also less inclined to use m-health as a health management strategy. Providing this group with additional support (e.g., additional education, creating simple video instructions) did not alter their opinion and intent about m-health. Conversely, millennials were more inclined to use m-health for consultation, medication management (e.g., reminders, blood glucose recording), lifestyle education and receive reminders on their appointments. They were also more likely to obtain and share health related advice online with their family and friends. However, both groups expressed concerns on privacy protections especially with the use of m-health.

Predictors of m-health app usage

Younger females especially those who own 2 or more electronic devices, those with higher education levels, were widows, and taking more than 20 medicines were more likely to embrace technology and use m-health to obtain health related information. We also noted that those who were married or had medical illnesses were more likely to

Table 2 Respondent's ability and perception towards ICT use for health (n=4,504)

Questions	Strongly disagree, n (%)	Disagree, n (%)	Neutral, n (%)	Agree, n (%)	Strongly agree, n (%)
Independently use mobile phone to connect to Wi-Fi	1,932 (42.9)	315 (7.0)	529 (11.7)	1,086 (24.1)	642 (14.3)
Able to search for information on the internet	1,849 (41.1)	337 (7.5)	509 (11.3)	1,155 (25.6)	654 (14.5)
Able to independently check e-mails	1,808 (40.1)	308 (6.8)	598 (13.3)	1,128 (25.0)	662 (14.7)
Make calls and SMS	348 (7.7)	119 (2.6)	823 (18.3)	2,098 (46.6)	1,116 (24.8)
Use mobile health devices/m-health for managing their health	2,026 (45.0)	795 (17.7)	765 (17.0)	671 (14.9)	247 (5.5)
Willing to use a mobile health device/ m-health if education was provided	554 (12.3)	383 (8.5)	1,314 (29.2)	1,782 (39.6)	471 (10.5)
Willing to use a mobile health device/ m-health if it was available free of charges	715 (15.9)	621 (13.8)	1,245 (27.6)	1,465 (32.5)	458 (10.2)
Willing to use a mobile health device/ m-health if it requires less than 10 steps to setup	576 (12.8)	568 (12.6)	1,355 (30.1)	1,583 (35.1)	422 (9.4)
Willing to use a mobile health device/ m-health if it requires less than 5 steps to setup	617 (13.7)	370 (8.2)	1,377 (30.6)	1,558 (34.6)	582 (12.9)
Comfortable with healthcare professionals to monitor my health using mobile health device	590 (13.1)	415 (9.2)	1211 (26.9)	1694 (37.6)	594 (13.2)
Comfortable with my health information being shared with family members	646 (14.3)	541 (12.0)	1,253 (27.8)	1,539 (34.2)	525 (11.7)
Use of mobile health technology to provide reminders	708 (15.7)	407 (9.0)	1,282 (28.5)	1,567 (34.8)	540 (12.0)
Use of mobile health technology to adjust medicine	742 (16.5)	425 (9.4)	1,347 (29.9)	1,515 (33.6)	475 (10.5)
Confident that mobile health technology can communicate my health condition accurately to medical professional	747 (16.6)	503 (11.2)	1,456 (32.3)	1,372 (30.5)	426 (9.5)
Confident that my privacy is protected	827 (18.4)	600 (13.3)	1,425 (31.6)	1,229 (27.3)	423 (9.4)

use m-health to manage their health condition (*Table 4*).

Discussion

This study was designed to elucidate and assess the Malaysians' ICT use in order to learn whether patients were interested in using m-health for chronic disease management. We found that younger individuals aged 39 and below, those with higher educational status and those who owned 2 or more mobile devices were more interested in adopting and using m-health and health related applications in their daily lives. The most common health services/application which they would use are the medication reminder, telemonitoring and teleconsultation services. Result of this study concurs with previous studies that have shown that the younger generation who grew up with technology was more inclined to adopt technology in managing their health issues (20-22). Furthermore, as younger respondents were more technology savvy compared to their older peers, this allows for an easier adoption of

Table 3 Respondent's ability to self-care and manage their health condition (n=4,504)

Questions	Strongly disagree, n (%)	Disagree, n (%)	Neutral, n (%)	Agree, n (%)	Strongly agree, n (%)
I was discouraged by my health conditions	1,665 (37.0)	613 (13.6)	916 (20.3)	1,082 (24.0)	228 (5.1)
I was fearful about my future health	1,398 (30.1)	759 (16.9)	930 (20.6)	1,157 (25.7)	276 (6.1)
My health is a worry in my life	1,315 (29.2)	681 (15.1)	1,085 (24.1)	1,155 (25.6)	268 (6.0)
I was frustrated by my health problems	1,406 (31.2)	764 (17.0)	1,077 (23.9)	1,028 (22.8)	229 (5.1)
I can independently follow a diet plan	222 (4.9)	290 (6.4)	835 (18.5)	2,358 (52.4)	799 (17.7)
I can independently take my medicine	317 (7.0)	417 (9.3)	842 (18.7)	2,173 (48.2)	755 (16.8)
I can independently exercise	486 (10.8)	846 (18.8)	881 (19.6)	1,637 (36.3)	654 (14.5)
I can independently attend my routine medical check-up	381 (8.5)	507 (11.3)	965 (21.4)	1,937 (43.0)	714 (15.9)
I can independently handle my feelings about my illness	356 (7.9)	480 (10.7)	1,118 (24.8)	1,830 (40.6)	720 (16.0)

technology among the younger population whenever new technologies are introduced. Results of this study also concur with a previous study conducted in Malaysia, which showed that Malaysians were receptive to use technology to seek for health related information, including obtaining information about the health condition, its symptoms and treatment options available (23-26).

The use of m-health can be a useful strategy to expand health care and empower individuals to monitor their own health and potentially reduce the cost of medical care (11). Malaysia as a developing country with a robust technology economy can be expected to benefit from the use of m-health services due to its high Internet and broadband penetration rates as well as high mobile penetration at 144.8%, indicating that most Malaysians currently own more than one mobile device (24). However, there is little research on how much interest in m-health exists among the Malaysian public. The feasibility of implementation of m-health in a primary care setting remains unclear. Results of this study suggest that m-health can be a feasible modality to assist Malaysians in taking charge of their own chronic condition. However, results from this study also suggest that most respondents were somewhat interested in using technology to manage their health. This result was similar to other studies performed to date (16,22,27). In a study by Samiei *et al.*, the authors reported that only 56.1% of respondents in Malaysia were interested in using Internet-based self-management program (28). This could be due to several reasons, including participants preference for face-to-face communication with their healthcare providers (29,30), limited understanding of the various functions of a smartphone as well as issues with the cost of embracing such technology (9).

The success and implementation of any m-health program depends upon the acceptance of users and healthcare professionals. A study by Ibrahim *et al.* reported that healthcare professionals were positive in their views about m-health (20). However, many of them still value face-to-face communication with their patients and consider direct communication with patients as important, especially prior to performing any procedure on a patient (25,26). The authors also reported that in order to improve users' acceptance of m-health, there is a need for additional education and training. This concurs with results of this study, where respondents reported that they were more willing to use a mobile health device if education was provided and if the procedure of using a mobile health device was simple.

Overall, results from this study showed that although respondents were optimistic about their current and future health, many individuals still require support in various lifestyle-related activities such as engaging in regular exercise, and emotional support. Due to the increasing innovation in medical devices and application such as wearables, remote monitoring, on-call doctors, online support groups, and various other technological innovation coupled with the increased connectivity in Malaysia, respondents had access to services that were specifically tailored to their needs. Unfortunately, as many as 62% of respondents had no knowledge that such m-health services

Table 4 Estimates of regression coefficient of multilevel regression analysis for patient characteristics stratified by preference of using m-health

Parameters (reference category)	Use of m-health to manage health condition	Use of m-health to improve health literacy
Intercept	1.433***	0.948***
Female patient (male)	0.218**	0.221**
Age group (21–30 years)		
31–40 years	0.675***	0.620***
41–50 years	0.424**	–0.030
51–60 years	–0.087	–0.333**
>60 years	–0.346*	–0.590***
Presence of comorbidities (none)		
One	0.520***	–0.036
Two or more	1.368***	0.296
Living status (alone)		
With caregiver	–0.571	–0.343
With family	–0.146	0.062
With friends	–1.201*	–0.655***
In a nursing home	–1.372	–1.009
Device ownership (one)		
Two	0.727***	0.799***
Three	0.403*	0.588**
Four	0.530	0.424
Five or more	–0.733	0.062
Marital status (single)		
Married	0.432**	0.053
Divorced	0.270	0.359
Widow	1.624***	1.207***
No of medications taken daily (5 or less)		
5–10	–0.238**	–0.210*
11–20	0.010	–0.014
>20	2.661*	2.488*

*, P value <0.05; **, P value <0.01; ***, P value <0.001.

existed. Similarly, less than half of the respondents viewed that m-health was beneficial in managing their health. This could have led to the lack of interest of respondents to use health management technologies. Additionally, slow connectivity, incompatibility of software and hardware, insufficient understanding of the benefits of m-health could be a possible reason for the low interest in utilizing m-health. Privacy of data and sharing of information with family members is another concern among respondents (29-31). As such, education initiatives are required to inform the Malaysian public on the benefits of m-health in managing their health as well as promote self-care management. This needs to go hand in hand with government policies to further promote the use of m-health.

Although results of this survey showed that millennial were more inclined to use m-health and mobile health applications compared to baby boomers', the adoption of m-health was not encouraging as only half of the millennial were willing to use m-health to manage their health. As this generation is usually younger and healthier, these factors could possibly explain the lack of urgency to maintain their health leading to the lackluster uptake of m-health. A low inclination on the use m-health amongst baby boomers was expected as respondents' view that the use of technology was unable to improve their health compared to conventional methods. Furthermore, these respondents reportedly showed a lack of interest to adopt and learn newer technologies such as m-health to care for their health. Therefore, this needs to be taken into consideration in any future policy implementation since most respondents felt that the current conventional monitoring methods were the best solution for them.

This study has several limitations which need to be taken into context. Firstly, results of this study are limited by the sampling method used. While we attempted to recruit as many and representative sample as possible using proportionate sampling, this was not feasible the limited resources we had. We were only able to compare the demographics between our cohort versus the general population in several parameters, namely gender, ethnic and age groups only. This was because these were the only data publically available and our attempt to have access to other data was not granted. However, the demographic profile of our respondents is generally similar to Malaysians in general, albeit higher proportion of Indian recruited in the sample (32), lending credibility to the findings. In addition, we had not examined the test-retest reliability of the questionnaire due to the cross-sectional design of the study. The samples were recruited from two districts which were semi-urban and urban setting and thus may not represent the opinion of those living in rural settings or other regions of the country. Finally, our questionnaire had examined limited domains to examine the reasons behind different reasons and preference for m-Health adoptions among participants. Nevertheless, we plan to explore the reasons for these differences in our qualitative research in the future.

In summary, m-health has the potential to bring about pragmatic changes to healthcare. Results of this study suggest that respondents were receptive to use m-health if sufficient training and education were provided. While resistance towards adopting new technology is common, a holistic approach involving the participation of various stakeholders such as academics, industry players, healthcare professionals and early adopters are required for the effective implementation of m-health.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study protocol was reviewed and approved by the Medical Research and Ethics Committee, Malaysia (NMRR-14–1453-22963) and Monash University Human Research Ethics Committee (CF14/1977–201456345463). All respondents provided written informed consent. All methods were performed in accordance with the relevant national and international guidelines and regulations.

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