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

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**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)

## 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.

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**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 $3^7$ 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? ☐Yes ☐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

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

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 $\beta_a$ divided by $-\beta_p$, where $\beta_a$ denotes the regression coefficient of the attribute or characteristic obtained from the regression model and $\beta_p$ 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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