Original Article



# Factors driving the use of mobile health app: insights from a survey

**Nur Farahin Mohd Johari[1,2]^, Nazlena Mohamad Ali[1]^, Mohamad Hidir Mhd Salim[1]^, Nor Aniza Abdullah[3]^**

[1]Institute of Visual Informatics, The National University of Malaysia, Bangi, Malaysia; [2]College of Computing, Informatics and Mathematics, Universiti Teknologi MARA, Melaka Branch, Melaka, Malaysia; [3]Faculty of Computer Science and Information Technology, University of Malaya, Kuala Lumpur, Malaysia

*Contributions:* (I) Conception and design: NF Mohd Johari, N Mohamad Ali, MH Mhd Salim; (II) Administrative support: NF Mohd Johari, N Mohamad Ali, MH Mhd Salim; (III) Provision of study materials or patients: NF Mohd Johari, N Mohamad Ali, MH Mhd Salim; (IV) Collection and assembly of data: NF Mohd Johari; (V) Data analysis and interpretation: NF Mohd Johari, N Mohamad Ali, MH Mhd Salim; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

*Correspondence to:* Nazlena Mohamad Ali, PhD. Institute of Visual Informatics, The National University of Malaysia, Level 1, Akademia Siber Teknopolis, 43600 Bangi, Selangor, Malaysia. Email: nazlena.ali@ukm.edu.my.

**Background:** Mobile health (mHealth) offers easy accessibility to healthcare information and services, promoting positive behaviour change. However, user engagement to mHealth diminishes over time, resulting in significant dropout rates. This study aims to investigate the factors contributing to the discontinuation of mHealth use and examine how persuasive elements influence users' intention to continue using mHealth. It also seeks to identify the key motivators and barriers affecting mHealth engagement.

**Methods:** A survey was conducted to assess persuasive elements, motivators, and barriers related to mHealth usage. The survey included measures to evaluate users' perceived persuasiveness of mHealth, the factors influencing their intention to continue using it, and both the motivators and barriers to its sustained use.

**Results:** The analysis revealed that unobtrusiveness had the strongest positive correlation with the intention to continue using mHealth. Additionally, a positive association was found between users' perception of mHealth's persuasiveness and their intention to continue using it. The study also identified key motivators that encourage mHealth adoption and several barriers that hinder long-term engagement.

**Conclusions:** These findings highlight the importance of developing strategies to enhance the long-term adoption of mHealth solutions and reduce dropout rates. Future research is needed to explore effective interventions for sustaining mHealth usage and addressing the barriers that lead to disengagement.

**Keywords:** Mobile health (mHealth); digital health; behaviour change; persuasive; persuasion

Received: 23 July 2024; Accepted: 13 December 2024; Published online: 14 March 2025.
doi: 10.21037/mhealth-24-44
**View this article at:** https://dx.doi.org/10.21037/mhealth-24-44

## Introduction

Mobile health (mHealth) refers to the use of mobile technology, such as smartphones or mobile apps, to deliver or support psychological or mental health interventions in healthcare, as well as public health practices (1). The dependence on mobile phones grew to nearly 100% worldwide during the pandemic, specifically in Malaysia (2). In conjunction with the Industrial Revolution 4.0 (IR4.0), the utilisation of this type of application has the chance to positively influence and contribute to enhancing individual well-being behaviour and outcomes, as well as to the government. The term 'revolution' in IR4.0 represents

^ ORCID: Nur Farahin Mohd Johari, 0000-0002-8339-0440; Nazlena Mohamad Ali, 0000-0002-2267-8328; Mohamad Hidir Mhd Salim, 0000-0003-4594-7751; Nor Aniza Abdullah, 0000-0001-6218-8772.

the sudden and radical changes in industries, economic, and social structures, including mHealth. Meanwhile, the number 4 replicates the fourth phase of the Industrial Revolution. As described by Papulova and Krcmery (3), the IR4.0 in healthcare is no different than other sectors, and the revolutions in healthcare are also known as Healthcare 4.0, Health 4.0, or eHealth. Healthcare 4.0 will significantly impact the healthcare sector by integrating the advances of current technology such as artificial intelligence (AI), the Internet of Things (IoT), and telemedicine into healthcare delivery systems (4), fundamentally altering how health services are provided and managed (5). Numerous mHealth applications have been developed that target several health-related objectives, such as managing sugar levels in the body, controlling weight, managing calorie consumption, assisting with physical activity, reducing stress, and managing sleep patterns. The number of mHealth developments is reported to keep growing daily, with an average of 200 new apps launched daily (6). These mobile apps have gained significant attention and recognition due to their ability to modify and influence users' behaviours and attitudes through well-designed digital interactions.

The success of mHealth applications heavily depends on their ability to persuade and engage users. Persuasiveness motivates users to modify, adopt and maintain healthy behaviours. This necessitates the incorporation of effective strategies to sustain user interest and commitment. Persuasive technology (PT) plays a pivotal role in this context, utilising various techniques to influence user behaviour towards achieving health-related goals. PT extends to Persuasive System Design (PSD) and Behaviour Change Support Systems (BCSS). They provide essential frameworks to persuade and facilitate behaviour change. There are several key components of PSD, such as primary task support, dialogue support, system credibility support, and social support (7), which are integral to the design of mHealth applications. For instance, mHealth apps often simplify health tracking (primary task support), send reminders and motivational messages (dialogue support), establish credibility through endorsements of certified experts (system credibility support), and foster community engagement (social support).

Perceived persuasiveness is a critical factor in the adoption and continued use of mHealth services. It refers to how users believe an application can influence their attitudes and behaviours. Research has shown that trust, perceived usefulness, and perceived ease of use are positively associated with mHealth service adoption (7). For example, as emphasised by Wan Ahmad and Mohamad Ali (8) trust plays a central role in whether users will adopt and continue using persuasive systems. If users perceive an app as persuasive, they are more likely to engage with it consistently, integrate it into their daily routines, and achieve their health goals. This perception is shaped by the app's design, functionality, and the relevance of its features to the user's personal health needs.

Despite the benefits of mHealth apps utilised with PSD components and BCSS, many studies reported that adopting these apps does not last long. One-quarter of users admit that they only use the app once after downloading it (9). A recent study by Jakob *et al.* also found that a substantial number of users decided to stop using the app and not consistently use the app in the long term (6). This is consistent with a study by Karppinen *et al.* (10) who conducted a study to describe how users perceive health apps with technology interventions. Although most users had positive feedback about their apps, the study revealed that some users experienced discouragement and a subsequent loss of motivation after a certain duration, with one user even opting to discontinue app usage. These findings highlight the importance of addressing the problem of users losing interest over time. It also emphasises the need for interventions to keep users motivated and committed to using the apps in the long run.

The existing literature lacks a comprehensive understanding of the motivational factors and barriers that influence users' long-term adoption or discontinuation of mHealth

### Highlight box

**Key findings**

- Persuasive elements and perceived persuasiveness positively influence the intention to continue using mHealth.
- Unobtrusiveness has the strongest correlation with the intention to continue using mHealth.

**What is known and what is new?**

- The Persuasive System Design model only explains part of the factors influencing mHealth app usage.
- Current mHealth applications cannot often adapt dynamically to the changing needs and preferences of users.

**What is the implication, and what should change now?**

- mHealth designers should consider adaptive and personalised design to cater to individual needs.
- Further research into the underlying psychological factors that drive user behaviour in mHealth contexts can inform the design of more effective persuasive technologies.

applications. Although several studies have explored the factors influencing mHealth app adoption, there is no clear agreement on the key factors. For instance, Al Katheeri (11) emphasises trustworthiness, competition opportunities, and learnability, while Alam *et al.* (12) highlight performance expectancy, social influence, privacy, and self-efficacy. Contradictions in the findings are also present; Alam *et al.* (12) found social influence to be significant, whereas Woldeyohannes and Ngwenyama (13) reported it as less influential, focusing instead on trust in technology, interaction time, and privacy concerns. A recent scoping review further identified common app components associated with increased user engagement, such as personalised content/feedback, data visualisation, reminders/push notifications, educational materials, logging/self-monitoring functions, and goal-setting features (14). Conversely, elements like social media integration, social forums, poor app navigation, and technical difficulties were linked to decreased engagement (15). Additionally, research on mHealth adoption from a persuasive perspective remains limited, leaving a gap in understanding how to effectively engage users over time.

## Methods

A survey-based approach was used to collect data from participants who actively use mHealth apps aimed at behaviour change. The survey consisted of both closed-ended questions, assessing various dimensions of user engagement and perceived persuasiveness, as well as open-ended questions that allowed participants to express their experiences and challenges in using these apps.

This study attempts to address the following research questions (RQs):

(I) RQ1: is there a relationship between perceived persuasiveness and the intention to continue using mHealth?
(II) RQ2: what are the motivating factors for users to continue using mHealth?
(III) RQ3: what barriers lead users to discontinue the use of mHealth?

### *Participants*

The inclusion criteria for the respondents were participants who were at least 18 years old, owned a smartphone and used any health application intended to change their behaviour. According to Standen & Rothman (16) mHealth apps are designed to support users in managing their health and changing behaviours in specific domains like physical activity or calorie tracking. These apps leverage key features such as goal setting, self-monitoring, and notifications to facilitate behavioural changes towards healthier habits (17). This study used convenience sampling to recruit participants due to its practicality and accessibility [as cited by (9)]. Participants were recruited through a variety of online platforms, including social media channels (e.g., Facebook, Instagram, WhatsApp) and university mailing lists. This approach allowed us to reach a diverse group of individuals who were either currently using or had previously used mHealth applications. Recruitment materials included a brief description of the study's purpose and a link to the online survey hosted on Google Forms.

To ensure informed consent, participants were provided with detailed information about the study, including its objectives, procedures, and confidentiality assurances, before they proceeded to the survey. No specific screening process was conducted, as the study aimed to gather insights from any individuals who used mHealth apps with the intent of supporting behaviour change. This convenience sampling method was chosen to capture a wide range of experiences and perspectives related to mHealth app usage. No monetary compensation or incentive was given to drive participation. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Institute of Visual Informatics, The National University of Malaysia (No. UKM.IVI.600-4/6/P112029). We confirm that this study obtained written consent from the participants, and participants must read and agree to the study terms and conditions before answering the survey. All participants understood that the data collection was only being conducted for research purposes. We confirmed that all participants voluntarily took part in the survey.

### *Survey instrument*

The survey was divided into two primary sections. The first section gathered information on the respondents' demographic characteristics, specifically: (I) gender; (II) age; (III) race; (IV) employment status; (V) mobile operating system use/d; (VI) app type use/d; and (VII) usage duration.

The second section included the complete Perceived Persuasiveness Questionnaire (PPQ) with minor adjustments. The PPQ used in this study was adopted from Lehto *et al.* (7) and serves as a comprehensive tool designed to assess users' subjective impressions of the persuasiveness

**Table 1** Sample item in the original PPQ (7)

| Construct | Item |
|---|---|
| Primary task support | (I) NIV provides me with means to lose weight |
| | (II) NIV helps me lose weight |
| | (III) NIV helps me change my eating habits |
| Dialogue support | (I) NIV provides me with appropriate feedback |
| | (II) NIV provides me with appropriate counselling |
| | (III) NIV encourages me |

PPQ, perceived persuasiveness questionnaire; NIV, Ned i Vekt.

of a system, message, or technology. This tool is particularly relevant in evaluating how effective a mHealth application is in influencing user behaviour and encouraging sustained engagement. By focusing on perceived persuasiveness, the PPQ helps determine whether users find the app convincing, influential, and relevant enough to continue using it over time, which directly impacts their willingness to adopt and integrate it into their daily routines (10).

The original PPQ was used to evaluate Ned i Vekt (NIV), a fully automated web-based behavior change support system. NIV was designed with three primary aims: (I) to assist users in changing their eating habits; (II) to improve users' positive emotions and mood; and (III) to aid users in losing body weight.

In this study, the PPQ was adapted to assess participants' perceptions of mHealth applications. The questionnaire consists of 23 carefully structured questions that gauge participants' perceptions of how persuasive a BCSS is. These questions are grouped into four core categories based on established persuasive design principles: (I) primary task support, which examines how well the system aids users in completing their intended tasks; (II) dialogue support, which looks at how the system interacts with users through reminders, feedback, or motivational messages; (III) credibility support, which measures the system's trustworthiness and reliability in the eyes of the user; and (IV) social support, which assesses the extent to which the system fosters a sense of community or encourages peer interaction. In addition, PPQ includes design aesthetics and unobtrusiveness principles, which might affect technology usage. *Table 1* provides a sample item from the original PPQ scale developed by Lehto *et al.* (7). This inclusion serves to illustrate the type of questions or statements used in the PPQ to assess participants' perceptions, offering context to the methodology and design of the current study. The following are the sample items in the original PPQ.

In this study participants were asked to rate each item on a 5-point Likert scale, indicating the extent to which they agreed or disagreed with the statements. The results of PPQ will answer the RQ1. For this study, the PPQ was modified slightly to better align with the context of mHealth applications. The original PPQ, designed to evaluate NIV systems, was focused on weight loss and eating habits. In contrast, the present study seeks to assess a broader range of health-related applications, including those aimed at physical activity, mental health, and general wellness. As such, the questions were adapted to reflect more diverse health targets and to ensure that the constructs remain relevant across various mHealth platforms. For example, the item in the primary task support (*NIV provid*es me with means to lose weight.) was modified to "*The app provides me with means to achieve my* health target". The full modified questionnaire is provided in the Table S1 for reference. The reliability and validity of the modified PPQ were assessed through a pilot study prior to full data collection. Both reliability and validity tests were conducted to ensure that the survey questions accurately measured the constructs of interest (18). To measure the intention to continue using mHealth, the following questions were asked:

(I) I plan to keep using the app;
(II) I plan to stop using the app.

The following open-ended questions were added to the survey to capture more detailed insights into the motivations and barriers to using mHealth applications:

(I) Based on (*previous questions on the intention to continue using mHealth*), why do you plan to keep using/to stop using the app?)

### *Statistical analysis*

Spearman's correlation coefficient analysis was conducted to evaluate the relationship between PSD elements, perceived persuasiveness and the intention to continue using mHealth applications. Data analyses were performed using IBM SPSS Statistics version 28.0.1.1 (19). Spearman's correlation coefficient tests were used where required, with the P value set at less than 0.05. Correlation analysis is a statistical method utilised to describe the strength and direction of the linear connection between two variables (20). Cohen (21) suggested that the r value from 0.10 to 0.29 indicates a small or weak correlation, r=0.30 to 0.49 shows a medium or moderate correlation, while r=0.50 to 1.0 indicates a strong correlation between variables. Preliminary analyses

were performed to ensure no normality, linearity, and homoscedasticity assumptions were violated.

### *Qualitative data analysis*

The inductive approach described by Braun & Clarke (22) is used to analyse this question. This approach is about finding patterns or themes in the information without relying on predetermined theories or hypotheses. It allows researchers to explore the information without deciding on themes beforehand (23). Instead, the themes come from the information itself. In this study, two researchers were primarily involved in determining and agreeing upon the themes, with a third researcher consulted in cases of disagreement. The inductive approach involves several key steps. Initially, researchers familiarize themselves with the data by reading through it multiple times and making preliminary notes. We then generate initial codes by identifying significant features in the data and assigning codes to relevant text segments, such as "track steps" and "monitor weight". Next, these codes are collated into broader themes that capture the main ideas, for instance, combining "track steps" and "monitor weight" into the theme "personal goal". The preliminary themes are reviewed for accuracy and relevance, involving collaboration among researchers and resolving disagreements through discussion. Finally, each theme is defined and named to ensure clarity, with detailed descriptions written to encapsulate their essence and scope.

## Results

### *Demographic*

The distribution of gender within the study population shows that out of the total of 122 respondents, 70 participants identified as female, constituting 57.4% of the respondents, while 52 participants identified as male, representing 42.6% of the respondents. Ninety-seven (79.5%) of the respondents were 18–35 years old, and 72 (59.0%) were full-time employed. In terms of race, the majority of participants were Malay (n=120, 98.4%), with only 2 identifying as Indian (n=2, 1.6%). More than half (n=67, 54.9%) of respondents use the Android operating system, and n=55 (45.1%) use the iOS operating system.

The most used mHealth categories were apps related to physical activity (n=104, 85.2%), weight management apps (n=60, 49.1%), and eating habits (n=24, 19.7%). 49.1% (n=60) of respondents reported that they used more than one type of mHealth. Seventy-nine (64.8%) respondents claimed they still use the stated app, while quite a large percentage (n=43, 35.2%) of the respondents admitted that they are not using the stated apps anymore. Most respondents (n=52, 42.6%) claimed they used the mHealth system for over 12 months, 44 (36.1%) used it for 3–12 months, and 26 (21.3%) used it for less than 3 months. Participants frequently reported using popular mHealth apps such as MyFitnessPal, Nike Run Club, and Strava for health and fitness tracking. This finding aligns with the other study (24) which similarly identified MyFitnessPal, Nike Run Club, Samsung Health, and Strava as some of the most frequently utilised mHealth apps among users. These apps are widely recognised for their comprehensive features in health and fitness tracking, including activity monitoring, calorie counting, and personalised workout plans. Additionally, some participants mentioned using less common or unfamiliar mHealth apps, indicating a diversity of preferences in app selection. These "unfamiliar apps" refer to applications that are less commonly downloaded or not typically encountered in mainstream app stores. They may not have the same level of popularity or recognition as more widely used apps like *MyFitnessPal* or *Strava*.

Participants also reported using several apps for weight management and eating habits, reflecting their focus on comprehensive health and wellness. Examples include Zero-Intermittent Fasting, Calories Counter, Lose It, HealthifyMe, MyDietCoach, Weight Tracker, and Fasting Tracking. This variety shows that many users are not only focused on physical activity but also on managing their dietary habits and overall health. The demographic characteristics summary is shown in *Table 2*.

### *mHealth perceived persuasiveness and usage intention*

*Table 3* presents the results of Spearman's correlation coefficient analysis, examining the relationship between persuasiveness elements and the intention to continue using mHealth applications. The analysis reveals significant correlations between various factors and users' intentions to continue using the system. Overall, there is a moderate positive correlation between the intention to continue using the system and primary task support ($\rho$=0.388, P<0.001) and dialogue support ($\rho$=0.216, P<0.001). This study shows that perceived credibility has a moderate positive correlation to continuing to use the system ($\rho$=0.236, P<0.001). This study also demonstrates that design aesthetics influence users'

**Table 2** Respondent's demographic (N=122)

| Characteristic | Category | Value |
|---|---|---|
| Gender | Female | 70 (57.4) |
| | Male | 52 (42.6) |
| Age | 18–35 years old | 97 (79.5) |
| | 36–55 years old | 24 (19.6) |
| | Over 55 years old | 1 (0.8) |
| Race | Malay | 120 (98.4) |
| | Indian | 2 (1.6) |
| Current employment status | Employed | 72 (59.0) |
| | Unemployed | 50 (41.0) |
| Mobile operating system | Android | 67 (54.9) |
| | iOS | 55 (45.1) |
| App type use/d | Physical activity | 104 (85.2) |
| | Weight management | 60 (49.2) |
| | Eating habit | 24 (19.7) |
| | Mental health | 8 (6.6) |
| | Other | 2 (1.6) |
| Still use/not | Yes | 79 (64.8) |
| | No | 43 (35.2) |
| Usage duration | Less than 3 months | 26 (21.3) |
| | 3–12 months | 44 (36.1) |
| | Over 12 months | 52 (42.6) |

iOS, iPhone operating system.

attitudes and behaviours, as evidenced by the moderate positive correlation between the intention to continue using the system and primary task support ($\rho$=0.249, P<0.001). The analysis highlights the significant influence of unobtrusiveness ($\rho$=0.432, P<0.001) on users' intentions to continue using the system.

Consistent with the persuasion theory, our study confirms that persuasive elements influence users' intention to use mHealth systems. Our findings underscore the positive influence between perceived persuasiveness and intention to continue using mobile health applications, as indicated by a statistically significant correlation coefficient ($\rho$=0.349, P<0.001). Users' perceptions of persuasiveness influence their initial adoption of mobile health applications and impact their continued engagement and usage over time. *Table 4* represents the results of Spearman's correlation coefficient analysis, examining the relationship between perceived persuasiveness and the intention to continue using mHealth applications.

**Table 3** Spearman's correlation coefficient between persuasive elements and intention to continue using mHealth

| Persuasive element | Correlation coefficient | Sig. (2-tailed) |
|---|---|---|
| Unobtrusiveness | 0.432** | <0.001 |
| Primary task support | 0.388** | <0.001 |
| Design aesthetics | 0.249** | <0.001 |
| Perceived credibility | 0.236** | <0.001 |
| Dialogue support | 0.216** | <0.001 |

**, correlation is significant at the 0.01 level (2-tailed). Sig., significance.

**Table 4** Spearman's correlation coefficient between perceived persuasiveness and intention to continue using mHealth

| Variable | Correlation coefficient | Sig. (2-tailed) |
|---|---|---|
| Perceived persuasiveness | 0.349** | <0.001 |

**, correlation is significant at the 0.01 level (2-tailed). Sig., significance.

### *mHealth usage motivation*

To tackle RQ2 and RQ3, we added an open-ended question: "Why do you plan to keep using or stop using the app?". This addition aimed to capture a more comprehensive understanding of user intentions and the underlying reasons for their continued use or discontinuation of mHealth applications. By incorporating this open-ended question, we aimed to complement the information gathered from the perceived persuasiveness questions and gain a more comprehensive understanding of mHealth adoption's complexities. The results of this study's analysis identified three main themes as motivators for mHealth usage. These themes were derived using an inductive approach, as detailed in the previous section. This method involved a qualitative analysis where data was collected, systematically coded, and reviewed to identify patterns and significant features. The themes were then named and defined to accurately reflect the underlying user motivations. The summary for each theme, including user remarks, is presented in *Table 5*.

**Table 5** mHealth usage motivations

| Theme | Description | User's remarks |
|---|---|---|
| System usability | Refer to effectiveness (how well users can achieve their goals), efficiency (how much effort is required), and satisfaction, as outlined by the ISO. For mHealth apps, usability also considers factors like mobility, connectivity, and cognitive load (25) | "Easy to use and helps me track all my habits, such as my sleep patterns and daily water intake." (P25, female, 18–35 years, unemployed) |
| | | "Easier to use compared to other free apps." (P26, female, 18–35 years, employed) |
| | | "It is user-friendly and easy to use." (P42, female, 36–55 years, employed) |
| | | "The app is highly informative and useful for monitoring calorie intake, calorie burn, and nutrient information." (P81, female, 18–35 years, employed) |
| Personal goal | A personal goal in the context of mHealth services refers to an individual's specific, desired outcome they aim to achieve, such as weight management, fitness improvement, or stress reduction (26) | "To get my desired ideal weight and adopt healthier habits as an investment for my old age." (P3, female, 18–35 years, unemployed), (P15, female, 18–35 years, employed), (P83, male, 18–35 years, employed), (P89, female, 18–35 years, employed) |
| | | "The application convinces me to adopt a healthy lifestyle." (P7, male, 18–35 years, unemployed), (P78, female, 18–35 years, unemployed), (P90, female, 18–35 years, unemployed) |
| | | "The app helps me to track and record my exercise routine." (P13, female, 18–35 years, unemployed), (P14, male, 18–35 years, unemployed) |
| | | "Allows me to monitor the consistency of physical activities related to my health needs." (P22, female, 36–55 years, employed) |
| | | "Helps me track the number of steps I take in a day." (P23, female, 18–35 years y, employed), (P59, male, 18–35 years, employed), (P91, female, 18–35 years, unemployed) |
| System features | mHealth systems include features such as real-time health monitoring through wearable sensors, advanced data management with blockchain and encryption for security, reminders, and rewards (27,28) | "This is the only app that is compatible with my current fitness device, band, or watch." (P65, female, 18–35 years, employed) |
| | | "Because this app is connected to my weighing scale and my watch. Every time I weigh myself, it provides an analysis of my body. I really like this app." (P45, female, 18–35 years, employed) |
| | | "Convenient and compatible with my Samsung Watch." (P21, male, 18–35 years, employed) |
| | | "I love using the app as it provides me with helpful guidance." (P35, male, 18–35 years, unemployed) |
| | | "Because I've been using it for over 2 years, and it has great features." (P16, female, 18–35 years, employed) |

ISO, International Organization for Standardization; P, participant.

### *mHealth usage barriers*

Three significant barriers were identified from the responses, namely (I) constraint; (II) lack of self-efficacy; and (III) perceived obsolescence. These reasons are perceived as barriers that usually lead to discontinuation of use, non-adherence, and attrition to the system. The user's remarks (including exemplary quotes) are shown in *Table 6*.

*Figure 1* illustrates factors influencing mHealth usage intention, with persuasion, motivators, and barriers all playing crucial roles. The persuasion factors (Dialogue Support, Primary Task Support, Unobtrusiveness, Design Aesthetics, and Perceived Credibility) are derived from statistical analysis results using the Lehto *et al.* (7) questionnaire. These factors contribute to the intention to continue using mHealth applications. Meanwhile,

**Table 6** Barriers to using mHealth

| Theme | Description | User's remarks |
|---|---|---|
| Constraints | Refers to difficulties or challenges faced by users in using the application | "My Bluetooth accessory is damaged." (P4, male, 18–35 years, employed) |
| | | "The device connected to the app, my Fitbit smartwatch, is currently not functioning properly." (P24, female, 36–55 years, employed) |
| | | "Because I am busy with my daily schedule." (P50, male, 18–35 years, unemployed) |
| | | "Requires payment for a subscription plan." (P62, female, 18–35 years, employed) |
| | | "I stopped because there is a lot of content that requires payment for access, although the app as a whole is very good." (P68, female, 18–35 years, unemployed) |
| Lack of self-efficacy | Self-efficacy refers to confidence in one's ability to perform the new health behaviour (29) | "Stopped because I lack discipline." (P17, female, 18–35 years, employed) |
| | | "Difficult to commit fully." (P29, female, 18–35 years, unemployed) |
| | | "I am not a consistent person." (P64, female, 36–55 years, employed) |
| Perceived obsolescence | Describes the fact that users decide to stop using a product, even though it still fulfils its function (30) | "I can estimate on my own." (P19, male, 18–35 years, employed) |
| | | "I can exercise without using the app." (P32, female, 18–35 years, unemployed) |
| | | "Because I have already reached my desired target." (P73, female, 18–35 years, employed) |
| | | "There is no need to use it anymore." (P85, male, 36–55 years, employed) |

P, participant.

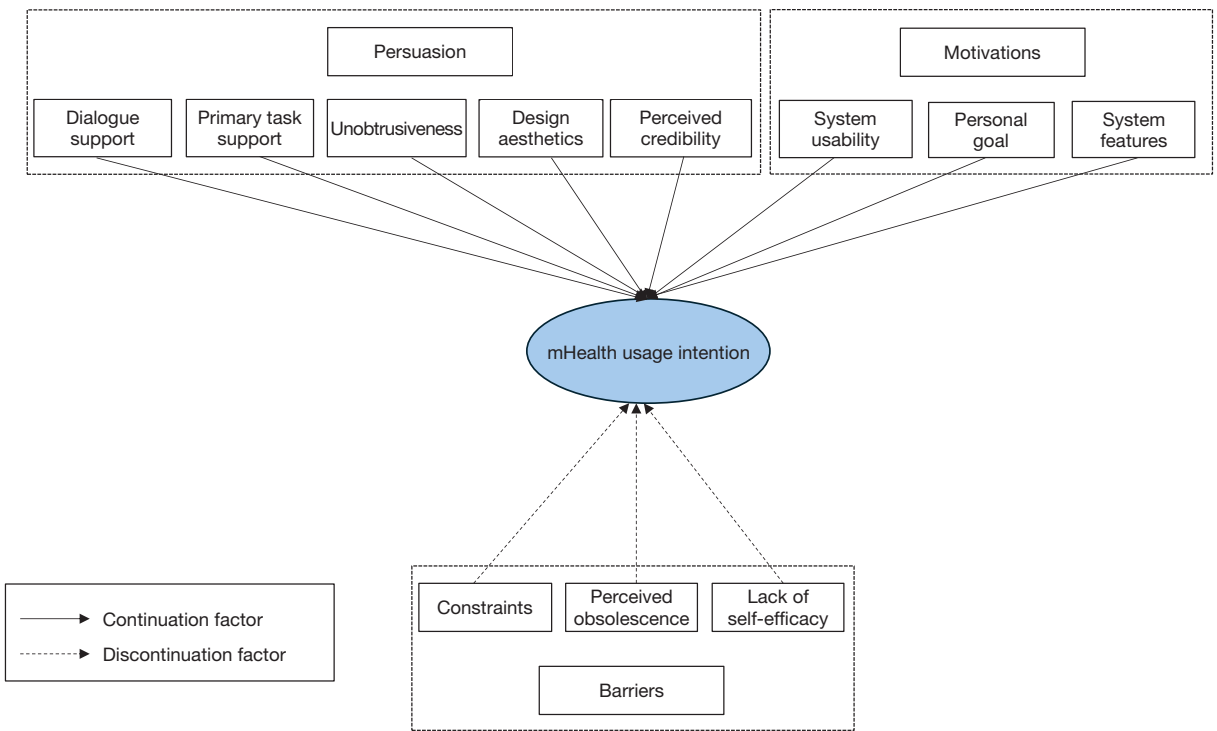


**Figure 1** Persuasion, motivations and barriers to mHealth usage.

the motivators (System Usability, Personal Goal, and System Features) and barriers (Constraints, Perceived Obsolescence, and Lack of Self-Efficacy) are identified from open-ended questions, as discussed in the previous section. These factors help to understand the reasons behind the continuation or discontinuation of mHealth usage.

## Discussion

### *mHealPerceived persuasiveness and usage intention*

In the present study, we tested the influence of the persuasive elements and perceived persuasiveness towards the intention of continuing using mHealth. Indeed, the persuasive elements appear to significantly impact the intention of continuing using mHealth (7). The results reveal varying degrees of correlation between different persuasive elements and the intention to continue using mHealth applications. Among the elements examined, unobtrusiveness demonstrated the strongest correlation ($r=0.432$, $P<0.001$) with user intention to continue using the app.

An unobtrusive system works in the background, allowing persuasive features to be effortlessly incorporated into users' regular routines without requiring extra attention to the persuasive intent or interfering with their natural flow of activities. The PSD model suggests that persuasive systems should not interfere with the user's primary tasks and should be easy to use (31,32). Unobtrusiveness is valued in mHealth because it allows users to integrate the app into their daily routine without significant interruption. Constant notifications, reminders, or prompts might overwhelm users, thus leading to disengagement. The results are likely influenced by the fact that the majority of respondents in this study are employed. The employed person often has a busy schedule, and they need technologies that can support their productivity without frequent interruptions. Physical activity and weight management apps, which are the most commonly used app types among respondents, significantly benefit from unobtrusive designs. These users need ongoing monitoring and feedback that seamlessly integrate into their daily routines without being intrusive. Moreover, long-term users (more than 12 months) represent nearly half of the respondents might also affect the results. Their extended engagement with the app suggests a higher level of trust and satisfaction towards the app. However, while unobtrusiveness minimizes disruption, it may unintentionally lower the app's ability to sustain user engagement over time. User may become less aware of their presence or decrease the feeling of urgency to engage. For instance, in the context of physical activity tracker apps, while the unobtrusive design allows the app to function quietly in the background, users might forget to check their progress or engage with the app regularly, ultimately undermining its effectiveness. On the contrary, highly obtrusive platforms—like social media apps—use updates, reminders, and persistent notifications to draw users to return to the platform. Even though it is viewed as intrusive, these persistent notifications effectively encourage users participation. These mechanisms create a sense of immediacy and fear of missing out (FOMO), driving users to engage regularly (33), even if the interruptions are disruptive. The contrast highlights a key challenge for mHealth app developers: balancing unobtrusiveness with sufficient engagement prompts. While it is important to avoid overwhelming users with constant interruptions, mHealth apps could benefit from adopting certain strategies employed by social media platforms to maintain user engagement.

Primary task support showed the second strongest correlation ($r=0.388$, $P<0.001$), indicating its significant role in driving user engagement. Primary task support refers to the extent to which the application offers tools and assistance to help users accomplish their main tasks. An example of primary task support in a mobile health application for exercise is a global positioning system (GPS)-based activity tracker. This feature assists users in monitoring their exercise sessions, such as walking, running, or cycling. It is often presented together with dialogue support features such as reminders, rewards, and praise. Given most of the respondents in this study use physical activity mobile apps, primary task support is essential to track records, simplify users' tasks and help users perform target behaviour. Physical activity apps often have clear and quantifiable goals (e.g., steps per day, calories burned), which align well with primary task support features like progress tracking and feedback. Other health apps might have more subjective goals, such as improving mental well-being or developing healthier eating habits, which could necessitate different types of primary task support. Weaker correlations for dialogue support suggest that this feature might not be as influential as it could be. While dialogue support features (e.g., reminders, push notifications) could give significant impact on the continuation of usage, studies highlighted that reminders and notifications can be intrusive or annoying, which might lead to disengagement. Personalised timing according to users' preferences and simple message might overcome this limitation (34).

Design aesthetics also demonstrated a positive, though moderate, correlation (r=0.249, P<0.001) with the intention to continue app usage. Research has consistently shown that the aesthetic appeal of a system significantly contributes to its overall usability and attractiveness, positively impacting perceived usefulness and trust in persuasive systems (35). It emerged as one of the four key attributes of user engagement, alongside other attributes such as perceived usability, and focused attention (36). This suggests that the visual design and attractiveness of a health app contribute to overall user engagement. However, the perception of aesthetics can be subjective according to individual preferences. Yet, designing for diverse user can be a complex process to satisfy individual tastes and differences. For instance, younger users might prefer bright colours, dynamic graphics, and interactive elements, while older users might prioritize simplicity, larger text, and a more straightforward layout. To overcome this issue, personalised features are suggested to enhance user engagement by allowing customization according to individual tastes (37).

Perceived credibility and dialogue support showed the weakest correlations with user intention (r=0.236, P<0.001 and r=0.216, P<0.001, respectively). Although both elements have a statistically significant impact on the intention to continue using mHealth apps, their lower correlation coefficients suggest that they may not be primary drivers of user continuation usage. In the context of persuasive systems, perceived system credibility is essential for technologies to be believable, trustworthy and persuasive. A critical issue noted by Wan Ahmad and Mohamad Ali (8) is the low-level trust problem in PT, which leads to a gradual decline in user engagement over time. Studies also have indicated that a high-credibility source tends to be more persuasive than a low-credibility one (19,38). In this study context, major respondents were young people (18–35 years old) who value credible information by the experts. Although we cannot find any studies associated with young people's perceived credibility towards physical activity mobile apps, many studies reported that young people tend to find credible sources of information (38,39). They often look for information that they perceive as trustworthy, accurate, and authoritative. For instance, in health, they tend to trust advice or information from medical experts, as this reassures them that the information is both accurate and safe to follow. Developers aiming to target a younger audience should consider incorporating elements that enhance perceived credibility, such as including expert advice, displaying relevant certifications, or integrating features that allow users to verify the source of health data. By building on the trust users have in expert information, mHealth tools can strengthen their persuasive impact and encourage sustained user engagement.

The finding that dialogue support showed the weakest correlation with user intention (r=0.216, P<0.001) raises important questions about the role of reminders, feedback, and motivational messages in sustaining mHealth app usage. Dialogue support in mHealth apps often acts as a trigger, using reminders, notifications, and motivational messages to prompt users toward certain actions, such as logging a workout or tracking dietary intake. According to Fogg (40), triggers are effective only when they align with a user's current motivation and ability. Studies have shown that reminders are effective in promoting adherence to treatment plans and appointments. For example, short message service (SMS) reminders were found to be highly accepted for improving antiretroviral treatment and healthcare appointments for people living with human immunodeficiency virus (HIV) (41,42). Given that the majority of participants in this study were young adults (18–35 years old, 79.5%) and largely employed (59%), these users may find frequent notifications and prompts from mHealth apps to be less impactful or even intrusive. Younger, tech-savvy users, particularly those with busy schedules, may prefer self-guided health management and find excessive dialogue support features, such as reminders and notifications, to disrupt their daily routines. Fogg's theory also indicates that triggers should be unobtrusive and delivered at the right moment to avoid user resistance. If dialogue support is too frequent or not contextually relevant, it may fail to persuade and could even lead to disengagement.

The persuasive systems design categories (primary task support, dialogue support, perceived credibility, design aesthetics, and unobtrusiveness) and perceived persuasiveness significantly impact the intention to continue using mHealth apps. Among these, unobtrusiveness emerged as the main factor affecting mHealth usage. However, while unobtrusive design can initially foster engagement by integrating seamlessly into daily routines, its influence appears to decline over time, as seen in this study (7). Many users, particularly within the 18–35 age group, struggle with consistent app use due to personal and situational factors such as busy schedules, work or study commitments, and competing priorities. This demographic often faces difficulties in dedicating time to mHealth apps, leading to a decrease in perceived benefits and relevance over time. Additionally, users may lose motivation if the app fails to adapt to their evolving health goals or provide

adequate support. Persuasive techniques can be effective at first, but they can also require a lot of mental and emotional effort from users. If mHealth apps do not continue to create positive feelings, like satisfaction or enthusiasm, users may stop using them because they feel tired or drained (43). Therefore, for mHealth apps to truly persuade users to keep using them, they need to balance motivating features with a positive, enjoyable experience that adapts to the user's changing needs.

This decline in adherence raises concerns about the long-term success of mHealth technologies. While technology offers the necessary tools and information to assist individuals, its effectiveness hinges on user acceptance and ease of use (39). Studies have shown that technology needs to be reliable, unobtrusive, and simple to integrate into daily life to ensure acceptance, especially among older populations (44-46). Yet, the weak correlations between the studied persuasive elements and the intention to continue using mHealth apps suggest that other underlying factors might play a more significant role in influencing user engagement and adherence. Personalisation is key here; tailoring content, recommendations, and interactions based on user behaviour, preferences, and progress can make the app experience more relevant and engaging. Adaptive features, such as dynamic goal setting, behavioural tracking, and real-time adjustments, can help the app evolve with the user's journey, enhancing its relevance (40,47). Recent research also emphasises that emotions play a crucial role in how users interact with persuasive technologies, including mHealth apps (48). From a psychological standpoint, emotions significantly influence decision-making, motivation, and behaviour change. The study suggests that persuasive strategies are not just about providing information or motivation; they must also trigger positive emotional responses, such as interest, pleasure, and satisfaction, to encourage user engagement.

However, while PT holds promise in encouraging behaviour change, the study also points to a critical challenge: the need to personalise persuasive strategies according to different demographics. For example, elderly users might benefit more from simple language and clear instructions, while younger users may require more dynamic features (49). This emphasises the importance of user-centred design in mHealth apps, as a one-size-fits-all approach may not be effective in sustaining long-term engagement. Research supports the importance of personalised mHealth interventions. For instance, Wang *et al.* describe a data-driven approach that optimizes the delivery of context-aware notifications, reducing interaction burden (50). Similarly, Woodward *et al.* emphasize tailoring notifications to better align with users' health goals (17). However, not all findings agree; James *et al.* (51) report that personalised behavioural goals did not significantly impact engagement, particularly among patients with severe mental illnesses, suggesting that a more dynamic strategy for adapting goal difficulty over time might be necessary. Ultimately, improving user adherence requires a careful balance between unobtrusive design and proactive engagement strategies, ensuring that the app remains relevant and supportive in driving consistent use and promoting effective behaviour change.

Nevertheless, from this study, the PSD model only explains part of the factors influencing mHealth app usage and adherence. While the PSD model effectively outlines how design principles can support user motivation and behaviour change, it does not fully account for other significant aspects such as user demographics, personal goals, and external constraints. The concept of a one-size-fits-all approach is not relevant to mHealth applications. The diverse needs and preferences of users necessitate a more personalised design strategy. Personalisation involves tailoring the app's features and interactions to meet individual user needs, which can significantly enhance user engagement and satisfaction.

### *mHealth usage motivations*

#### System usability

The most frequent perceived motivator is system usability. According to Kaya *et al.* (52), numerous mobile applications on the PlayStore have yet to be adopted, and some even stopped using them due to the apps' complexity, confusing features, and difficulty in use. It shows that usability is thus one of the most important quality elements influencing both the initial intention to use a system and the continuance use of mobile apps. This study found that system usability plays the most prominent role in keeping users adopting and adhering to a mHealth system. However, it is important to acknowledge the differences in information technology (IT) support among various mHealth tools. Most apps analysed in this study are relatively well-funded (Strava, NikeRunClub, MyFitnessPal, etc.), allowing for greater investment in technical support, user interface design, and ongoing updates to improve usability. In contrast, many mHealth technologies, especially those with limited financial and technical resources, may struggle to offer the same level of usability, potentially hindering user adoption and long-term engagement. A finding from Tahsin *et al.* (53)

supports the critical role of usability, highlighting that technological problems diminish user engagement and are a significant reason some people stop using the system. This disparity in IT support underscores the need for mHealth developers, particularly those with fewer resources, to focus on simplifying design and prioritizing user experience to enhance system usability.

**Personal goal**

Another dominant factor in mHealth usage is personal goals. Personal goal factors include helping users maintain weight, aiding them in managing their sleep patterns, and assisting users in controlling their daily calorie intake. mHealth is a great help that enables users to set their goals. Unlike traditional and inefficient health systems, the contemporary mHealth system allows real-time data analysis and interaction (54). The study identifies various personal goals, such as weight management, sleep pattern management, and calorie intake control, as drivers of mHealth usage. When considering demographic characteristics, it is essential to recognise that different age groups and employment statuses may have distinct personal goals related to health and wellness. For instance, younger individuals may focus more on maintaining physical fitness and managing stress levels, while older individuals may prioritize chronic disease management and overall health monitoring. By understanding these diverse personal goals, developers can tailor mHealth apps to cater to different demographic segments' specific needs and preferences.

**System features**

The mHealth systems offer various favourable features such as scheduling, reminders, real-time chat, health tracking, and care support. System features are key characteristics that influence the use of mHealth (55). It is essential to consider different demographic groups' technological preferences and familiarity. For example, respondents who predominantly use Android or iOS devices may have different expectations and preferences regarding app features and functionalities. System features could differ according to individual objectives and targets; thus, it is essential to identify the main purposes and goals of the apps to effectively cater to the needs of different users.

### *mHealth usage barriers*

**Constraints**

A few perspectives were expressed in terms of constraints. Time constraint was recognised as the challenge that stopped users from using the application. When considering the demographic characteristics of the respondents, certain groups may be more susceptible to these constraints. In this study context, employed individuals, particularly those in the 18–35 age group, may face more time constraints due to their busy schedules, which can hinder their ability to engage with mHealth apps consistently. PSD strategy has stressed the unobtrusiveness attribute, which refers to the non-interference of users' daily routines. Even mHealth involvement could benefit users in their health management, but the users themselves hold the key to a successful deployment, whether they can or are ready to commit (7). Another constraint that was identified in this study was the money constraint. Some respondents claimed that they stopped using an app because they needed to pay for a subscription, and some features were unavailable due to limited access to the free app. Unemployed respondents, who represent 41% of the sample, may face financial constraints that limit their access to paid mHealth apps or subscription-based features. Health constraints also contributed to usage discontinuation. In other words, the user cannot follow the system's recommendations or suggestions. Individuals with specific health conditions or limitations may need help to follow the recommendations or suggestions provided by mHealth apps, leading to discontinuation of use. Fogg (40), in his early study of the Fogg Behaviour Model (FBM), listed several ability factors that lead users to act. Some of them are time, money, and physical effort. Fogg defines ability as simplicity; if there is no ability, the simplicity will be lost, and the action will not happen. A finding by Mohadis & Mohamad Ali (56) expressed concerns about reminders sent during users' time at home, emphasising the need to understand the context in which user behaviours occur. Unobtrusiveness in this context involves delivering persuasive messages without causing a disturbance or interruption to users (56).

**Lack of self-efficacy**

There were a variety of thoughts about self-efficacy. According to the Cambridge Dictionary, self-efficacy is "a person's belief that they can be successful when carrying out a particular task". A study by Kwon *et al.* (57) describes self-efficacy as one's ability to perform a behaviour if one believes one can. In this study, the most reported apps used were physical activity and weight management apps. The lack of self-efficacy might be due to the user who cannot cater to app requirements. The use of physical activity

apps may pose challenges for users in meeting daily goals, while weight management apps may require adherence to specific dietary rules, which can be difficult for users and impact their self-efficacy (58). Some respondents admitted losing interest in certain apps and discontinued usage. Some even confessed that they had stopped using them because they lacked discipline. This problem can be solved by understanding the motivator factors proposed by Fogg (40) and Social Cognitive Theory (59). Motivation can boost a person's self-discipline and prompt them to act. As stated by prior research by Kwon, self-efficacy positively affects the intensity of health app use. In addition to self-efficacy, the lack of involvement from healthcare professionals, like doctors, makes this problem worse. In fields like cardiology, digital tools often include direct support from doctors, but most mHealth apps do not have this kind of professional help. Without this support, users may feel less guided and confident in using these tools correctly. Adding professional support to mHealth apps could improve users' self-efficacy by providing expert advice, personalised feedback, and ongoing encouragement, which could lead to better use of mHealth (60,61).

**Perceived obsolescence**

It refers to the belief that mHealth has become unnecessary or outdated, even the fact that the app is still functional (30). Users may express this perception by stating that they have already reached their target or desired goals using mHealth. They feel that they have achieved the desired outcomes and, as a result, may see no further need to engage with the application. Furthermore, individuals may consider the mHealth application irrelevant to their current circumstances or needs. This could stem from changes in their health conditions or preferences, where they perceive that the application no longer caters to their specific requirements. Consequently, users may assert that there is no longer a need to use the application since they believe they can estimate or manage their health needs independently. This perception of self-sufficiency may lead individuals to discontinue their usage of mHealth tools, as they feel confident in their ability to monitor and address their health concerns without external assistance. It is important to note that the statements regarding perceived obsolescence are not necessarily barriers to mHealth usage but rather reasons why individuals may no longer use these applications. Within the scope of this study, the most reported apps were physical activity apps and weight management apps. It is believed that users stop using these apps because they have achieved their health goals.

## Conclusions

This study successfully addressed the RQ1, revealing a significant relationship between perceived persuasiveness and the intention to continue using mHealth applications. We also confirmed that primary task support, dialogue support, perceived credibility, design aesthetic, and unobtrusiveness significantly impact users' continued usage intention. The findings show that unobtrusiveness was the most influential attribute contributing to the intention to continue using the system. Users will keep using mHealth if it does not interfere with their routine. The study further answers RQ2 and RQ3 which uncover the key motivations for mHealth usage, including system usability, system features, and personal goals. A user-friendly interface and intuitive design motivate users to engage with mHealth and incorporate it into their daily lives. Moreover, users' personal goals significantly influence their motivation to continue using mHealth. Users with specific health or wellness goals are more likely to rely on mHealth technologies to monitor their progress and receive support. Additionally, factors like financial constraints and lack of time reflect the system's simplicity aspect. These barriers may prevent users from continuing to use the mHealth system. The finding calls attention to investigating the barriers to mHealth usage to ensure long-term usage and adherence, thus decreasing the dropout rate. This study will make a valuable contribution to the fields of information systems (IS) and e-health by informing the designers and mobile health developers to emphasize the factors that lead to mHealth dropout.

Despite these promising findings, several critical gaps remain in the field that need to be addressed. Firstly, many mHealth applications struggle with maintaining user engagement over extended periods. The study noted a significant drop-off in user adherence, underscoring the necessity for more effective long-term engagement strategies. Future research should explore, and test specific interventions designed to sustain user interest and commitment over time. Secondly, current mHealth applications often lack the ability to adapt dynamically to the changing needs and preferences of users. Personalisation based on real-time data and feedback is crucial for maintaining long-term user engagement. Developing adaptive systems that can tailor interventions to individual users' health behaviours and goals is a critical area for

future research. Lastly, the psychological and behavioural mechanisms through which persuasive elements influence user engagements are not thoroughly understood. Further research into the underlying psychological factors that drive user behaviour in mHealth contexts can inform the design of more effective persuasive technologies. Addressing these gaps will enhance the effectiveness of mHealth applications and contribute to better health outcomes.

This study has a few limitations. The study's age distribution was skewed towards individuals aged 18 to 35, with only a small representation of older age groups. This may limit the generalisability of the findings, as perspectives from older demographics may need to be adequately captured. Future research should aim for a more balanced participant pool to enhance the study's external validity. The study did not examine the impact of locality and digital literacy on mHealth usage, overlooking significant variables that could influence adoption and usage patterns. Future research should address these aspects to obtain a more comprehensive understanding. Another limitation of this study is that it mainly looked at well-funded digital health tools. This study may not fully represent the wider range of mHealth tools, especially those used in hospitals that focus more on health than fitness. Future research should include more types of mHealth apps to better understand user engagement and the challenges faced by apps with fewer resources.

## Acknowledgments

We want to thank all respondents who participated in this study.

## Footnote

*Data Sharing Statement:* Available at https://mhealth.amegroups.com/article/view/10.21037/mhealth-24-44/dss

*Peer Review File:* Available at https://mhealth.amegroups.com/article/view/10.21037/mhealth-24-44/prf

*Funding:* The work was supported by The National University of Malaysia under the research grant (No. GUP-2023-036).

*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at https://mhealth.amegroups.com/article/view/10.21037/mhealth-24-44/coif). 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 was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Institute of Visual Informatics, The National University of Malaysia (No: UKM.IVI.600-4/6/P112029). We confirm that this study obtained written consent from the participants, and participants must read and agree to the study terms and conditions before answering the survey. All participants understood that the data collection was only being conducted for research purposes. We confirmed that all participants were voluntary to take part in the survey.



## References

1. Clough BA, Casey LM. The Smart Therapist: A Look to the Future of Smartphones and mHealth Technologies in Psychotherapy. Prof Psychol Res Pract 2015;46:147-53.
2. Hilmy I. Smartphone usage nears 100%. TheStar 2022 Sep 26 [cited 2023 Jun 24]; Available online: https://www.thestar.com.my/news/nation/2022/09/26/smartphone-usage-nears-100
3. Papulova Z, Krcmery S. Innovations in Healthcare Sector Connected to Industry 4.0. In: Management Trends in the Context of Industry 40 European Alliance for Innovation n.o.; 2021. Available online: https://eudl.eu/doi/10.4108/eai.4-12-2020.2303350
4. Gupta A, Singh A. Healthcare 4.0: recent advancements and futuristic research directions. Wirel Pers Commun 2023;129:933-52.
5. Li J, Carayon P. Health Care 4.0: A Vision for Smart and Connected Health Care. IISE Trans Healthc Syst Eng 2021;11:171-80.
6. Jakob R, Harperink S, Rudolf AM, et al. Factors

Influencing Adherence to mHealth Apps for Prevention or Management of Noncommunicable Diseases: Systematic Review. J Med Internet Res 2022;24:e35371.
7. Lehto T, Oinas-Kukkonen H, Drozd F. Factors Affecting Perceived Persuasiveness Of A Behavior Change Support System 2012. Available online: https://api.semanticscholar.org/CorpusID:17471645
8. Mohamad Ali N, Wan Ahmad WN. A User Study on Trust Perception in Persuasive Technology. Int J Bus Inf Syst 2018;29:1. doi: 10.1504/IJBIS.2018.10009818.
9. Vaghefi I, Tulu B. The Continued Use of Mobile Health Apps: Insights From a Longitudinal Study. JMIR Mhealth Uhealth 2019;7:e12983.
10. Karppinen P, Oinas-Kukkonen H, Alahäivälä T, et al. Persuasive user experiences of a health Behavior Change Support System: A 12-month study for prevention of metabolic syndrome. Int J Med Inform 2016;96:51-61.
11. Al Katheeri H. The Adoption of mHealth Apps Testing the UTAUT Model with Gamification Impact. 2020 Jan 1; Available online: https://discovery.researcher.life/article/the-adoption-of-mhealth-apps-testing-the-utaut-model-with-gamification-impact/e3c0625f925432a9889d5201a3e9f34f
12. Alam MZ, Hu W, Alam MMD, et al. Understanding the determinants of mHealth apps adoption in Bangladesh: A SEM-Neural network approach. Technol Soc 2020;61. Available online: https://discovery.researcher.life/article/understanding-the-determinants-of-mhealth-apps-adoption-in-bangladesh-a-sem-neural-network-approach/47932f0170b739eeadcc6f7ca9c69401
13. Woldeyohannes HO, Ngwenyama OK. Factors Influencing Acceptance and Continued Use of mHealth Apps. 2017 Jan 1; Available online: https://discovery.researcher.life/article/factors-influencing-acceptance-and-continued-use-of-mhealth-apps/94641cff9b6c3b97945aef3caef74804
14. Ghosh P, Proffitt R, Bosworth KT, et al. mHealth app features that facilitate adolescent use for lifestyle management, and are endorsed by caregivers and health care providers. Mhealth 2024;10:21.
15. Oakley-Girvan I, Yunis R, Longmire M, et al. What Works Best to Engage Participants in Mobile App Interventions and e-Health: A Scoping Review. Telemed J E Health 2022;28:768-80.
16. Standen EC, Rothman AJ. Capitalizing on the potential of mobile health applications as behavioral interventions: A research agenda for calorie-tracking and activity-tracking applications. Soc Personal Psychol Compass 2023;17. Available online: https://discovery.researcher.life/article/capitalizing-on-the-potential-of-mobile-health-applications-as-behavioral-interventions-a-research-agenda-for-calorie-tracking-and-activity-tracking-applications/38239926c0dc3a7899a51131ec2b0292
17. Woodward J, Chen YP, Jurczyk K, et al. A Survey of Notification Designs in Commercial mHealth Apps. In: Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems New York, NY, USA: Association for Computing Machinery; 2021. (CHI EA '21). Available online: https://doi.org/10.1145/3411763.3451639
18. Kouam Arthur William F. Mastering Validity and Reliability in Academic Research: Meaning and Significance. Int J Res Publ 2024;144. doi: 10.47119/ijrp1001441320246160.
19. Pornpitakpan C. The Persuasiveness of Source Credibility: A Critical Review of Five Decades' Evidence. J Appl Soc Psychol 2004;34:243-81.
20. Pallant J. SPSS Survival Manual: A Step by Step Guide to Data Analysis Using SPSS for Windows Version 15 7th ed. 2020. Available online: https://www.taylorfrancis.com/books/mono/10.4324/9781003117452/spss-survival-manual-julie-pallant
21. Cohen J. Statistical Power Analysis for the Behavioral Sciences Second Edition 2nd ed. New York; 1988. Available online: https://www.taylorfrancis.com/books/mono/10.4324/9780203771587/statistical-power-analysis-behavioral-sciences-jacob-cohen
22. Braun V, Clarke V. Using thematic analysis in psychology. Qual Res Psychol 2006;3:77-101.
23. Vaismoradi M, Turunen H, Bondas T. Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. Nurs Health Sci 2013;15:398-405.
24. Mustafa AS, Ali N, Dhillon JS, et al. User Engagement and Abandonment of mHealth: A Cross-Sectional Survey. Healthcare (Basel) 2022;10:221.
25. Patel B, Thind A. Usability of Mobile Health Apps for Postoperative Care: Systematic Review. JMIR Perioper Med 2020;3:e19099.
26. Schuster L, Parkinson J. Personal goals in consumers' adoption of mHealth services. J Serv Theory Pract 2021;32. Available online: https://discovery.researcher.life/article/personal-goals-in-consumers-adoption-of-mhealth-services/ed738bdf9fc630c88f166490e0759631
27. Taralunga DD, Florea BC. A Blockchain-Enabled Framework for mHealth Systems. Sensors (Basel) 2021;21:2828.
28. Alwashmi MF, Fitzpatrick B, Davis E, et al. Features of a

 

mobile health intervention to manage chronic obstructive pulmonary disease: a qualitative study. Ther Adv Respir Dis 2020;14:1753466620951044.
29. Orji R, Vassileva J, Mandryk R. Towards an effective health interventions design: an extension of the health belief model. Online J Public Health Inform 2012;4:ojphi.v4i3.4321.
30. Pardo-Vicente MA, Camacho-Magriñan P, Pavon-Dominguez P. Influence of Technology on Perceived Obsolescence though Product Design Properties. Sustainability 2022;14. Available online: https://discovery.researcher.life/article/influence-of-technology-on-perceived-obsolescence-though-product-design-properties/2e2d44857dee3b4689baf14415f5339a
31. Ciocarlan A, Masthoff J, Oren N. Actual Persuasiveness: Impact of Personality, Age and Gender on Message Type Susceptibility. In: Oinas-Kukkonen H, Win KT, Karapanos E, et al. editors. Persuasive Technology: Development of Persuasive and Behavior Change Support Systems. Cham: Springer International Publishing; 2019:283-94.
32. Tikka P, Oinas-Kukkonen H. RightOnTime: The role of timing and unobtrusiveness in behavior change support systems. In: Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics). Oulu: Springer Verlag; 2016:327-38.
33. Alutaybi A, Al-Thani D, McAlaney J, et al. Combating Fear of Missing Out (FoMO) on Social Media: The FoMO-R Method. Int J Environ Res Public Health 2020;17:6128.
34. Wei Y, Zheng P, Deng H, et al. Design Features for Improving Mobile Health Intervention User Engagement: Systematic Review and Thematic Analysis. J Med Internet Res 2020;22:e21687.
35. Chaouali W, Yahia I Ben, Lunardo R, et al. Reconsidering the "What Is Beautiful Is Good" Effect. Int J Bank Mark 2019;37:1525-46.
36. Holdener M, Gut A, Angerer A. Applicability of the User Engagement Scale to Mobile Health: A Survey-Based Quantitative Study. JMIR Mhealth Uhealth 2020;8:e13244.
37. Peñate GP, Parra NO, Morera JAD, et al. Assessing the clinical benefit, safety, and patient-reported outcomes with the use of the PAHcareTM digital platform in pulmonary arterial hypertension: a pilot study. Front. Public Health 2024;12:1335072. doi: 10.3389/fpubh.2024.1335072.
38. Scanlan F, Jorm A, Reavley N, et al. Treatment choices for depression: Young people's response to a traditional e-health versus a Health 2.0 website. Digit Health 2017;3:2055207617690260.
39. Sun CJ, Anderson KM, Kuhn T, et al. A Sexual Health Promotion App for Transgender Women (Trans Women Connected): Development and Usability Study. JMIR Mhealth Uhealth 2020;8:e15888.
40. Fogg BJ. A Behavior Model for Persuasive Design. In: Persuasive '09: Proceedings of the 4th International Conference on Persuasive Technology 2009. Available online: https://dl.acm.org/doi/10.1145/1541948.1541999
41. Pérez-Sánchez IN, Candela Iglesias M, Rodriguez-Estrada E, et al. Design, validation and testing of short text messages for an HIV mobile-health intervention to improve antiretroviral treatment adherence in Mexico. AIDS Care 2018;30:37-43.
42. Pai YH, Chen YC, Hung CK, et al. Willingness to Receive Text Message Appointment Reminders Among Patients With HIV Infection. J Nurs 2016;63:59-67.
43. Wan Ahmad WN, Mohamad Ali N. The impact of persuasive technology on user emotional experience and user experience over time. J Inf Commun Technol 2018;17:601-28.
44. Spann A, Stewart E. Barriers and facilitators of older people's mHealth usage: A qualitative review of older people's views. Hum Technol 2018;14:264-96.
45. Hawley-Hague H, Boulton ER, Hall A, et al. Older adults' perceptions of technologies aimed at falls prevention, detection or monitoring: A systematic review. Int J Med Inform 2014;83:416-26.
46. Gaiduk M, Seepold R, Martínez Madrid N, et al. Digital Health and Care Study on Elderly Monitoring. Sustainability 2021;13:13376.
47. Orji R, Moffatt K. Persuasive technology for health and wellness: State-of-the-art and emerging trends. Health Informatics J 2018;24:66-91.
48. Wan Ahmad WN, Ali NM, Ahmad Rodzuan AR. Understanding user emotions through interaction with persuasive technology. Int J Adv Comput Sci Appl 2020;11:225-35.
49. Salim MHM, Ali NM, Noah SAM. Mobile application on healthy diet for elderly based on persuasive design. Int J Adv Sci Eng Inf Technol 2017;7:222-7.
50. Wang S, Zhang C, Kröse B, et al. Optimizing Adaptive Notifications in Mobile Health Interventions Systems: Reinforcement Learning from a Data-driven Behavioral Simulator. J Med Syst 2021;45:102.
51. James LJ, van Heugten JMA, Van Gorp PME, et al. Evaluation of personalized treatment goals on engagement

 

of SMI patients with an mHealth app. In: 2022 IEEE International Conference on Bioinformatics and Biomedicine (BIBM); 2022:1568-73.
52. Kaya A, Ozturk R, Altin Gumussoy C. Usability Measurement of Mobile Applications with System Usability Scale (SUS). In: Calisir F, Cevikcan E, Camgoz Akdag H. editors. Industrial Engineering in the Big Data Era. Cham: Springer International Publishing; 2019:389-400.
53. Tahsin F, Tracy S, Chau E, et al. Exploring the relationship between the usability of a goal-oriented mobile health application and non-usage attrition in patients with multimorbidity: A blended data analysis approach. Digit Health 2021;7:20552076211045579.
54. Cosco TD, Firth J, Vahia I, et al. Mobilizing mHealth Data Collection in Older Adults: Challenges and Opportunities. JMIR Aging 2019;2:e10019.
55. Vaidya A. Key Features of mHealth Apps & Trends in Use 2022 [cited 2022 Aug 29]. Available online: https://mhealthintelligence.com/tag/mhealth-applications
56. Mohadis H, Mohamad Ali N. Designing Persuasive Application to Encourage Physical Activity at Workplace among Older Workers. In: 2016 Sixth International Conference on Digital Information and Communication Technology and its Applications (DICTAP) 2016. Available online: https://ieeexplore.ieee.org/document/7544013
57. Kwon MW, Mun K, Lee JK, et al. Is mobile health all peer pressure? The influence of mass media exposure on the motivation to use mobile health apps. Convergence 2017;23:565-86.
58. Alnooh G, Alessa T, Hawley M, et al. The Use of Dietary Approaches to Stop Hypertension (DASH) Mobile Apps for Supporting a Healthy Diet and Controlling Hypertension in Adults: Systematic Review. JMIR Cardio 2022;6:e35876.
59. Bandura A. Social foundations of thought and action. Englewood Cliffs, NJ: Prentice-Hall, Inc.; 1986:23-8.
60. Fortuna KL, Glass JE, Goldstein CM, et al. Certified Peer Specialists' Perspective of the Barriers and Facilitators to Mobile Health Engagement. J Technol Behav Sci 2020;5. Available online: https://discovery.researcher.life/article/certified-peer-specialists-perspective-of-the-barriers-and-facilitators-to-mobile-health-engagement/d553e72bd3c43c45a8960b2fc637052d
61. Sengupta A, Williams S. Can an Engagement Platform Persuade Students to Stay? Applying Behavioral Models for Retention. Int J Hum Comput Interact 2021;37:1016-27.

doi: 10.21037/mhealth-24-44
**Cite this article as:** Mohd Johari NF, Mohamad Ali N, Mhd Salim MH, Abdullah NA. Factors driving the use of mobile health app: insights from a survey. mHealth 2025;11:12.