



A discrete choice experiment to examine the factors influencing consumers' willingness to purchase health apps

Zhenzhen Xie, Hao Liu, Calvin Or

Department of Industrial & Manufacturing Systems Engineering, The University of Hong Kong, Hong Kong, China

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Correspondence to: Calvin Or, PhD. Department of Industrial & Manufacturing Systems Engineering, The University of Hong Kong, Room 8-7, Haking Wong Building, Pokfulam, Hong Kong, China. Email: klor@hku.hk.

Background: The benefits of health apps can only be realized when consumers purchase them for use. Thus, it is important to understand what factors influence consumers' willingness to purchase health apps. Therefore, this study aimed to examine the influence of health app attributes and sociodemographic characteristics on consumers' willingness to purchase health apps, and how the value of the health app attributes varies for individuals with different sociodemographic characteristics.

Methods: A questionnaire-based discrete choice experiment (DCE) was conducted with a random sample of 561 adults. A standard logit regression was applied to assess the influence of health app attributes and sociodemographic characteristics on consumers' willingness to purchase health apps, and marginal willingness to pay (MWTP) was calculated for each factor using regression coefficients. Interaction effects were also examined to determine how the value of health app attributes varies by sociodemographic characteristics.

Results: Usefulness, ease of use, security and privacy, and attitudes of healthcare professionals toward consumers' use of health apps were the attributes of health apps that positively influenced consumers' willingness to purchase them. Conversely, smartphone storage consumption, mobile Internet data consumption, and app price negatively influenced consumers' willingness to purchase the apps. For sociodemographic characteristics, being male, having a household size greater than three, having a monthly household income of HK\$30,000 or more, having a lower education level (below diploma), having previously used health apps, and having previously purchased health apps were associated with a higher willingness to purchase health apps.

Conclusions: Health app attributes that influenced consumers' willingness to purchase the apps and populations that were less willing to purchase health apps were identified. Efforts should be made to improve health app attributes and enhance the promotion of health apps among these underserved populations.

Keywords: Discrete choice experiment (DCE); mobile health apps; mHealth; marginal willingness to pay (MWTP)

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Introduction

Health apps have become a popular tool for improving consumers' access to health information and their knowledge and awareness of healthcare (1-7). Many nations have promoted this technology through national

health approaches. For instance, Germany's DiGA allows physicians to recommend digital healthcare apps to their patients. In the UK, NHSX and the NHS ORCHA app library have been launched with the aim to offer the public safe and quality-assured health apps. In addition to

authoritative institutions, consumers also play an important role in the implementation and diffusion of health apps, as the benefits of health apps can only be realized when consumers are willing to purchase them for use (8-10). There has been research on consumers' intention to use health apps (11-15); however, little attention has been placed on examining willingness to purchase. Studying the intention to use health apps can be relevant for health app design and implementation, but may not be sufficient to determine whether consumers would purchase health apps, because willingness to purchase implies a financial commitment, whereas an intention to use does not imply that the consumer wishes to commit to out-of-pocket spending.

Consumers' willingness to purchase health apps depends on how much they value the apps, or how much benefit they perceive them to have. The perceived values and benefits can be influenced by the attributes of the app, such as effectiveness and reliability (12,15-17). Moreover, the perceived importance of these attributes may differ based on individuals' characteristics, such as age, gender, socioeconomic status, and educational attainment (3,11, 18-20). While these factors are crucial to understanding consumers' willingness to purchase health apps, there is a

dearth of research on this topic. Furthermore, even fewer studies have examined the association between consumer characteristics and how consumers value different health app attributes.

Discrete choice experiments (DCEs) can be a useful approach to gain a deeper understanding of the factors influencing consumers' willingness to purchase health apps (21-25). To implement DCEs to assess health apps, researchers typically identify the attributes that may influence willingness to purchase, such as price, usefulness, and ease of use, and assign several levels to each attribute. The researchers then create a series of hypothetical health app profiles. Each profile comprises descriptions of the attributes of a hypothetical health app, with each attribute having a corresponding level. Although all of the profiles share the same set of attributes, the combination of attribute levels varies across profiles. These profiles are then presented to relevant individuals (e.g., end users of the product/technology under evaluation), who are asked to carefully consider the attributes of the health apps and use them as the basis for their willingness to purchase each hypothetical health app. By knowing and analyzing which hypothetical health apps are frequently chosen as willing to be purchased, and which populations are more willing to purchase them, researchers can identify the attributes that influence and the sociodemographic characteristics that are associated with willingness to purchase.

In this study, we aimed to implement a DCE to examine the influence of health app attributes and sociodemographic characteristics on consumers' willingness to purchase health apps. We believe that the findings of this study will provide useful information to assist product development, policy making, and marketing strategies for the development and promotion of health apps. We present this article in accordance with the STROBE reporting checklist (available at <https://mhealth.amegroups.com/article/view/10.21037/mhealth-22-39/rc>).

Methods

Study design

A DCE was conducted to examine the factors influencing willingness to purchase health apps, including health app attributes and sociodemographic characteristics. A paper-based questionnaire was used to collect the study participants' sociodemographic information and to administer the DCE.

Highlight box

Key findings

- Seven health app attributes and six sociodemographic characteristics are found to influence consumers' willingness to purchase health apps.

What is known and what is new?

Known:

- Health apps are widely used, but little understanding has been obtained regarding consumers' willingness to purchase health apps.

New findings:

- Usefulness, ease of use, security/privacy, healthcare professionals' attitude, smartphone storage consumption, mobile Internet data consumption, and price influenced willingness to purchase health apps.
- Willingness to purchase health apps was associated with gender, household size, income, education, previous health app purchase, and previous health app use.

What is the implication, and what should change now?

- Enhancing health app attributes through design and usability, involving medical professionals, advertising, and establishing regulatory measures for privacy and efficacy.
- Increasing access to health apps for underserved people.

Table 1 The seven health app attributes and their levels and descriptions

Attribute	Level	Description
Usefulness	Slightly useful	This health app seems slightly useful to you
	Moderately useful	This health app seems moderately useful to you
	Very useful	This health app seems very useful to you
Ease of use	Not easy to use	This health app does not seem very easy to use. You would need to spend much time and effort to learn to use it
	Moderately easy to use	This health app seems moderately easy to use. You could learn to use it quickly
	Very easy to use	This health app seems very easy to use. You would be able to use the app immediately without any tutorial or help
Security and privacy	No security assurance	This health app offers no information about protection of personal health information
	Some security policies	This health app provides some information about security policies related to personal health information
	Complete security system	This health app has a complete security system to protect your personal health information
Healthcare professionals' attitude	Neutral	A healthcare professional whom you trust has a neutral attitude about your use of this health app.
	Moderately supportive	A healthcare professional whom you trust is moderately supportive of your use of this health app
	Very supportive	A healthcare professional whom you trust is very supportive of your use of this health app
Smartphone storage consumption	>100 MB	This health app is large (>100 MB)
	Approximately 38 MB	This health app is a medium size (around 38 MB)
	<10 MB	This health app is small (<10 MB)
Mobile Internet data consumption	Data-consuming	Internet connection is a must for this health app. It is quite data-consuming
	Somewhat data-consuming	Some functions of this health app require an Internet connection. It is somewhat data-consuming
	Data-saving	This health app can be used offline. It is quite data-saving
Price	HK\$100	The price of this health app is HK\$100
	HK\$50	The price of this health app is HK\$50
	HK\$10	The price of this health app is HK\$10

HK\$1 ≈ US\$0.128. MB, megabyte.

Based on previous research on the determinants of health app/health information technology acceptance and adoption (11,15,26), we identified seven health app attributes that may influence willingness to purchase for examination in the DCE, including usefulness, ease of use, security and privacy, healthcare professionals' attitude, smartphone storage consumption, mobile Internet data consumption, and price. We assigned three levels to each attribute, ranging from least to most favorable (see *Table 1*).

The DCE questionnaire presented multiple hypothetical

health app profiles to the study participants and asked them if they were willing to purchase each of the hypothetical health apps (example shown in *Table 2*). A 3⁷ orthogonal factorial design was used to examine the main effects of the seven attributes, each with three levels, generating 18 hypothetical health app profiles to be included in the DCE questionnaire.

Prior to data collection, a pilot test with 12 people was conducted to ensure the effectiveness of the experiment and the readability of the questionnaire.

Table 2 Example of a hypothetical health app profile and the question used to examine willingness to purchase

Health app attribute	Description
Usefulness	This health app seems very useful to you
Ease of use	This health app seems very easy to use. You would be able to use the app immediately without any tutorial or help
Security and privacy	This health app has a complete security system to protect your personal health information
Healthcare professionals' attitude	A healthcare professional whom you trust is moderately supportive of your use of this health app
Smartphone storage consumption	This health app is large (>100 MB)
Mobile Internet data consumption	This health app can be used offline. It is quite data-saving
Price	The price of this health app is HK\$10
Would you like to purchase this health app? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Read the attributes and descriptions of the hypothetical health app above, consider them carefully, and indicate your willingness to purchase the health app by responding to the question at the end.	
HK\$1 ≈ US\$0.128. MB, megabyte.	

Health app attributes and corresponding study hypotheses

We identified seven health app attributes that may influence consumers' willingness to purchase health apps. This section introduces the seven attributes and the study hypothesis for each of them.

Usefulness

According to the technology acceptance model (27,28), perceived usefulness is a key determinant of individuals' intention to use information technology, including health apps (12,15-17). Higher levels of usefulness were hypothesized to improve consumers' perceptions of health apps, making them more willing to accept and use them and increasing their willingness to purchase them. Accordingly, we tested the following hypothesis.

H1: Improvement in the usefulness of health apps is associated with an increase in consumers' willingness to purchase them.

Ease of use

According to the technology acceptance model (27,28), perceived ease of use directly influences an individual's intention to use information technology and also indirectly influences it by influencing perceived usefulness. Higher levels of ease of use were hypothesized to improve consumers' perceptions of the usefulness of health apps, making them more willing to accept and use them and increasing their willingness to purchase them. Accordingly, we tested the following hypothesis.

H2: Improvement in the ease of use of health apps is associated with an increase in consumers' willingness to purchase them.

Security and privacy

Concerns about security and privacy have been identified as a major barrier to the adoption of health apps (29-31). Consumers may be less likely to purchase health apps when they believe that using them would pose a risk to their information security. Accordingly, we tested the following hypothesis.

H3: Improvement in the security and privacy of health apps is associated with an increase in consumers' willingness to purchase them.

Healthcare professionals' attitude

Healthcare professionals' attitude has been reported to have an impact on the adoption of health apps, as healthcare professionals can explain the benefits of health apps to consumers, thus encouraging them to purchase and use the apps (32-34). Accordingly, we tested the following hypothesis.

H4: Improvement in healthcare professionals' attitude toward the consumers' use of health apps is associated with an increase in consumers' willingness to purchase the apps.

Smartphone storage consumption

Smartphone storage consumption has been reported as a factor influencing the adoption of health apps (35). Consumers may not purchase a health app if they believe

that it will take up too much of their smartphone storage space. Accordingly, we tested the following hypothesis.

H5: A decrease in health apps' smartphone storage consumption is associated with an increase in consumers' willingness to purchase them.

Mobile Internet data consumption

Mobile Internet data consumption has also been reported as a factor influencing the adoption of health apps (36,37). Consumers may not purchase a health app if they believe that using it will intensely consume mobile Internet data, which will incur additional costs. Accordingly, we tested the following hypothesis.

H6: A decrease in health apps' mobile Internet data consumption is associated with an increase in consumers' willingness to purchase them.

Price

The price of health apps has often been mentioned as a factor influencing their adoption in previous studies (29,30,33,36). When the perceived benefits of a health app remain unchanged, a higher price results in more reluctance by consumers to purchase it. Accordingly, we tested the following hypothesis.

H7: A decrease in health apps' price is associated with an increase in consumers' willingness to purchase them.

Participants and sample size

The study sample comprised individuals recruited from the general public in Hong Kong, stratified by age group (18–24, 25–34, 35–44, 45–54, 55–64, and ≥65 years old), gender, and district of residence. Individuals were enrolled if they (I) were 18 years or older, (II) could understand written and spoken Chinese, and (III) agreed to participate in the study.

We used Orme's equation (38) for sample size estimation

$$n > \frac{500c}{t \times a} \quad [1]$$

where n is the number of participants required, c is the largest number of levels for any one attribute, t represents the number of choice tasks in the DCE, and a represents the number of health apps in a choice task. Therefore, our DCE required no less than 84 participants ($c=3$, $t=18$, and $a=1$).

Procedure

A researcher randomly approached individuals in public areas in Hong Kong (e.g., subway stations, shopping malls, public squares, and parks), introduced the study to them, invited them to participate, and confirmed their eligibility. Eligible individuals who provided a written informed consent were enrolled in the study. Each participant received a grocery coupon worth HK\$50 after completing the study. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013) and was approved by the Human Research Ethics Committee of the University of Hong Kong (No. EA1810020).

Statistical analysis

Descriptive statistics were used to illustrate participants' sociodemographic characteristics. A standard logit regression model was used to examine the influence of health app attributes and sociodemographic characteristics on participants' willingness to purchase health apps. The following sociodemographic variables were dichotomized before they were entered into the logit regression model: gender (female, male), age (18–44, ≥45; in years), household size (≤3, >3), monthly household income (<30,000, ≥30,000; in HK\$), education level (lower than diploma, diploma or higher), whether the participant had health apps installed (yes, no), and whether the participant had previously bought health apps (yes, no). We also calculated the marginal willingness to pay (MWTP) for each health app attribute and sociodemographic characteristic to quantify their influence on participants' willingness to purchase the hypothetical health apps. The MWTP was calculated as β_a divided by $-\beta_p$, where β_a denotes the regression coefficient of the attribute or characteristic obtained from the regression model and β_p denotes the regression coefficient of price (per HK\$) (39–41). We also examined how the importance of health app attributes varied across individuals with different sociodemographic characteristics. Multiple comparisons were counteracted through Bonferroni corrections.

Results

Sociodemographic characteristics of the participants

Six hundred people agreed to take part in the study, but

Table 3 Sociodemographic characteristics of the sample (N=561)

Sociodemographic characteristics	Number of participants (%)
Gender	
Male	256 (45.6)
Female	305 (54.4)
Age group (years)	
18–24	58 (10.3)
25–34	96 (17.1)
35–44	107 (19.1)
45–54	98 (17.5)
55–64	97 (17.3)
≥65	105 (18.7)
Household size	
1	48 (8.6)
2	119 (21.2)
3	183 (32.6)
4	154 (27.5)
≥5	57 (10.1)
Monthly household income (HK\$)	
<6,000	23 (4.1)
6,000–9,999	20 (3.6)
10,000–14,999	49 (8.7)
15,000–19,999	67 (11.9)
20,000–24,999	54 (9.6)
25,000–29,999	53 (9.5)
30,000–39,999	64 (11.4)
40,000–49,999	80 (14.3)
50,000–59,999	37 (6.6)
60,000–79,999	42 (7.5)
80,000–99,999	31 (5.5)
≥100,000	41 (7.3)
Education	
Some primary school	20 (3.5)
Completed primary school	43 (7.7)
Some secondary school	61 (10.9)
Completed secondary school	152 (27.1)

Table 3 (continued)

Table 3 (continued)

Sociodemographic characteristics	Number of participants (%)
Diploma, advanced diploma, associate degree, or equivalent	88 (15.7)
Bachelor's degree	125 (22.3)
Master's degree	56 (10.0)
Doctoral degree	16 (2.8)
Whether had used health apps	
Yes	262 (46.7)
No	299 (53.3)
Whether had bought health apps	
Yes	56 (10.0)
No	505 (90.0)

only 561 provided valid data and were included in our sample and data analysis. *Table 3* presents the participants' sociodemographic characteristics.

Influence of health app attributes and sociodemographic characteristics on willingness to purchase health apps and their corresponding MWTP

Table 4 presents (I) the influence of health app attributes and sociodemographic characteristics on participants' willingness to purchase health apps, and (II) the MWTP for each health app attribute level and sociodemographic characteristic. The mean MWTP across all significant variables was HK\$70.46, with a standard deviation of HK\$40.53.

Usefulness, ease of use, security and privacy, and attitudes of healthcare professionals toward consumers' use of health apps were attributes of health apps that positively influenced consumers' willingness to purchase them. Conversely, smartphone storage consumption, mobile Internet data consumption, and app prices negatively influenced consumers' willingness to purchase the apps. The MWTP of significantly influential health app attribute levels ranged from HK\$25.26 to HK\$183.38.

For sociodemographic characteristics, being male, having a household size greater than three, having a monthly household income of HK\$30,000 or more, having a lower education level (below diploma), having previously used health apps, and having previously purchased health apps

Table 4 Logit regression results and marginal willingness to pay values

Factor	Level/specification	Coefficient	Standard error	P value	Marginal willingness to pay (HK\$)
Constant	–	–2.94	0.14	<0.001	–
Health app attribute					
Usefulness	Slightly useful	–	–	–	–
	Moderately useful	0.05	0.07	0.503	5.57
	Very useful	0.64	0.07	<0.001	76.74
Ease of use	Not easy to use	–	–	–	–
	Moderately easy to use	0.66	0.07	<0.001	79.62
	Very easy to use	0.55	0.07	<0.001	65.59
Security and privacy	No security assurance	–	–	–	–
	Some security policies	0.27	0.07	<0.001	32.41
	Complete security system	0.50	0.07	<0.001	59.77
Healthcare professionals' attitude	Neutral	–	–	–	–
	Moderately supportive	0.73	0.07	<0.001	88.28
	Very supportive	1.53	0.08	<0.001	183.38
Smartphone storage consumption	>100 MB	–	–	–	–
	Approximately 38 MB	0.10	0.07	0.151	11.55
	<10 MB	0.33	0.07	<0.001	40.12
Mobile Internet data consumption	Data-consuming	–	–	–	–
	Somewhat data-consuming	0.49	0.08	<0.001	58.65
	Data-saving	0.21	0.07	0.002	25.26
Price (in HK\$)	–	–0.01	0.00	<.001	–
Sociodemographic characteristic					
Gender	Male (N=257)	–	–	–	–
	Female (N=304)	–0.42	0.05	<0.001	–50.51
Age group	18–44 (N=262)	–	–	–	–
	≥45 (N=299)	–0.04	0.06	0.451	–5.24
Household size	≤3 (N=350)	–	–	–	–
	>3 (N=211)	0.20	0.05	<0.001	24.23
Monthly household income (HK\$)	<30,000 (N=267)	–	–	–	–
	≥30,000 (N=294)	0.13	0.06	0.015	15.98
Education level	Below diploma (N=276)	–	–	–	–
	Diploma or higher (N=285)	–0.15	0.06	0.011	–18.30
Whether had used health apps	No (N=300)	–	–	–	–
	Yes (N=261)	0.45	0.06	<0.001	53.67
Whether had bought health apps	No (N=505)	–	–	–	–
	Yes (N=56)	0.86	0.08	<0.001	103.05

MB, megabyte.

were associated with a higher willingness to purchase health apps, with MWTP values ranging from HK\$15.98 to HK\$103.05.

Interaction effects

Two significant interaction effects were observed between sociodemographic characteristics and health app attributes. The first interaction effect indicated that participants with an education level of diploma or higher were more likely to be willing to purchase health apps with a usefulness level categorized as “very useful” (coefficient =0.54, standard error =0.12). The second interaction effect indicated that participants with an education level of lower than diploma were more likely to be willing to purchase health apps with a price of HK\$100 (coefficient =0.44, standard error =0.13).

Discussion

Main findings

Seven health app attributes and seven sociodemographic characteristics were examined in a DCE for their associations with consumers’ willingness to purchase health apps. MWTP values were generated to measure the influence of these factors. The following sections discuss each significant factor.

Significant influencing factors

Usefulness of health apps

When individuals believe that using a health app can effectively help them (with health management or health information access, for example), they will be more aware of the benefits of using the health app and more interested in learning about and using the health app. Thus, they will be more willing to purchase health apps (12,15,17,42). Possible ways to improve usefulness include conducting user testing and usability inspection to model and understand users’ expectations and needs and improving the design accordingly (5,13,43-49); incorporating features such as symptom assessment and monitoring, regularly updated information, and individualization (50); involving medical professionals in the development process to ensure the reliability of the information provided in the health app (51,52); and promoting advertising to enhance consumers’ perceptions of the usefulness of health apps.

Ease of use of health apps

Poorer ease of use may be associated with higher learning costs and a poorer user experience, which can reduce consumers’ perceived usefulness, acceptance, and intention to use health apps, and thus negatively affect their willingness to purchase them (12,53,54). This is because lower ease of use tends to increase the occurrence of user errors and reduces users’ interest in learning about and using health apps, resulting in users not fully appreciating the benefits of the apps. User testing and usability inspection can be used to identify usability problems (13). Addressing usability problems through redesign can help improve ease of use. Some commonly used techniques include simplifying operations, increasing the inclusion of user errors, providing instructions, and optimizing the user interface. At the same time, health app developers should apply user-centered design while developing health apps for disadvantaged populations (13,44,55), such as providing easier-to-read user interfaces for older users and providing speech interaction for visually challenged users.

Security and privacy

Privacy concerns are often listed as one of the key barriers to the use of health apps (29-31,56). Health apps should avoid collecting unnecessary personal data, should always seek the user’s consent before collecting such information, and should anonymize stored data. Health app developers should also provide users with complete information about the apps’ policies on personal data collection and use. Additionally, policymakers should enact regulations on the collection and use of personal data in health apps to prevent the leakage and misuse of such data.

Healthcare professionals’ attitude toward consumers’ use of health apps

Prior research (32-34,57) has examined the impact of healthcare professionals’ attitudes on the acceptance of health-related products, but little attention has been given to their effect on the willingness to purchase. Our study revealed that healthcare professionals’ attitude toward consumers’ use of health apps positively influenced their willingness to purchase them. One possible explanation is that professionals are opinion leaders in healthcare and have a major impact on consumers. Their positive attitudes may increase consumers’ confidence in the usefulness and reliability of health apps and thus increase their

willingness to purchase them. Healthcare professionals should encourage their patients to use health apps when appropriate to augment their self-care ability. However, healthcare professionals may be hesitant to recommend general health apps to their patients because they are uncertain about the safety and effectiveness of these apps. Some measures, such as accreditations by authorities, proof from clinical studies, and recommendations from other healthcare providers, can assist healthcare professionals in determining the reliability of health apps and allowing them to promote these apps to patients (58). At the same time, policymakers should establish regulations to prevent healthcare professionals from abusing their influence on consumers for profit.

Smartphone storage consumption and mobile Internet data consumption

It has been reported that facilitating conditions help to improve healthcare technology acceptance. What these facilitating conditions entail depends on the context in which the technology is used. This study identified two facilitating conditions that influence consumers' willingness to purchase health apps: smartphone storage consumption and mobile Internet data consumption. Larger smartphone storage consumption was found to be disadvantageous, because a high storage occupation could result in unpredictable delays when operating smartphone apps, leading to negative perceptions of the apps (59). Developers should try to optimize the data storage allocation strategy; for example, by encouraging users to clear cached data regularly. At the same time, older people, those with a low income, and those living in less developed areas may have less smartphone storage capacity and poorer mobile Internet access, and therefore they may be reluctant to purchase and use health apps. This points out the barrier to accessibility that health apps are currently facing and calls for researchers, health app developers, and policymakers to find ways to facilitate the acceptance of health apps by these populations.

Price

Our study confirmed that lower pricing for a health app is associated with a greater willingness to purchase it. This suggests that affordability is an important consideration for consumers when deciding whether to purchase health apps. To encourage the purchase and use of health apps, developers and policymakers should explore strategies that make health apps more affordable to individuals who may

benefit from them but lack financial resources. One strategy is to introduce different pricing tiers or subscription plans for health apps, allowing users to choose a plan that suits their budget and needs. For instance, developers can offer a free basic version with limited features and a premium version with additional functionalities at a reasonable cost. Furthermore, partnering with healthcare providers to bundle health apps with their services can also improve affordability. By offering discounted or free access to health apps as part of a comprehensive healthcare package, users are more likely to find them affordable and appealing. Additionally, collaborating with private or public healthcare funding bodies to offer financial assistance for health app users can be another effective approach.

Gender

Men were more likely to be willing to purchase health apps than women. One possible explanation is that men have a greater consumer technology innovativeness than women (60-63). However, health apps are generally more widely accepted by women than men (3,20). This difference may suggest that women are more willing to use health apps, but are less willing to spend money on them. Health apps can provide women with a convenient and private means of health management; for example, it has been proven that the use of health apps can significantly reduce postnatal depression in first-time mothers (4). To make the benefits of health apps available to more women, medical institutions or healthcare organizations should offer free health apps to women to enhance their wellbeing (64).

Household size

Consumers with a household size greater than three were more likely to be willing to purchase health apps. One explanation is that families with a larger household size are more likely to have older people, children, and family members with chronic conditions and are thus more willing to invest in health management (65). For this reason, in addition to allowing personal health management, health apps should also allow users to manage the health needs of their family members, especially those who cannot independently perform health management (43,66). This may help facilitate health management for younger and older family members in a large family.

Monthly household income

Consumers with a monthly household income of HK\$30,000 or greater were more likely to be willing to

purchase health apps. One explanation is that health apps are more commonly accepted and used among people who have a higher income (20,30). A higher monthly household income is also associated with a higher healthcare investment (67). Based on this finding, the overpricing of health apps may disadvantage people with a low income by reducing their purchase and use. Therefore, policy makers may need to establish guidelines for the reasonable pricing of health apps and provide low-income populations with financial assistance to purchase health apps. In this way, more low-income populations will have access to convenient medical care through health apps.

Education level

Consumers whose education level was lower than diploma were more likely to be willing to purchase health apps. One possible explanation for this is that people with a higher education level tend to seek help from healthcare professionals rather than use self-help services (68). Participants with education levels at or above diploma are more likely to be willing to purchase health apps when the usefulness of the apps is high. A possible reason for this is that people with a higher education level have better health literacy (69) and are more capable of assessing the usefulness of health apps. Participants with education levels below diploma were more willing to pay for a health app when the price was high. One explanation for this is that a lower education level is positively associated with a tendency toward impulse buying (70,71). This finding confirms that health apps can help provide healthcare services to socially disadvantaged groups, i.e., those with a low education level or a low income. However, the capabilities provided by current health apps are still very limited, and researchers should further examine the healthcare-related needs of these populations and try to find ways to provide these populations with more comprehensive and better quality medical services through health apps.

Previous use and purchase of health apps

Consumers who had previously used and bought health apps were more likely to be willing to purchase health apps. This may suggest that the experience of buying or using health apps had increased the consumers' awareness of potential benefits, as well as positive perceptions and acceptance of health apps. Therefore, health app providers could use tryouts to attract consumers to use and experience the benefits of health apps. Another possible explanation is that people are already more likely to be willing to purchase

health apps when they have previously used or bought health apps. However, this could not be verified by the data obtained in this study.

Limitations

The primary limitation of this study is that an estimation of how much money consumers are willing to pay for health apps was not provided. Future studies should focus on estimating the value of consumers' willingness to pay for health apps. Next, the DCE was performed by the participants in person. This may have put time pressure on the participants, which may have led them to give inaccurate answers because they were rushing to complete the questionnaire. In addition, participants who had difficulty going out due to poor health conditions were less likely to be recruited from public places for the study, which may have affected the representativeness of the participants.

Conclusions

To improve the likelihood of consumers purchasing health apps, greater attention should be given to enhancing their usefulness, ease of use, security and privacy features, and healthcare professionals' attitudes toward their use; reducing smartphone storage and mobile Internet data consumption; and lowering their prices. Additionally, it is important to improve the accessibility of health apps, especially for underserved populations, to ensure that there is equal access to health services.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work and for 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 Human Research Ethics Committee of the University of Hong Kong (No. EA1810020) and informed consent was provided by all participants individually.

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References

- Whitehead L, Seaton P. The effectiveness of self-management mobile phone and tablet apps in long-term condition management: a systematic review. *J Med Internet Res* 2016;18:e97.
- Or CK, Liu K, So MKP, et al. Improving self-care in patients with coexisting type 2 diabetes and hypertension by technological surrogate nursing: randomized controlled trial. *J Med Internet Res* 2020;22:e16769.
- Xie Z, Nacioglu A, Or C. Prevalence, demographic correlates, and perceived impacts of mobile health app use amongst Chinese adults: cross-sectional survey study. *JMIR Mhealth Uhealth* 2018;6:e103.
- Chan KL, Leung WC, Tiwari A, et al. Using smartphone-based psychoeducation to reduce postnatal depression among first-time mothers: randomized controlled trial. *JMIR Mhealth Uhealth* 2019;7:e12794.
- Cheung DST, Or CKL, So MKP, et al. Usability testing of a smartphone application for delivering Qigong training. *J Med Syst* 2018;42:191.
- Cheung DST, Or CK, So MKP, et al. The use of eHealth applications in Hong Kong: results of a random-digit dialing survey. *J Med Syst* 2019;43:293.
- Liu H, Peng H, Song X, et al. Using AI chatbots to provide self-help depression interventions for university students: a randomized trial of effectiveness. *Internet Interv* 2022;27:100495.
- Mair FS, May C, O'Donnell C, et al. Factors that promote or inhibit the implementation of e-health systems: an explanatory systematic review. *Bull World Health Organ* 2012;90:357-64.
- van Limburg M, van Gemert-Pijnen JE, Nijland N, et al. Why business modeling is crucial in the development of eHealth technologies. *J Med Internet Res* 2011;13:e124.
- Karsh B, Holden RJ, Or CKL. Human factors and ergonomics of health information technology implementation. *Handbook of Human Factors and Ergonomics in Health Care and Patient Safety*, 2nd edition CRC Press, Boca Raton 2011:249-64.
- Xie Z, Or C. Acceptance of mHealth by elderly adults: A path analysis. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting 2020*;64:755-9.
- Or CK, Karsh BT, Severtson DJ, et al. Factors affecting home care patients' acceptance of a web-based interactive self-management technology. *J Am Med Inform Assoc* 2011;18:51-9.
- Or CK, Holden RJ, Valdez RS. Human factors engineering and user-centered design for mobile health technology: Enhancing effectiveness, efficiency, and satisfaction. In: Duffy VG, Ziefle M, Rau PLP, et al. editors. *Human-Automation Interaction: Mobile Computing*. Cham: Springer International Publishing; 2023:97-118.
- Liu K, Or CK, So M, et al. A longitudinal examination of tablet self-management technology acceptance by patients with chronic diseases: integrating perceived hand function, perceived visual function, and perceived home space adequacy with the TAM and TPB. *Appl Ergon* 2022;100:103667.
- Or CK, Karsh BT. A systematic review of patient acceptance of consumer health information technology. *J Am Med Inform Assoc* 2009;16:550-60.
- Yan M, Or C. A 12-week pilot study of acceptance of a computer-based chronic disease self-monitoring system among patients with type 2 diabetes mellitus and/or hypertension. *Health Informatics J* 2019;25:828-43.
- Yan M, Or C. Factors in the 4-week acceptance of a computer-based, chronic disease self-monitoring system in patients with type 2 diabetes mellitus and/or hypertension.

- Telemed J E Health 2018;24:121-9.
18. Xie Z, Chen J, Or CK. Consumers' willingness to pay for eHealth and its influencing factors: systematic review and meta-analysis. *J Med Internet Res* 2022;24:e25959.
 19. Chua V, Koh JH, Koh CHG, et al. The willingness to pay for telemedicine among patients with chronic diseases: systematic review. *J Med Internet Res* 2022;24:e33372.
 20. Meurk C, Leung J, Hall W, et al. Establishing and governing e-mental health care in Australia: a systematic review of challenges and a call for policy-focused research. *J Med Internet Res* 2016;18:e10.
 21. Jonker M, de Bekker-Grob E, Veldwijk J, et al. COVID-19 contact tracing apps: predicted uptake in the Netherlands based on a discrete choice experiment. *JMIR Mhealth Uhealth* 2020;8:e20741.
 22. Ryan M. Discrete choice experiments in health care. *BMJ* 2004;328:360-1.
 23. Nittas V, Mütsch M, Braun J, et al. Self-monitoring app preferences for sun protection: discrete choice experiment survey analysis. *J Med Internet Res* 2020;22:e18889.
 24. Ryan M, Gerard K. Using discrete choice experiments to value health care programmes: current practice and future research reflections. *Appl Health Econ Health Policy* 2003;2:55-64.
 25. Szinay D, Cameron R, Naughton F, et al. Understanding uptake of digital health products: methodology tutorial for a discrete choice experiment using the Bayesian efficient design. *J Med Internet Res* 2021;23:e32365.
 26. Determann D, Lambooi MS, Gyrd-Hansen D, et al. Personal health records in the Netherlands: potential user preferences quantified by a discrete choice experiment. *J Am Med Inform Assoc* 2017;24:529-36.
 27. Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly* 1989;3:19-40.
 28. Davis FD. A technology acceptance model for empirically testing new end-user information systems: theory and results. Cambridge, MA: Massachusetts Institute of Technology; 1985.
 29. Kutlu B, Ozturan M. Determinants of e-Health readiness of end-users. *Int Med J* 2012;19:287-91.
 30. Krebs P, Duncan DT. Health app use among US mobile phone owners: a national survey. *JMIR Mhealth Uhealth* 2015;3:e101.
 31. Peeters JM, Krijgsman JW, Brabers AE, et al. Use and uptake of eHealth in general practice: a cross-sectional survey and focus group study among health care users and general practitioners. *JMIR Med Inform* 2016;4:e11.
 32. Reger GM, Browne KC, Campellone TR, et al. Barriers and facilitators to mobile application use during PTSD treatment: clinician adoption of PE coach. *Prof Psychol Res Prac* 2017;48:510-7.
 33. Peng W, Yuan S, Holtz BE. Exploring the challenges and opportunities of health mobile apps for individuals with type 2 diabetes living in rural communities. *Telemed J E Health* 2016;22:733-8.
 34. Collado-Borrell R, Escudero-Vilaplana V, Calles A, et al. Oncology patient interest in the use of new technologies to manage their disease: cross-sectional survey. *J Med Internet Res* 2018;20:e11006.
 35. Velu AV, van Beukering MD, Schaafsma FG, et al. Barriers and facilitators for the use of a medical mobile app to prevent work-related risks in pregnancy: a qualitative analysis. *JMIR Res Protoc* 2017;6:e163.
 36. Simblett S, Greer B, Matcham F, et al. Barriers to and facilitators of engagement with remote measurement technology for managing health: systematic review and content analysis of findings. *J Med Internet Res* 2018;20:e10480.
 37. Nijland N, van Gemert-Pijnen JE, Kelders SM, et al. Factors influencing the use of a Web-based application for supporting the self-care of patients with type 2 diabetes: a longitudinal study. *J Med Internet Res* 2011;13:e71.
 38. Orme B. Sample size issues for conjoint analysis studies. Getting started with conjoint analysis: strategies for product design and pricing research. Fourth Edition ed. Madison, Wisconsin: Research Publishers LLC; 2019.
 39. Reed Johnson F, Lancsar E, Marshall D, et al. Constructing experimental designs for discrete-choice experiments: report of the ISPOR Conjoint Analysis Experimental Design Good Research Practices Task Force. *Value Health* 2013;16:3-13.
 40. Clark MD, Determann D, Petrou S, et al. Discrete choice experiments in health economics: a review of the literature. *Pharmacoeconomics* 2014;32:883-902.
 41. Soekhai V, de Bekker-Grob EW, Ellis AR, et al. Discrete choice experiments in health economics: past, present, and future. *Pharmacoeconomics* 2019;37:201-26.
 42. Oyibo K, Vassileva J. Relationship between perceived UX design attributes and persuasive features: a case study of fitness app. *Information* 2021;12:365.
 43. Wong RSM, Yu EYT, Wong TW, et al. Development and pilot evaluation of a mobile app on parent-child exercises to improve physical activity and psychosocial outcomes of Hong Kong Chinese children. *BMC Public Health* 2020;20:1544.

44. Or CK, Valdez RS, Casper GR, et al. Human factors and ergonomics in home care: current concerns and future considerations for health information technology. *Work* 2009;33:201-9.
45. Tao D, Or C. editors. A paper prototype usability study of a chronic disease self-management system for older adults. *IEEE International Conference on Industrial Engineering and Engineering Management*; 2012; Hong Kong, China: IEEE.
46. Or C, Tao D. Usability study of a computer-based self-management system for older adults with chronic diseases. *JMIR Res Protoc* 2012;1:e13.
47. Cheung ST, Tiwari AFY, Hui V, et al. editors. Usability testing of a smartphone application for delivering Qigong training. *Academy on Violence & Abuse 2016 Global Health Summit on Violence & Abuse*; 2016; Spartanburg, South Carolina.
48. Hermawati S, Lawson G. Establishing usability heuristics for heuristics evaluation in a specific domain: is there a consensus? *Appl Ergon* 2016;56:34-51.
49. Boothe C, Strawderman L, Hosea E. The effects of prototype medium on usability testing. *Appl Ergon* 2013;44:1033-8.
50. Kahnbach L, Lehr D, Brandenburger J, et al. Quality and adoption of COVID-19 tracing apps and recommendations for development: systematic interdisciplinary review of European apps. *J Med Internet Res* 2021;23:e27989.
51. Casper GR, Karsh BT, Or CK, et al. Designing a technology enhanced practice for home nursing care of patients with congestive heart failure. *AMIA Annu Symp Proc* 2005;2005:116-20.
52. Or C. Pre-implementation case studies evaluating workflow and informatics challenges in private primary care clinics for electronic medical record implementation. *Int J Healthc Inf Syst Inform* 2015;10:56-64.
53. Lin SP, Yang HY. Exploring key factors in the choice of e-health using an asthma care mobile service model. *Telemed J E Health* 2009;15:884-90.
54. Mohamed AHM, Tawfik H, Al-Jumeily D, et al. editors. MoHTAM: a technology acceptance model for mobile health applications. *Developments in E-systems Engineering*; 2011: IEEE.
55. Lin CJ, Ho SH. The development of a mobile user interface ability evaluation system for the elderly. *Appl Ergon* 2020;89:103215.
56. Nittas V, Lun P, Ehrler F, et al. Electronic patient-generated health data to facilitate disease prevention and health promotion: scoping review. *J Med Internet Res* 2019;21:e13320.
57. Teoh SL, Ngorsuraches S, Lai NM, et al. Factors affecting consumers' decisions on the use of nutraceuticals: a systematic review. *Int J Food Sci Nutr* 2019;70:491-512.
58. Leigh S, Ashall-Payne L, Andrews T. Barriers and facilitators to the adoption of mobile health among healthcare professionals from the United Kingdom: discrete choice experiment. *JMIR Mhealth Uhealth* 2020;8:e17704.
59. Gaudette B, Wu CJ, Vrudhula S. editors. Improving smartphone user experience by balancing performance and energy with probabilistic QoS guarantee. *IEEE International Symposium on High Performance Computer Architecture (HPCA)*; 2016.
60. Wilson M. A conceptual framework for studying gender in information systems research. *J Inform Technol* 2004;19:81-92.
61. Borrero JD, Yousafzai SY, Javed U, et al. Expressive participation in Internet social movements: Testing the moderating effect of technology readiness and sex on student SNS use. *Comput Hum Behav* 2014;30:39-49.
62. Chau PYK, Hui KL. Identifying early adopters of new IT products: A case of Windows 95. *Inf Manage* 1998;33:225-30.
63. Lee S, Park G, Yoon B, et al. Open innovation in SMEs—an intermediated network model. *Res Policy* 2010;39:290-300.
64. Choudhury A, Asan O, Choudhury MM. Mobile health technology to improve maternal health awareness in tribal populations: mobile for mothers. *J Am Med Inform Assoc* 2021;28:2467-74.
65. Kokebie MA, Abdo ZA, Mohamed S, et al. Willingness to pay for social health insurance and its associated factors among public servants in Addis Ababa, Ethiopia: a cross-sectional study. *BMC Health Serv Res* 2022;22:909.
66. Wong RSM, Wong WL, Yu YTE, et al. editors. Pilot study on the efficacy of a mobile app on parent-child partner exercise to enhance health-related quality of life and behavior of children in Hong Kong Chinese families. *International Conference on Active Living and Health*; 2018.
67. Gidey MT, Gebretekle GB, Hogan ME, et al. Willingness to pay for social health insurance and its determinants among public servants in Mekelle City, Northern Ethiopia: a mixed methods study. *Cost Eff Resour Alloc* 2019;17:2.
68. Hesse BW, Nelson DE, Kreps GL, et al. Trust and sources of health information: the impact of the Internet and its

- implications for health care providers: findings from the first Health Information National Trends Survey. *Arch Intern Med* 2005;165:2618-24.
69. Paasche-Orlow MK, Parker RM, Gazmararian JA, et al. The prevalence of limited health literacy. *J Gen Intern Med* 2005;20:175-84.
70. Awan AG, Abbas N. Impact of demographic factors on impulse buying behavior of consumers in Multan-Pakistan. *Eur J Bus Manage* 2015;7:96-105.
71. Fenton-O’Creevy M, Furnham A. Money attitudes, personality and chronic impulse buying. *Appl Psychol* 2020;69:1557-72.

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